University of Plymouth

PEARL **https://pearl.plymouth.ac.uk**

04 University of Plymouth Research Theses 01 Research Theses Main Collection

2010

A BI-REGIONAL CGE MODEL OF THE SOUTH WEST HOUSING MARKET

KEAST, SARAH-JANE

http://hdl.handle.net/10026.1/2127

http://dx.doi.org/10.24382/3750
University of Plymouth

All content in PEARL is protected by copyright law. Author manuscripts are made available in accordance with publisher policies. Please cite only the published version using the details provided on the item record or document. In the absence of an open licence (e.g. Creative Commons), permissions for further reuse of content should be sought from the publisher or author.

A Bi-Regional CGE Model of the South West Housing Market

by

SARAH-JANE KEAST

A thesis submitted to the University of Plymouth

in partial fulfilment for the degree of

DOCTOR OF PHILOSOPHY

Plymouth Business School

Faculty of Social Sciences & Business

June 2010

9008776301
333.338 KEA

A Bi-Regional CGE Model of the South West Housing Market

By Sarah-Jane Keast

ABSTRACT:

Volatility within the UK housing market is thought to be a significant factor driving instability in the wider macro economy. Research investigating the characteristics and behaviour of the housing market has suggested that under supply of housing is one of the key reasons for the high and increasing levels of house prices the nation has recently been experiencing. Consequently, much of the current government's housing policy is aimed at increasing the level of supply by reforming the planning system and increasing investment in the development of new housing. Under supply is also a major concern at the regional level, particularly in the South West, where net inward migration, growth in the number of single person households and growth in the numbers of second homes is placing increasing pressure on the housing market.

Understanding the likely effects of any policy changes prior to their implementation is vitally important for a successful outcome and to that end economic analysis has played a significant role in the development of policy at the national level. However, this is not the case at the regional and sub-regional levels where only limited use of economic analysis techniques have been made, partly due to resource issues and partly due to the lack of regional data.

In order to partially address the lack of analysis of the regional impacts of the latest housing policies, this study is based upon the development of a mathematical economic model of the South West housing market. This model is then used to estimate the likely impacts of increasing housing supply at both the regional and broad sub-regional levels.

CONTENTS

1 Introduction 25

1.1 Aim of this Study 27

1.2 Conclusion 31

2 Economics of the Housing Market 24

2.1 Demand for Housing 36

2.1.1 Defining Demand 36

2.1.2 Price of Housing 37

2.1.3 Household Income 41

2.1.4 Interest Rates 42

2.1.5 Other Factors 44

2.2 The Supply of Housing 49

2.2.1 Supply from Existing Stock 49

2.2.2 New Construction 51

2.3 The Operation of the Housing Market 54

2.3.1 Disequilibrium in the Housing Market 54

2.3.2 The Housing Market in the Long Run 55

2.3.3 The Effect of Exogenous Shocks on the Housing Market 56

2.4 The Impact of the Housing Market 63

2.4.1 Consumption and Wealth Effects 63

2.4.2 Business Financing 66

2.4.3 Labour Market and Migration Effects 66

2.4.4 Welfare and Equity Effects 68

2.5 Conclusion 69

3 The UK Housing Market 74

3.1 The UK Housing Market and Housing Policy in the 20th Century 75

3.1.1 The 1940s through 1960s 75

3.1.2 The 1970s and 1980s 81

3.1.3 The 1990s 88

3.1.4 The housing market from 2000 to 2007 90

3.2 Major Trends in the UK Housing Market 94

3.3 Recent Trends in Housing Policy 108

3.3.1 A Brief Overview of International Housing Policy Trends 110

3.3.2 Measuring Affordability 111
3.4 Housing Policy: The Role of Economic Analysis 114
3.4.1 Application to Housing Policy 116
3.5 Conclusion 118

4 Regional Housing Markets and Housing Policy 121
4.1 Regional Housing Markets 123
4.1.1 Labour Market Mobility 123
4.1.2 Earnings and Unemployment 125
4.1.3 Urban Population 125
4.1.4 House Prices and the Ripple Effect 126
4.1.5 Vacant and Second Homes 127
4.1.6 Submarkets 129
4.2 UK Regional Housing Markets 131
4.2.1 Tenure, Prices and the Labour Market 131
4.2.2 Supply 137
4.3 The South West Housing Market 142
4.3.1 Tenure and Migration 142
4.3.2 Population 145
4.3.3 Second Homes 148
4.3.4 House prices, Incomes and Output 150
4.4 Regional Housing Market Policy 154
4.5 South West Housing Policy 159
4.5.1 Sustainability in the South West 162
4.6 Conclusion 163

5 Regional Economic Modelling 166
5.1 Keynesian Multiplier Analysis 170
5.2 Regional Econometric Models 173
5.3 Regional Input-Output Models 177
5.3.1 Econometric Input Output models 173
5.4 Social Accounting Matrices 183
5.5 Computable General Equilibrium Models 187
5.6 Sub-regional Economic Modelling 192
5.6.1 Sub-Regional Flows 192
5.6.2 Scale 194

5.7 Software 196
5.7.1 General Mathematical and Statistical Software 196
5.7.2 Computable General Equilibrium Software 198
5.8 Conclusion 201

6 A Social Accounting Matrix for the South West 203
6.1 The Construction of Social Accounting Matrices 205
6.1.1 Framework 205
6.1.2 Compilation and Data Reconciliation Issues 207
6.2 The South West Social Accounting Matrix 214
6.2.1 Structure 214
6.2.2 Data 216
6.2.3 Variables 218
6.2.4 Primary assumptions 220
6.3 Construction of the South West SAM 222
6.3.1 Output (block 1) 222
6.3.2 Intermediate Inputs (Block 2) 228
6.3.3 Factor inputs (Block 3) 229
6.3.4 Imports and Exports (Blocks 4 and 5) 233
6.3.5 Distribution of Value Added (Block 6) 234
6.3.6 Taxes, Government transfers and expenditures (Blocks 7, 8 and 9) 235
6.3.7 Household Spending (Block 10) 237
6.3.8 Savings and Investments (Blocks 11 and 12) 238
Unbalanced South West Sam 240
Balanced South West Sam 241
6.4 South West Sub-Regional SAMs 242
6.4.1 Primary assumptions 242
6.4.2 Output and intermediate inputs 242
6.4.3 Factor Inputs 245
6.4.4 Exports to and imports from the Rest of the World 247
6.4.5 Distribution of Value Added 249
6.4.6 Government transfers and spending 251
6.4.7 Household Consumption and Savings 253
6.4.8 Investment 255
6.4.9 Exports and Imports between the Sub-Regions 257
6.4.10 Balancing the South West SAMs 260

6.4.11 SAM for the North 261
6.4.12 SAM for the South 262
6.5 Incorporating the Benchmark Data Into the CGE 265
6.6 Final SAM 270
6.7 Conclusion 271

7 A Bi-regional CGE Model for the South West Housing Market 272
7.1 An Overview of Regional CGE Modelling 274
7.1.1 Production and Product Markets 274
7.1.2 Household Demand 276
7.1.3 Factor Markets 277
7.1.4 Savings and Investment 278
7.1.5 Government 278
7.1.6 Static vs. Dynamic Models 279
7.1.7 Model Closure 281
7.1.8 Model Parameterisation 284
7.2 CGE Models of the housing market 285
7.2.1 Structure 286
7.2.2 Scope and Dimensionality 286
7.2.3 Housing Market 288
7.2.4 Hedonic Pricing 290
7.3 The Development and Structure of the South West Model 292
7.3.1 Geography, Variables and Time Scale 292
7.3.2 Production 292
7.3.3 Household Income 297
7.3.4 Household Consumption 297
7.3.5 Government 300
7.3.6 Dynamics 301
7.3.7 Closure Rules 301
7.3.8 Counterfactual Scenarios 303
7.3.9 Software and Solution Issues 305
7.3.10 Model Summary 306
7.4 Conclusion 308

8 Results and Conclusions 310
8.1 The Bi-Regional CGE Model of the South West Housing Market 311

8.1.1 Summary of Model Structure 312
8.2 Results of the Counterfactual Scenarios 315
8.2.1 Scenario 1 315
8.2.2 Scenario 2 320
8.2.3 Scenario 3 323
8.2.4 Scenario 4 328
8.2.5 Summary 333
8.2.6 The Effects of Consumer Preferences 334
8.2.7 Summary 339
8.3 Sensitivity Analysis 341
8.3.1 Results of the Sensitivity Analysis 341
8.4 Conclusions 346
8.4.1 Why is the housing market important? 346
8.4.2 The UK Housing Market 349
8.4.3 UK Regional Housing Markets 350
8.4.4 The South West Housing Market 350
8.4.5 Regional Economic Modelling 351
8.4.6 A Bi-Regional Model of the South West Housing Market: An Assessment 352
8.5 Further Research 355
8.5.1 Final Thoughts and Reflections on the development of the South West Model 357

Appendix 1: MPS/GE Model Code 359

Appendix 2: GAMS Code for Balancing the SAM 365

References 373

FIGURES

Figure 2-1 Stock Adjustment Model 55

Figure 2-2 Property and Asset Markets 57

Figure 2-3 Effects of a Change in Demand 60

Figure 2-4 Changing Aggregate Demand for Owning Houses 61

Figure 2-5 Change in the Supply of New Construction 62

Figure 3-1 Inflation, UK (Percentage Change over 12 months in RPI) 76

Figure 3-2 Patterns of Tenure, UK (% of households) 79

Figure 3-3 Completions of Permanent Dwellings by Tenure, UK (%) 80

Figure 3-4 House prices (£) and Percentage Change in House prices, UK 80

Figure 3-5 Percentage Change in House Prices and GDP, UK 81

Figure 3-6 Unemployment Rate, UK (%) 82

Figure 3-7 Percentage Change in the Number of Households by Tenure, GB 85

Figure 3-8 Dwelling Stock by Tenure, GB (April, %) 86

Figure 3-9 Annual House Price Inflation Rate, UK 87

Figure 3-10 Permanent Dwellings Completed by Tenure, GB (%) 88

Figure 3-11 House Prices and the Annual House Price Inflation Rate, UK 90

Figure 3-12 Percentage Change in Real GDP per Head and Households Gross Disposable Income per Head, UK 91

Figure 3-13 RPI, UK (All items - % change over 12 months) 92

Figure 3-14 Trends in Tenure, UK (% of households) 96

Figure 3-15 Property Transactions in England and Wales 97

Figure 3-16 Annual Average of Bank Rate and Number of Variable Rate Mortgages as a Percentage of All Mortgages, UK 97

Figure 3-17 Housing Transactions (millions) and Average Annual Bank Rate (%), England and Wales 98

Figure 3-18 Number of Permanent Dwellings Completed, UK 100

Figure 3-19 Household Composition, GB 101

Figure 3-20 Annual Percentage Change in the Number of Households (GB) and Annual House Price Inflation (UK) 102

Figure 3-21 House Price Inflation and Completions in the UK 102

Figure 3-22 Average house price and house price inflation in the UK 104

Figure 3-23 Income Ratio and Completions in the UK 105

Figure 3-24 UK Household Savings Ratio and the Spend on Housing* as a Percentage of Total Consumption 106

Figure 5-1 The Regional Multiplier 171

Figure 5-2 Input-output Transactions Table 177

Figure 5-3 Structure of a Regional CGE Model 188

Figure 6-1 Structure of a Social Accounting Matrix 205

Figure 6-2 Structure of the initial SW SAM 215

Figure 6-3 Summary of the Steps Used to Allocate South West Transactions to the Sub-Regions 254

Figure 6-4 Structure of Rectangular Sub-Regional SAM 258

Figure 7-1 Production Structure of the South West CGE 295

Figure 7-2 Structure of Utility Function 299

Figure 7-3 Model Summary 306

Figure 8-1 Model Structure 312

TABLES

Table 3-1 UK Average House Prices and House Price Inflation rates 92

Table 3-2 Recent Changes UK Average House Price 93

Table 3-3 Housing Assets and Loans, UK 99

Table 4-1 Tenure patterns and Migration (%) 132

Table 4-2 Average Dwelling Price (£ and index) 132

Table 4-3 Net Inter-Regional In-Migration, 1998 (000s) 133

Table 4-4 Net Inter-Regional In-Migration, 2006 (000s) 134

Table 4-5 Median gross weekly pay (index UK =100) and April unemployment rate (seasonally adjusted) 134

Table 4-6 Average Loan to Value Ratios 135

Table 4-7 Average Recorded Income of Borrowers as a Percentage of Average Dwelling Price 136

Table 4-8 Stock of dwellings and change in prices 137

Table 4-9 Household and dwelling balance, England 138

Table 4-10 Completions of dwellings (000s) 139

Table 4-11 Second homes as a percentage of all dwellings 140

Table 4-12 Estimated Household Forecasts by English Region (millions) 140

Table 4-13 Tenure (%) 142

Table 4-14 South West Net inward migration by age (000s) 143

Table 4-15 Age Structure of Population (%) 143

Table 4-16 Inter-regional migration 144

Table 4-17 Population density, house prices and unemployment rate 145

Table 4-18 .Population in the South West 146

Table 4-19 Sub-regional components of population change 147

Table 4-20 Sub-regional changes in population, 2005 to 2006 148

Table 4-21 Second homes (% of all dwellings) 149

Table 4-22 Percentage change in average house price 150

Table 4-23 Ratio of lower quartile house price to lower quartile Yearly earnings 151

Table 4-24 Median gross weekly pay 152

Table 4-25 Ratio of median house price to median earnings 152
Table 4-26 GVA per head (Index UK = 100) – NUTS regions 153
Table 4-27 Sub-regions and PUAs Identified in the Regional Planning Guidance 161
Table 4-28 Projected Additional Dwellings Per Annum 161
Table 6-1 Data Sources 217
Table 6-2 SAM Variables 219
Table 6-3 Definition of Net Housing Expenditure 224
Table 6-4 Total expenditure on housing services 225
Table 6-5 Constructors output in the South West (£ million) 226
Table 6-6 Output of Construction (£ million) 226
Table 6-7 Value of house sales in the South West, 2001 227
Table 6-8 Output of new housing construction (£ million) 227
Table 6-9 Output of other industries (£ million) 227
Table 6-10 SAM Block 1 - Gross Output (£ million) 227
Table 6-11 Intermediate inputs in construction 228
Table 6-12 SAM Block 2 - Intermediate purchases by Sector (£ million) 228
Table 6-13 Tax and earnings by occupation (£ million) 229
Table 6-14 Earnings by occupation (£ million) 230
Table 6-15 Labour earnings in the new housing construction sector (£ million) 230
Table 6-16 Labour earnings by sector (£ million) 230
Table 6-17 Percentage of labour earnings by sector and by occupation (%) 230
Table 6-18 Labour inputs (£ million) 231
Table 6-19 Household income and tax by source 232
Table 6-20 Capital inputs (£ million) 232
Table 6-21 Total expenditure on housing factors 233
Table 6-22 Exports (£ million) 233
Table 6-23 Imports (£ million) 233
Table 6-24 Household income from capital (£ million) 234
Table 6-25 Household income from labour (£ million) 234

Table 6-26 Percentage of house types owned by each type of household (%) 235
Table 6-27 Household income from housing (£ million) 235
Table 6-28 Tax by households (£ million) 236
Table 6-29 Tax by factor (£ million) 236
Table 6-30 Government transfers (£ million) 236
Table 6-31 Government expenditure on final demand (£ million) 236
Table 6-32 Household expenditure on goods and services (£ million) 237
Table 6-33 Housing expenditure by socio economic group 238
Table 6-34 Spending on housing service by households (£ million) 238
Table 6-35 Investment (£ million) 238
Table 6-36 Savings by household type (£ million) 239
Table 6-37 Key for the SAM 239
Table 6-38 Percentage of output by region, 2001 243
Table 6-39 Number of housing starts by region, 2001 243
Table 6-40 Percentage of households by region (%) 243
Table 6-41 Production Elements of the South West Sam 243
Table 6-42 Proportions of South West Outputs and Intermediate Inputs Allocated to the North 244
Table 6-43 Outputs and Intermediate Inputs for North Sub-region 245
Table 6-44 Outputs and Intermediate Inputs for South Sub-region 245
Table 6-45 Proportions Used to Allocate Output and Factor Inputs to North Sub-Region 246
Table 6-46 Factor Inputs Used in the North Sub-Region 246
Table 6-47 Factor Inputs Used in the South Sub-Region 247
Table 6-48 Proportions of South West Output, Imports and Exports Allocated to North Sub-Region 248
Table 6-49 RoW Exports and Imports for the North Sub-Region 248
Table 6-50 RoW Exports and Imports for the South Sub-Region 248
Table 6-51 Distribution of Factor Taxes and Endowments in the South West 249
Table 6-52 Factor Tax Rates and Proportion of Factor Endowments, South West (%) 250
Table 6-53 Total Factor Returns 250

Table 6-54 Distribution of Value Added and Factor Taxes, North 251
Table 6-55 Distribution of Value Added and Factor Taxes, South 251
Table 6-56 Transfer Payments by Household, South West 251
Table 6-57 Proportions of Households by Type and by Region (%) 252
Table 6-58 Transfer Payments to Household and Total Household Income, North 252
Table 6-59 Transfer Payments to Household and Total Household Income, South 252
Table 6-60 Government Revenue and Expenditure 253
Table 6-61 Government Expenditure on Goods and Services, North 253
Table 6-62 Government Expenditure on Goods and Services, South 253
Table 6-63 Proportion of households by region of residence 254
Table 6-64 South West Household Consumption and Saving 254
Table 6-65 Household Consumption and Saving, North 255
Table 6-66 Household Consumption and Saving, South 255
Table 6-67 South West Investment by Sector 256
Table 6-68 Investment by Sector, North 256
Table 6-69 Investment by Sector, South 256
Table 6-70 Sales of Commodities, North 257
Table 6-71 Exports from the North to the South 257
Table 6-72 Exports from the South to the North 258
Table 6-73 Combined Production Block for North and South 264
Table 6-74 Combined Sectors 265
Table 6-75 Combines Imports and Exports 265
Table 6-76 Household Income from Factor Returns 266
Table 6-77 Household Spending Patterns 267
Table 6-78 Household consumption and transfer payments 268
Table 6-79 Final Model Variables 269
Table 7-1 Projected additional dwellings per annum 304
Table 7-2: Changes in Factor Endowments 305
Table 7-3: Summary of Counterfactual Scenarios 305

Table 8-1 Summary of Counterfactual Scenario Changes 315
Table 8-2 Factor Inputs (Scenario 1) 316
Table 8-3 Output, Prices and Household Demand (Scenario 1) 316
Table 8-4 Household Welfare and Consumption (Scenario 1) 316
Table 8-5 Regional Impacts (Scenario 1) 316
Table 8-6 Summary of Counterfactual Scenario Changes 320
Table 8-7 Factor Inputs (Scenario 2) 321
Table 8-8 Output, Prices and Household Demand (Scenario 2) 321
Table 8-9 Household Welfare and Consumption (Scenario 2) 321
Table 8-10 Regional Impacts (Scenario 2) 321
Table 8-11 Summary of Counterfactual Scenario Changes 324
Table 8-12 Factor Inputs (Scenario 3) 325
Table 8-13 Output, Prices and Household Demand (Scenario 3) 325
Table 8-14 Household Welfare and Consumption (Scenario 3) 325
Table 8-15 Regional Impacts (Scenario) 325
Table 8-16 Summary of Counterfactual Scenario Changes 329
Table 8-17 Factor Inputs (Scenario 4) 330
Table 8-18 Output, Prices and Household Demand (Scenario 4) 330
Table 8-19 Household Welfare and Consumption (Scenario 4) 330
Table 8-20 Regional Impacts (Scenario 4) 330
Table 8-21 Changes in Commodity Prices 335
Table 8-22 Changes in Total Household Demand 336
Table 8-23 Changes in Output 337
Table 8-24 Changes in Factor Prices 338
Table 8-25 Changes in Welfare 339
Table 8-26 Model Elasticities 341
Table 8-27 Elasticity of Substitution Between Factors (ELASVA) 342
Table 8-28 Elasticity of Substitution Value Added and Intermediate Inputs (ELASS) 342
Table 8-29 Armington Elasticity (ELASARM) 343

Table 8-30 Elasticity of Substitution in Housing Consumption (ESUBH)..... 343

Table 8-31 Consumption Elasticity of Substitution for all Commodities (ESUBU)..... 344

ACKNOWLEDGEMENTS

I would like thank my director of studies, Professor Peter Gripaios, for giving me the opportunity to engage in this research project and Dr Eric McVittie and Dr Steven Brand for their help in framing the research project.

Thanks are also due to Dr Paul Bishop who provided support as a mentor and whose advice is always gratefully received.

My thanks also go to Mr Ian Rosewall for providing many years of tea and sympathy and to Dr Michael Towler for asking the right kind of stupid questions.

Finally, I wish to dedicate this thesis to my mother, Mrs June Keast, for her continuous support, encouragement and endless patience and without whom I would never have achieved all that I have.

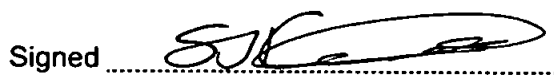
AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Committee.

This study was not part of any collaborative research.

The author of this study did not attend any training courses or conferences. The work has not been presented at any time or published in any form.

Word count of main body of thesis: 79,025

Signed 

Date 12/7/2010

1 INTRODUCTION

"Housing has profound and often unappreciated impacts upon our lives. It directly affects our quality of life, our health and well-being; it determines our transport needs and often our choice of work; it affects our family structures and our friendship networks. Housing also affects our national economic well-being: the rate of economic growth and our prosperity. It also influences the distribution of resources between regions, individuals and generations." (Barker, 2003: p 1)

Housing is a complex good: it provides basic services such as shelter and security whilst it is also a source of wealth accumulation and a means to fund consumption. Thus, housing is important to the welfare of the individual, the household and the wider economy. Research has also highlighted the important role that the housing market plays in the wider macro economy (Muellbauer and Murphy, 1997) and disparities in the housing market are thought by some to be a key driver of macroeconomic volatility (Cooper, 2004).

Recent empirical investigations have found significant correlations between real house price growth and variables such as real GDP, unemployment, interest rates and inflation (Borio and McGuire, 2004; Capozza et al., 2002; Englund and Ioannides, 1997; Tsatsaronis and Zhu, 2004). The reasons for these relationships are varied but many are generated through links between housing and the labour market. For example, relative house price differentials between regions exert a significant influence on worker mobility as high relative house prices discourage migration and this leads to reduced flexibility in the labour market (Harrigan et al., 1986; Jackman and Savouri, 1992; Potepan, 1994).

Furthermore, there is evidence that indicate relationships between change in the housing market and cycles of economic growth (HM Treasury, 2003; Miles, 2004; Muellbauer and Murphy, 1997). At least some of this will result from the link between house prices and levels of household consumption. Rising house prices have increased the value of housing assets and homeowners can fund consumption by liquidating their assets or by accessing secured credit (Cocco et al., 2005; Silos, 2007).

Fluctuations in the housing market also exert pressure upon the corporate sector. Previous studies indicate that property prices are negatively related to the rate of business failures and thus as house prices increase, the rates of business failures decrease (Vlieghe, 2001). Suggested reasons for this include the fact that the business activities of entrepreneurs are frequently funded from collateral raised on their own property and rising prices result in increased levels of available credit. Moreover, in times when house prices are rising, creditors may be less likely to force debtors into insolvency because the risk to loan repayment has been reduced (Fabling and Grimes, 2005).

Before the recent slowdown in the economy, house prices had been increasing across the UK, prompting a debate about the need to stimulate the supply of housing to offset problems of affordability (Bramley, 2007). The current UK government commissioned a major study into the impacts of undersupply in the UK housing market and the resultant report, *The Barker Review of Housing Supply* (Barker, 2004), emphasised the importance of the housing market to the national economy. It concluded that weak, unresponsive housing supply in the UK has led to a less stable economy and, furthermore, it recommended a significant increase in the supply of housing, although this had been recognised at the regional level for some time. For example, South West regional housing policy as outlined in the *Regional Planning Guidance* (Government Office for the South West, 2001) is specifically aimed at addressing the issue of undersupply in the region.

Choosing the type, scope and timing of regional policies is not easy and successful outcomes are never guaranteed. It is invaluable to have some mechanism by which the likely impact of policy decisions can be estimated before the policies are implemented in order to prevent costly errors of judgement. It is in this environment where the use of regional economic modelling has seen the greatest developments.

Regional economies are more specialised than their national counterparts, with higher levels of both labour and capital mobility and a greater degree of openness. Therefore, estimating the impact of regional economic policy is not simply a case of using national data and scaling it

accordingly. The development of dedicated regional economic models has resulted from the need to provide a greater understanding of the operation of regional economies and in some cases a tool for analysing policy decisions.

The most common types of regional models are econometric models and multiplier models, specifically input-output (IO) models: the former is an approach that attempts to reproduce the behaviour of the key mechanisms driving the economy and the latter involves the identification of inter-industry linkages and the estimation of their relative importance. However, in recent years, computable general equilibrium (CGE) models have become much more widely used. This approach, inspired by the work of Scarf (1967), generates detailed mathematical models of entire economies or systems of economies and includes detailed inter-industry linkages and endogenous prices; it can also include a dynamic element.

The attraction of both multiplier models and econometric models is that they are relatively inexpensive and straightforward to implement, although their simplicity is also the root cause of much criticism. Whilst IO and CGE models are both more expensive and more difficult to implement, they incorporate comprehensive inter-industry linkage data providing a more detailed and realistic approach to policy impact analysis. Nevertheless, IO models, unlike CGE models, are completely static and entirely demand driven, leaving them unsuited to long-term or supply-side policy analysis.

1.1 Aim of this Study

"The highest priority item on the research agenda in the economic theory of housing markets is the development of ... models of the housing market. This is essential for the analysis of appropriate government intervention in the housing market." (Arnott, 1987)

Nicol (2002) notes that local authorities have needed to develop a more detailed understanding of housing in their local area for several decades. They have been required to produce evidence demonstrating the need for intervention in the housing market and to secure funding and support for local policy implementation. Nevertheless, the planning system has faced criticism for the

lack of economic analysis involved in shaping planning decisions and, in particular, the limited analysis of the impacts of alternative development patterns (Cullingworth, 1997). One of the primary reasons for the underuse of economic modelling in the policy and planning process has been the complex nature of many of these models and the inability of policy makers to interpret the outcomes of such analyses.

The aim of this study is to develop an economic model of the South West housing market to gain greater understanding of the links between the housing market and the local economy as no such model currently exists. This model is used to analyse changes to both demand and supply in the housing market by analysing the impact of demographic changes and changes to the level of housing supply.

In order to justify the significance of this research, the thesis begins with an exposition of the reasons why housing is an important issue for developed economies by identifying the relationships between the housing market and the macro and micro economy. The thesis continues with a discussion of the overall significance of housing both to the UK economy and to the South West regional economy. Furthermore, the current state of the UK housing market is analysed and the factors likely to exert pressure in the market over the next few years are examined.

The overall importance of housing has encouraged government intervention in the market since the beginning of the last century. In order to understand the origins of South West regional housing policy, the major policy trends are discussed and the nature of the policy setting process is explained, including an examination of the role that economic analysis can and does play in policy development.

There are a number of techniques used for the construction of economic models and regional models in particular, and the most popular are described in this study. The primary reasons for choosing the computable general equilibrium (CGE) approach are discussed and the overall structure of such models is examined, together with an analysis of the application of such models to housing markets.

The remainder of the study is devoted to the development the South West housing market model and the use of the model to analyse the behaviour of the regional housing market. Specifically, the model is used to estimate the impact that demographic changes have on the region in addition to modelling the impact of a change in supply as suggested in the South West's *Regional Planning Guidance* (Government Office for the South West, 2001).

The study concludes with an overall assessment of the research undertaken, a critique of the model itself and a discussion of its future development.

The thesis is structured as follows:

- Chapter 2 presents an overview of economic theory pertaining to the operation of the housing market and the links between the housing market and the macro economy.
- Chapter 3 discusses the economic importance of the UK housing market and describes the key issues associated with the operation of the housing market. It concludes with a description of the key policy and planning considerations including the role economic analysis has to play in the development of housing market policy.
- Chapter 4 gives an overview of the characteristics regional housing markets in the UK. In particular, it discusses the nature of the housing market in the South West and concludes with a description of regional housing market policy.
- Chapter 5 discusses the development and application of regional economic modelling techniques. It contains descriptions of the principal techniques used in the process of regional economic modelling and a discussion of the relative merits of each approach. It also gives a justification of the modelling technique chosen for this particular study and describes the available choices of software to facilitate the development of the model.
- Chapter 6 describes the construction of a benchmark data set for the model, including a brief overview of social accounting matrices and a full description of the methods and data used to produce benchmark accounts.

- Chapter 7 gives an overview of the computable general equilibrium (CGE) technique and describes the key issues associated with the construction of a model of this type. The chapter also contains a review of the use of CGE models in the housing market and concludes with a description of the model for the South West.
- Chapter 8 presents the results of the model, linking the outcomes with the overall framework of the model. The thesis concludes with some reflections on the study as a whole and a discussion of the process of building economic models for use as policy setting tools.

1.2 Conclusion

In the UK, housing is as important to the national economy as it is to the individual household. Houses provide shelter and security and a means of storing wealth, whilst its importance to the economy comes both from the operation of the housing market and from the use of housing to fund consumption. It is therefore important to understand how the housing market functions and how it affects the economy. There is already a substantial body of such research at the national level. However, at the regional level there are fewer studies and the focus is largely on local housing markets at the sub-regional and urban level.

The aim of this research is the development of a computable general equilibrium model of the housing market in the South West region of the UK. This process requires a detailed understanding and analysis of the operation of housing markets in general and, more specifically, regional housing markets including an appreciation of regional housing policy. It is also necessary to collect, collate and construct a suitable regional data set with which to populate the model.

The model once developed, is used to estimate the impact of demographic changes on the behavior of the South West housing market and the potential economic changes brought about by an increase in the supply of housing as suggested in the *Regional Planning Guidance* (Government Office for the South West, 2001).

The contribution of this study is two-fold. Firstly, no other model of the South West housing market currently exists and so this will be the first of its type. Secondly, the study will make a contribution to knowledge of the regional housing market both though the research required to inform the process of model construction and through the use of the model to assess the impact of changes in the housing market.

2 ECONOMICS OF THE HOUSING MARKET

"Housing is a basic human need, which is fundamental to our economic and social well-being." (Barker, 2004: p 1)

The issue of housing is linked to the welfare of the individual, not only providing for such basic needs as shelter but also acting as a source of wealth. Moreover, property frequently represents the largest portion of household wealth and, for the majority of households, buying a house will be the largest single transaction made in their lifetime: in Europe, for instance, paying for housing typically involves a fifth to a quarter of disposable income (Gibb and Hoesli, 2003; Kenny, 1999; Maclennan et al., 1998). Over recent years, rising house prices have led to increased levels of housing wealth for home-owners. This, together with increased access to mortgage finance, has stimulated consumer demand, particularly during the UK's consumer boom in the late 1980s (Miles, 1994; Muellbauer and Murphy, 1997).

In general, it is believed that the UK housing market is "an important source and/or channel of transmission of volatility at the macroeconomic level." (Cooper, 2004) and it is considered a key driver of urban economies (Gibb and Hoesli, 2003; Kenny, 1999; Muellbauer and Murphy, 1997). Thus, the perceived importance of the UK housing market has led to a significant proportion of public funds invested in the development of housing and both national and regional government have devoted considerable resources to influencing property markets (Gibb and Hoesli, 2003). According to Maclennan et al. (1998), between 1 and 3 percent of GDP in the EU is devoted to housing from public sources. Research by Corkindale (1999) suggests that British land-use planning costs somewhere in the region of £1billion per annum of public expenditure besides the costs imposed on businesses and individuals. Consequently, it is important that the operation and interactions of the housing market be understood in order to facilitate any interventions in the market .

Since houses provide basic services to the household, the housing market has serious implications for welfare. Home-ownership has been associated with a series of social benefits including personal well-being. For example, an empirical study of the US by Rossi and Webber

(1996) found that home owners report a higher sense of 'well-being' when compared to renters. Aaronson (1999), however, identified that these benefits are externalities arising from residential stability and therefore originate indirectly from home ownership. Externalities from housing remain the subject of debate and, in particular, the wider urban regeneration effects of property investment in disadvantaged areas (Adair et al., 2003).

Housing market research is a multi-disciplinary field with the dominant approach being economic (Wallace, 2004). Quantitative economic models have made a significant contribution to knowledge of various aspects of the housing market including the operation of the market, land use, rental markets, planning and housing finance (O'Sullivan et al., 2003). One criticism of this approach is that the mathematical and statistical techniques involved are becoming increasingly complex, partly because certain characteristics particular to the housing market complicate the modelling process. Consequently, theories that apply to other commodity markets are not particularly informative when looking at housing and thus it is necessary to understand how the market for housing differs from other commodity markets.

Like other durable goods, houses generate a flow of services for the lifetime of the property. Unlike other durables, however, houses can also be a significant source of personal wealth. The housing market, encompassing both the owning and renting of houses, is distinguishable from other markets in several ways (Miles, 1994; Oxley, 2004):

- Houses are significantly more durable than other physical assets: for example, in England 40 percent of dwellings are more than 60 years old (Office of the Deputy Prime Minister, 2005a). Houses can be bought and sold many times during their lifetime and can be subdivided or otherwise converted to change or increase the flow of services offered. The durability of houses also ensures that there is well-developed secondary market for housing.
- The housing market exhibits a high degree of heterogeneity in terms of property characteristics and therefore the services provided. This leads to difficulties in determining the value of housing.

- House are spatially immobile, often leading to shortages of stock and high prices in popular areas and vacant properties and low prices in less desirable locations.
- Houses can be used as collateral, allowing house owners to borrow against the value of the asset often at a lower cost than in the absence of the asset. Moreover, the ownership of housing is linked to the holding of credit and/or store cards. For example, the British Household Panel Survey 2000 data reported that 75 percent of home-owning couples and 71 percent of home-owning singles had credit or store cards in comparison to only 32 percent of tenant couples and 24 percent of tenant singles.
- Changing patterns of home ownership have had a significant impact on the level and distribution of housing. For example, housing wealth is primarily accessed by downsizing or re-mortgaging and if house prices rise, potential home owners face the prospect of greater levels of indebtedness (Bridges et al., 2004).
- Houses not only provide services that meet 'needs' such as shelter but are also a physical manifestation and reflection of 'tastes' and levels of personal wealth.
- Production of housing is constrained by the availability of land with necessary characteristics, such as planning permission, implying that housing cannot be treated like other reproducible assets.
- The housing market is subject to large transactions costs, primarily because financial intermediaries are more closely involved in the housing market than in any other markets. The inefficiency arising from information asymmetries between buyers and sellers often induces both parties to employ agents to help with the property search and reduce transactions costs (Maclennan, 1982).

The complex role that houses play in the lives of individuals and the heterogeneity of housing means that demand for housing can be difficult to define. The analysis of housing supply is also complex with stock resulting from new construction and from the renovation and conversion of existing property. Housing cannot adjust immediately to changes in the market since property takes a considerable time to reproduce, cannot be relocated and can last for several generations. The exchange of properties results in high transactions costs, including search, legal,

psychological and financial costs, although these have been alleviated somewhat by the development of the internet (Quigley, 2002). Thus, the housing market is often inefficient and adjusts slowly to changes in market conditions. As this discussion will demonstrate, disequilibrium is therefore a persistent feature of the housing market (Maclennan, 1982).

The aim of the remainder of the chapter is to describe the operation of the housing market by identifying the key drivers of both supply and demand, the interaction of supply and demand in the market and the effects the housing market has on the consumer and the wider economy.

2.1 Demand for Housing

Demand for housing depends primarily upon the ability and desire to purchase or rent housing. Nevertheless, the detailed analysis of demand for housing is complicated by the heterogeneity of both houses and households, the high level of transactions costs associated with the trade of property and dual role of housing as a source of basic services and as an asset.

Before defining the components of demand it is necessary to define the commodity being demanded. The heterogeneity of housing has led to a significant proportion of housing market research using the services derived from houses as the standard unit of housing; for a classic example see Muth (1964). Many of these studies assume that housing stock and housing services are interchangeable, with the standard assumption that one homogenous unit of housing stock provides one unit of housing service (Smith et al., 1988). This assumption allows abstraction from the tenure choice decision with housing modelled as a single market rather than as a rental or an asset market, thus simplifying the analysis whilst still capturing many of the most important characteristics. This has been the preferred approach for many of the empirical studies estimating elasticities of supply and demand. In this study, it is assumed that housing refers to the flow of housing services unless otherwise stated.

2.1.1 Defining Demand

According to consumer choice theory, consumers choose between housing and non-housing goods in order to optimise their utility according to their tastes and needs and depending upon income and price constraints. Hence, the key drivers of demand for housing can be summarised by the following general functional form:

$$D = f(P, Y, I, O)$$

where P is the real price of housing, Y is household income, I is the prevailing interest rate and O represents other factors such as 'tastes' and 'needs' (related primarily to the size and composition of the household) (Wilkinson, 1973).

2.1.2 Price of Housing

Demand for housing is usually assumed to be negatively related to real house prices and previous research suggests that the relationship between the price and demand for housing can be decomposed into several distinct effects (Harrington, 1989; Nordvik, 2001). The first is the *direct price effect* that either pushes down or increases consumption of housing in the current period. The second is a *wealth effect* where, for example, the real value of a lifetime income decreases as the cost of consuming houses increases, driving down the consumption of housing services in all periods. Finally, there is also a significant effect on the *number* and *timings* of planned house moves. This framework provides a useful model with which to understand the effects of prices on demand. However, these relationships are difficult to verify empirically, partly due to data issues and partly due to the fact that the actual relationships between house prices and housing demand are very complex. This section will consider each of these three effects in order to identify the major links between price and demand.

Direct Price Effect

Measuring the direct effect of changing prices on demand is generally accomplished using a standard elasticity measure. In the case of housing, the expectation is that the price elasticity of demand is negative and empirical studies, including those for the UK, have confirmed this (Pozdena, 1988; Rosenthal, 1989). Short-run estimates generally take values between -0.1 and -0.9, implying that housing demand is relatively unresponsive to price changes, at least in the short term (Cheshire and Sheppard, 1998; de Leeuw, 1971; Ermisch et al., 1996; Hanushek and Quigley, 1980; Harrington, 1989; Lee and Kong, 1977; Muth, 1971; Polinsky and Ellwood, 1979; Schwab, 1982). However, long-run estimates indicate that demand is likely to be elastic over longer timescales; for example the study by Kearl (1979) estimated a long run elasticity of -1.5. This may reflect the mixed benefits derived from the consumption of housing. For instance, if house prices are rising they may become more attractive as an asset (depending upon the relative prices of other forms of assets) thereby reducing the downward pressure on demand. Moreover, due to the complexity of the relationship between house prices and other drivers of

housing demand, multi-collinearity issues often dog elasticity calculations. Although some of these effects are often accounted for in the estimation, some are almost impossible to isolate, such as feedback effects between prices and income.

When analysing price effects on demand, it is common to assess the impact of changing the price of both substitute and complementary goods. In the case of housing, however, there are no real substitutes unless one considers housing in terms of the separate services provided. For example, structurally similar dwellings in different locations could be considered substitutes and the degree of substitutability is directly related to household preferences (Oxley, 2004). By decomposing demand for housing into demand for different characteristics of housing, it is possible to gain an insight into both the substitutability of housing within a spectrum of particular characteristics and overall consumer preferences. There have been various attempts to analyse housing markets in such a manner but the most common approach is to use hedonic pricing, first developed by Rosen (1974). It is assumed that buyers pay a price for the property, the level of which reflects their valuation of the characteristics of that property (Evans, 1996). In other words, hedonic pricing attempts to quantify the value households place on specific characteristics of housing. This approach has frequently been used to isolate linkages between demand and factors that are less quantifiable than price, such as pollution (Smith and Huang, 1993).

The hedonic pricing approach suggests that housing is not a single distinct market but is instead a group of submarkets delineated by groups of characteristics. Since in reality no such markets actually exist, it is assumed that there is an implicit market for housing characteristics. This idea of an implicit market encompasses the production, exchange and consumption of commodities that are primarily traded in 'bundles', thus a house is treated as a bundle of commodities such as location, size and quality (Barker, 2003; Sheppard, 1997). The submarket comprises the observable transactions and prices for the bundle as a whole, i.e. the price of houses exhibiting a certain combination of characteristics.

Hedonic pricing studies have generally focused upon the creation of housing price indices; thus, the level of substitutability between differing characteristics remains a relatively unexplored area. There is, however, one such study by Bajic (1984) that estimated cross elasticities between several different groups of housing attributes in the Toronto metropolitan area. The study used four attribute groups that represented

- neighbourhood attributes and transportation to city centre;
- size of the plot;
- basic structure including floor area, number of rooms and number of exterior walls;
- internal structure including condition of the property and the number of bathrooms.

The author found significant positive cross price elasticities between these groups with magnitudes less than 0.9 thus indicating that the attributes are reasonable substitutes for each other, although it might also suggest the absence of submarkets, at least in this case.

Analysing the price effects of complementary goods on the demand for housing is also accomplished using hedonic pricing. Again, few empirical studies estimating cross price elasticities exist and these tend to examine the effect of land prices on the demand for some characteristic of housing. Although land is not strictly a complementary good since it is necessary for the construction of property, if one considers the demand for plot size instead, these issues can be overlooked. An example of such a study is that by Ball and Kirwan (1977) analysing the cross price elasticity of demand for plot size with respect to the price of land in the Bristol area. The resulting elasticity was approximately -1 implying that a 10 percent decrease in the price of land would result in a 10 percent increase in the size of plot demanded. This indicates that the price of land and the plot size are negatively related, as might be expected.

Wealth Effects

Research has shown that rising house prices are associated with an overall increase in aggregate consumption, resulting from increased housing wealth for homeowners. Consumption is funded though mechanisms such as increased access to secured credit (Campbell and Cocco, 2007; Case et al., 2003; Muellbauer and Murphy, 1990; Ortalo-Magné and Rady, 2006). This might

imply that demand for housing also increases in the face of rising house prices because of the use of property as an asset. Case and Shiller (1989) conducted surveys of recent buyers showing that buyers in a booming market treated the purchase of a home as an investment. Furthermore, in a market when prices are rising, consumers are more likely to be optimistic about economic prospects and are therefore more likely to increase consumption of all goods including housing (Aoki et al., 2002). Higher prices may also be associated with higher levels of inflation, which will have different effects on the income of consumers depending on their marginal tax rate. For instance, analysis by Titman (1982) found that the cost of housing increases relatively more for those with low marginal tax rates in comparison to those with high rates.

Empirical evidence points to the possible existence of complex feedback relationships between housing and income. For example, the belief that movements in earnings may be capitalised in future house prices suggests that increasing income might imply rising house prices (Bover et al., 1989). Previous studies have also identified income as one of the key drivers of house prices; for examples see the studies by Englund and Ioannides (1993), Malpezzi (1990), Muellbauer and Murphy (1997) and Poterba, (1992). Much of this work has relied on using average measures that capture the fact that when households are richer, they demand more of all normal goods.

Transactions Volumes

It is generally accepted that there is a clear positive relationship between house prices and transactions. For example, during periods of rising prices the number of transactions increases because capital gains for home owners can be used as leverage to make a preferred choice of housing (Benito, 2006). Throughout periods of falling prices, the ability of homeowners to make a down payment on a new property is reduced, thereby reducing the volume of transactions. Empirical evidence from the UK and the US indicates that the positive relationship between the price of housing and the volume of transactions in the housing market has persisted for some time (Ortalo-Magné and Rady, 2004).

2.1.3 · Household Income

The effects of household income on demand for housing take one of two forms:

- When income increases, households demand more of all normal goods, including housing services, and vice versa;
- Larger incomes can release binding credit constraints on households where the optimal consumption level is above the maximum that can be borrowed. This increases the opportunity for first time buyers to purchase housing and for existing owners to increase their consumption of housing.

A common measure of the responsiveness of housing demand to changes in household income is income elasticity of demand. A study by Muellbauer and Murphy (1997) estimated that the long run elasticity is approximately 1.32, implying that demand for housing is elastic relative to income and confirming that it is a normal good. There are, however, previous studies estimating income elasticities of demand close to unity and the value depends upon whether the elasticity calculation uses permanent or measured income (Charles, 1977). Evidence indicates that demand for housing is more responsive to changes in permanent income (current and future labour income streams plus the stock of household wealth) in comparison to changes in measured income (sum of permanent income and transitory income) (Lee and Kong, 1977). This follows the lifecycle permanent income hypothesis, according to which consumers estimate the ability to consume over the long run and then adjust their current consumption in order to smooth their lifetime consumption (Hall, 1978). Consequently, elasticity measures that use permanent income tend to be higher (frequently greater than unity) than those that use measured income (values are grouped about 0.5) (Carliner, 1973). Nevertheless, the measurement of income elasticity of demand is difficult due to the heterogeneity of both housing and households. For instance, empirical evidence has shown significant variations between socio-economic groups, with higher income groups being more responsive to income changes, possibly because these groups are more likely to treat housing as an investment (Wilkinson, 1973).

The effect of income on the demand for housing by credit-constrained households is an area that has not yet been investigated empirically. The largely theoretical literature that has examined the consumption of credit constrained households has shown that a combination of factors affects the consumption of housing, but that income growth expectations are important (Aron and Muellbauer, 2006). There is also empirical evidence indicating a positive correlation between the income of first time buyers and house prices. A study by Ortalo-Magne and Rady (2006) examines the effects of changes in income that free households from binding credit constraints. Specifically they focus on young households who are first time buyers and demonstrate that an increase in the income of these households is positively correlated with house prices. The reasoning is that rising incomes increase the likelihood that young households can afford the deposit for a property.

2.1.4 Interest Rates

A simple model can be utilised to explain the key relationship between interest rates and demand for housing (Follain, 1982; Pozdena, 1990). It is assumed that housing demand is determined as follows:

$$H = H(U, W, D)$$

where H is demand for housing, U is the user cost of housing, W is household wealth and D represents demographic factors such as population and household formation behaviour. It is also assumed that

$$U = P[i(1-t) - h(1-c) + d]$$

where P is the market price of a unit of housing, t is the marginal tax rate on normal income, c is the marginal tax rate on capital gains, d is the depreciation rate, i is the nominal interest rate (i.e. $i = r + e$ where r is the real interest rate and e is the rate of inflation) and h is expected house price inflation. Therefore, the user cost of housing is positively related both to the nominal interest rate (scaled for the marginal tax rate) and to the deprecation rate. The user cost of

housing is also negatively related to expected house price inflation rate (scaled for the marginal tax rate on capital), implying that any gains in housing wealth offset costs.

If we assume that $h = e$ and substitute $i = r + e$ then this equations becomes

$$U = P[(r+e)(1-t)-e(1-c)+d]$$
$$= P[r(1-t)-e(t-c)+d]$$

Thus, it is clear that when the real interest rate r increases, the user cost of housing rises and, ceteris paribus, a rise in user cost will depress demand for housing.

The effect of changes in interest rate through changes in the expected rate of inflation depends upon the income tax rate, t, and the capital tax rate, c. If $t < c$, then a rise in the expected rate of inflation will increase user costs thus depressing demand. Whilst if $t > c$, then a rise in the expected rate of inflation will actually decrease user costs, thereby raising the demand for housing. Consequently, the relationship between inflation expectations and demand is positive provided capital gains receive preferential tax treatment (i.e. $t > c$). Other factors, such as the expected increase in user costs resulting from an anticipated increase in inflation are also likely to depress demand. Changes in inflation that affect the relative returns of alternative assets may increase or decrease demand depending upon how attractive the alternative assets become.

Empirical evidence for this theory is mixed with some studies such as those by Hendershott (1980), Hendershott and Shilling (1980) and Rosen and Rosen (1980) finding evidence for a positive relationship between inflation expectations and housing demand. Studies by Kearl (1979), Boehm and McKenzie (1982) and Follain (1982) found that the rate of anticipated inflation has reduced housing demand. The relationship between interest rate and the demand for housing is not yet understood in detail but depends upon such factors as relative tax rates, differences in asset portfolios held by households and variations in mortgage markets.

2.1.5 Other Factors

Other factors that influence the demand for housing generally fall into one of the following categories: *transactions costs*, *demographics* and *household needs/tastes*. This section discusses these other factors, thus completing the description of demand.

Transactions Costs

One of the unique characteristics of the housing market is the level of transactions costs associated with the trade of housing. Haurin and Gill (2002) estimated that costs associated with selling a home amount to 3 percent of the value of the house and approximately 4 percent of average household earnings and are much larger than transactions costs associated with the trade of most other goods. Moreover, there are costs associated with each step involved in the sale and purchase of dwellings. In the initial phases of a house move, there are opportunity costs associated with market search and explicit costs resulting from agents employed to reduce overall search costs. Due to the spatial fixity and heterogeneity of dwellings, participants in the market spend considerable resources acquiring information such as value of the specific bundle of housing attributes associated with each housing unit (Muth, 1974). Even with higher levels of technology making the flow of information much faster, gathering market information remains a lengthy process.

At the point of purchase there are legal fees, brokerage fees, possible re-financing costs and one of the most significant costs, namely stamp duty (Nordvik, 2001). When the household relocates, moving costs are incurred, including the cost of re-decorating and re-furnishing the new property and the psychological costs involved in breaking attachments to the previous location and forming attachments in the new location (Hanushek and Quigley, 1978; Weinberg et al., 1981). Brokerage costs alone account for around 6 percent of the final sales price of the housing unit (Smith and Smith, 2007).

Transactions are likely to have a significant effect on the likelihood of a household choosing to move. For example, a study by Harmon and Potepan (1988) found that the length of stay in a property (a proxy for psychological attachment) was significantly negatively associated with the

probability of moving, as was the cost associated with mortgage lock-in (the costs of changing a mortgage or mortgage supplier). Interestingly, they also found that increasing family size was negatively related to the probability of moving, which is contrary to what one might assume. A possible explanation for this effect is simply the fact that if the family size increases, the household may not have sufficient income to change the level of consumption of housing given the financial costs involved in raising a larger family. It could also be for less simple reasons, such as increased psychological costs resulting from changing schools and being further away from family support.

The evidence presented here would suggest that households are likely to be in disequilibrium (i.e. are not able to consume the quantity of housing that they wish to consume) because of high adjustment costs. Nonetheless, homeowners can adjust their consumption of housing without actually needing to move: by renovating their property in order to adjust the housing services derived from that property. Historically these mechanisms have been used to remedy small imbalances between the utility maximising level of demand for housing services and the actual level of consumption of housing services (Mendelsohn, 1977; Rosen and Smith, 1986). Nevertheless, these types of adjustments also involve costs, which are likely to be significant. Estimates for the US for 1995 showed that expenditure on maintenance, repair, improvements and alterations of the housing stock totalled $111.7 billion in comparison to expenditure on private construction of new residential buildings, which totalled $162.4 billion (Dipasquale, 1999). Estimates for the UK indicate that total spending on building maintenance increased by 66 percent from the mid 1980s to the mid 1990s, representing over 5 percent of GDP (El-Haram and Horner, 2002).

Due to the nature and size of the costs associated with changing the level of housing consumption, households do not respond to changes in the determinants of demand until the present value of expected benefits from changing the level of housing consumption exceeds the costs associated with housing adjustment (Smith et al., 1988). These adjustments occur only slowly and thus inhibit the movement of house prices to long-run equilibrium levels (Fair, 1972; Muth, 1960; Rosen and Smith, 1983). Empirical analysis has shown evidence of this slow

adjustment process. Muth (1960) found that during one year, of those households facing a gap between their actual and desired stock of housing approximately one third adjust their consumption levels by moving house. In a similar study, Hanushek and Quigley (1979) found that approximately 19 percent of the gap between actual and desired levels of consumption was closed in a single year.

Demographics

The rate of household formation has a significant impact on housing demand and is also linked to rates of population growth, rates of marriage and cohabitation and the life cycle of the consumer (Charles, 1977). An empirical study by Meen (1990) found that, ceteris paribus, if there was no housing supply adjustment, a 1 percent increase in the number of households would result in an increase in house prices of 1.8 percent. Dicks (1990), however, estimated a unitary elasticity of house price with respect to household numbers. There are those who suggest that demographic influences on housing demand dominate market forces (Chevan, 1989; Masnick, 2002; Myers, 2004), whilst others believe market forces are the main determinant of changing housing consumption patterns (Green and Hendershott, 1996; Gyourko et al., 1997; Haurin and Rosenthal, 2007). Thus, the exact nature of the effects of demographic change remains the subject of some debate, although it is generally believed that demographic changes are an important component of demand.

There exists evidence suggesting that perceptions of the housing market may influence demographic changes, particularly the rate of household formation. An investigation by Smith et al. (1984) of Great Britain, USA, Canada and France concluded that numbers of non-family households were directly related to the real cost of housing services. Garasky et al. (2001) found in a study of the US that the probability of living outside the parental home and living alone is 12 percent lower in areas of high (twice the mean) real housing costs in comparison to areas of low (half the mean) housing costs. They also found that variation in headship rates of young households was between 9 percent and 18 percent lower in areas of high housing costs. This suggests that high house prices are likely to depress non-family household formation rates

thereby reducing overall demand. These feedback effects imply that estimating demand for housing cannot rely solely on uni-directional relationships between demographics and demand.

Tastes/Needs

There has been a significant quantity of analysis of the demand and price of various characteristics of housing including structural, such as the number of bedrooms, locational, such as the proximity to urban centres and environmental, such as air quality. Whether these are tastes or needs depends upon the attitude, priorities and the stage of the life cycle of the household (Straszheim, 1973). However, the effect on demand of varying the qualities of housing can be significant. For instance, Bogart and Cromwell (1997) found that up to 7.5 percent of variation in sales price between different urban areas in the US was attributable to variations in neighbourhood characteristics. Specifically, the most desirable housing is located near urban centres, open green areas and/or recreational facilities, in addition to being located in high quality neighbourhoods (evidenced by the incomes of neighbouring households) and with greater living space (Apps, 1974; Beeson and Eberts, 1989; Cheshire and Sheppard, 1995; Haurin et al., 1996; Palmquist, 1984; Peek and Wilcox, 1991; Potepan, 1994).

At the urban level, local school quality is recognised as an important determinant of house prices (Goodman and Thibodeau, 1998; Haurin and Brasington, 1996). For instance, Bradbury et al. (1997) found that school quality was significant in determining the magnitude of percentage changes in house prices in 208 towns and cities in the US. For the UK, Rosenthal (2003) estimated that the elasticity of purchase price to school quality (raw GCSE proportions at grades A-C) is approximately 0.05. Studies of urban areas also show significant relationships between schools and the housing market. For example, Leech and Campos (2003) estimated a premium on house prices of between 16 percent and 20 percent in the catchment area of two popular, oversubscribed secondary schools in Coventry. Cheshire and Sheppard (1998) focused on two local authority areas in the UK and found that secondary school catchment areas exhibited a significant relationship with local house prices. Although these studies focus on

specific urban areas, the overall evidence suggests that the quality of schools in an area has a positive influence on the price of housing in the locality.

The balance between jobs and housing has a significant impact on the local housing market since the housing mix should be suitable for the range of income and occupational groups of workers in the area. The more balanced the mix of jobs and housing in an area, the closer the workers can locate to their workplace and the shorter their commute will be (Frank and Pivo, 1994; Horner, 2004; Sultana, 2002). However, the location decisions made by dual-career households are more complex as living near the workplace of one household member may mean living far from another (Giuliano and Small, 1993; Waddell, 1996). There is also evidence to suggest that dual-career households are less mobile than single adults and single-career households (Green, 1997; Jarvis, 1999). This is becoming an increasingly significant issue as the number of dual-career households in the UK is rising. According to the study by Green (1997), the number of dual career households in Great Britain increased by 300,000 between 1984 and 1991 such that in 1991, dual career households accounted for 6 percent of all households. Consequently, the proliferation of dual-career households will continue to have major consequences on the demand for housing.

2.2 The Supply of Housing

There are two sources of housing supply, the existing stock and construction of new dwellings, and the change in the stock of housing over time can be represented using the following equation:

$$H_t = (1-\delta)H_{t-1} + A_t$$

where H_t and H_{t-1} are the levels of housing stock in the current and previous time periods respectively, δ is the depreciation rate and A_t is the number housing completions. In the short-run, the supply of housing stock is relatively fixed: new dwellings take a considerable time to produce due to the time required to acquire land with appropriate permissions and then build the properties. Hence A_t is relatively small compared to H_t and empirical studies have confirmed this, at least for the UK (Bramley, 1993b). Since existing stock will be sold intermittently, the supply of housing is generally assumed to be inelastic with respect to houses prices. Nevertheless, empirical estimates of price elasticity of supply vary widely. Malpezzi (1996) suggests that the long run elasticity of supply in the UK is between 0.9 and 2.1 (using post 1945 data) whilst estimates for English counties by Bramley (1993b) range from 0.15 to 1.8. The conflicting evidence is explained by the timescale: in general, the larger the time scale, the greater the relative price elasticity ceteris paribus. Geography and building constraints also have an effect on elasticity estimates: studies at the national level tend to report relatively high levels of elasticity whilst areas with greater levels of building constraints show relative inelasticity.

2.2.1 Supply from Existing Stock

Supply arising from existing stock changes in both quantity and quality over time due to maintenance, depreciation and demolition. Empirical estimates indicate that as much as 95 percent of housing services produced in any given year arise from existing stock (Smith et al., 1988) and thus supply from existing stock is an important determinant of housing conditions within an economy. The decisions made by owners and landlords in terms of maintenance and

renovation need to be considered together with those involved in the construction of new housing supply when considering aggregate supply to the market.

As previously mentioned, maintenance and conversion costs constitute a significant portion of GDP. Adjustments to stock can be made that alter the housing services derived from the property, thus changing the type of stock available and possibly the decision to sell the property (Dipasquale, 1999). For example, loft conversions can increase the living space of a house significantly thereby negating the need for a family to move to a larger property. However, it is very difficult to estimate the value of housing services created through maintenance and renovation because it is not sold on a market and thus proxy measures are used, such as the sales of building materials. Previous estimates for the US put the value of stock created through maintenance and renovation at approximately 30% of the total value of stock created (Smith et al., 1988).

The supply from existing stock is largely dependent upon the decisions made by households to put their property onto the market. Demand for housing among existing homeowners, and therefore the desire to sell, is stimulated by such factors as change in incomes and other general changes in circumstances. At the national level this will make no difference to prices since an increase in demand will be matched by an increase in supply unless the homeowners are changing tenures or emigrating. At the sub-national level, however, the story may be very different. Due to the spatial fixity of housing, a mismatch between supply and demand in a particular area may result in properties left vacant or rapidly increasing house prices at the other extreme.

Low demand for housing in certain urban areas has been a recognised problem for some time. Whilst this is not a significant issue at the national level (Bramley et al. (2000) estimated that only 2.6 percent of private sector dwellings are affected by low demand), a report by Bramley and Pawson (2002) found that 27 percent of local authorities in England reported problems of low demand suggesting that this is a localised issue. Although low demand is a problem in

itself, it also associated with increased levels of crime and low economic activity rates, thereby reducing the quality of the neighbourhood and further affecting demand (Keenan et al., 1999).

The mismatch of supply and demand also puts additional pressure on house prices in areas where demand outstrips supply. Increasing prices have serious implications for the mobility of workers and commuting. Large and increasing house price differentials between areas may discourage workers from migrating, affecting the supply of labour, unemployment and commuting (Berger and Blomquist, 1992; Cameron and Muellbauer, 1998; Johnes and Hyclak, 1999). Expectations of future prices can also have an effect on the supply of housing stock. If there is a perception that property prices will be higher in the future, this may encourage owners to refrain from selling their property in order to maximise their expected future gain.

2.2.2 New Construction

The decision to build depends mostly upon the expected selling price of the house(s) relatively to the cost of construction (Fair, 1972). Other important factors are the relative profitability of residential construction relative to non-residential construction as well as costs associated with labour and materials. Models of residential construction are based measures of construction costs for housing and the price of housing. Other important factors include measures of demand for housing, interest rates (if they have not already been incorporated into the specification of costs) and expectations of the future state of the market (Follain, 1979). Thus, new housing supply can be modelled by the following function:

$$S = f(P, C, L, O)$$

where P is the price of a unit of housing, C is the cost of construction materials, L is the labour wage rate and O represents other factors (Dipasquale and Wheaton, 1994; Follain, 1979; Topel and Rosen, 1988).

Empirical evidence on the price elasticity of housing supply is mixed. Some studies such as that by Muth (1960), Follain (1979) and Stover (1986) found no statistically significant relationship between output and price, indicating perfectly elastic supply. However, De Leeuw (1971)

estimated values ranging from 0.3 to 0.7. Malpezzi and Maclennan (2001) estimate supply elasticities for the US that range from 4 to 13. As with demand, supply tends to be more elastic over the long run. Due to the nature of the house building industry, there will always be a time lag between the price signal and the changes to the industry's output resulting in short-run inelasticity (Meen, 1996a).

Supply of Land

In general, it is assumed if the cost of land rises, ceteris paribus, the supply of housing will decline. There have been studies indicating that new construction may exhibit a backward bending supply curve with respect to land due to planning restrictions. Titman (1985) demonstrated that vacant land can be viewed as an option to buy a housing unit in the future and it is therefore valuable to hold land vacant because this permits the developer to wait until future uncertainty begins to resolve. Moreover, land planning regulations increase future uncertainty thus reinforcing the value of holding land vacant. At the extreme, the value of vacant land may exceed the value of developed land and thus housing will not be supplied at all. Consequently planning controls are likely to increase land costs.

Pryce (1999) found that the land elasticity of house prices (i.e. the responsiveness of house prices to changes in land supply) is dependent upon price elasticities of demand. He estimated that a 75 percent increase in land supply would result in a fall in prices of 32.4 percent. Bramley (1993a) found a much smaller response with the same increase in land supply resulting in a decrease in the price of housing of approximately 12 percent. Whilst a later study by Bramley (1999) estimated that, in northern counties of the UK, an average reduction in land release of approximately 36 percent resulted in price increases of no more than 3 percent, whilst for southern counties, the change in price was much higher at between 10 percent and 12 percent. This indicates that private sector new construction is sufficiently sensitive to the overall amount of land available for construction (and sufficiently insensitive to prices) that any significant increase in the number of new houses being constructed is likely to require a substantial release of greenfield land.

Construction Costs

What is perhaps the most surprising result from the analysis of residential construction is that virtually no studies have found a significant relationship between construction costs and the supply of new housing (Bramley, 1999; Dipasquale and Wheaton, 1994; Topel and Rosen, 1988). Blackley (1999) reported a weak positive relationship between supply and wages in the construction. Although this is likely a result of the use of aggregate data rather than data where the builder is the unit of observation (Dipasquale, 1999). Consequently, the way in which suppliers view the market is not understood and counterintuitive results between construction costs and supply of new construction cannot be adequately explained.

Planning Policy

Government policy also has a profound effect on the supply of housing. Supply-side policies such as those encouraging development on Brownfield land distort the market, raising the question of whether these policies add to the stock or crowd out private activity (Dipasquale, 1999). There are those who believe that land shortages caused by the planning system are the root of supply inelasticity (Evans, 1996) and have reduced labour mobility, thus contributing to Britain's lack of competitiveness in Europe and elsewhere (Muellbauer, 1990). Certainly, there is evidence to suggest that Government planning policies have had a constraining effect on house building (Monk and Whitehead, 1996). Moreover, Mayer and Sommerville (2000) found that construction is less responsive to price shocks in markets with more local regulation, providing some evidence that regional or sub-regional regulation also reduces the responsiveness of new supply. Meen (1996b) conducted an econometric analysis of the price elasticity of supply of new housing for the UK regions, finding that the South East exhibited a significantly lower value in comparison to the other regions and suggesting that this was attributable to the level of planning restrictions in the South East over the period 1973 to 1990. Nevertheless, planning does have some benefits, such as preventing urban sprawl and current objectives attempt to ensure that less desirable urban land is used before Greenfield sites (Hall et al., 1974).

2.3 The Operation of the Housing Market

In the case of housing the quantity demanded is not expected to exactly equal to the quantity supplied but instead market supply will equal the quantity demanded plus a positive number of vacancies necessary for the requirements of market turnover (Fair, 1972). However, the supply of housing services responds relatively slowly to changes in demand and hence over the short run, supply is inelastic implying that housing markets are commonly in a state of disequilibrium.

2.3.1 Disequilibrium in the Housing Market

If one considers the quantity of housing demanded at a particular point in time (Q_{Dt}) and the quantity supplied to the market (Q_{St}) together with the quantity of vacancies required for normal turnover V_t then market clearing would imply that

$$Q_{Dt} + V_t = Q_{St} \text{ or } Q_{Dt} = Q_{St} - V_t$$

Disequilibrium is observed when

1. $Q_{Dt} > Q_{St} - V_t$ or
2. $Q_{Dt} < Q_{St} - V_t$

In case 1, the net supply is insufficient to meet demand and in this case prices should increase inducing builders to construct more housing than they would when meeting standard growth rates (from demographic change and depreciation/demolition) and discouraging household movements. Similarly in case 2, net supply is greater than demand and thus prices should fall causing builders to reduce their rate of construction below the level required for standard growth and deterring current owners from selling their property.

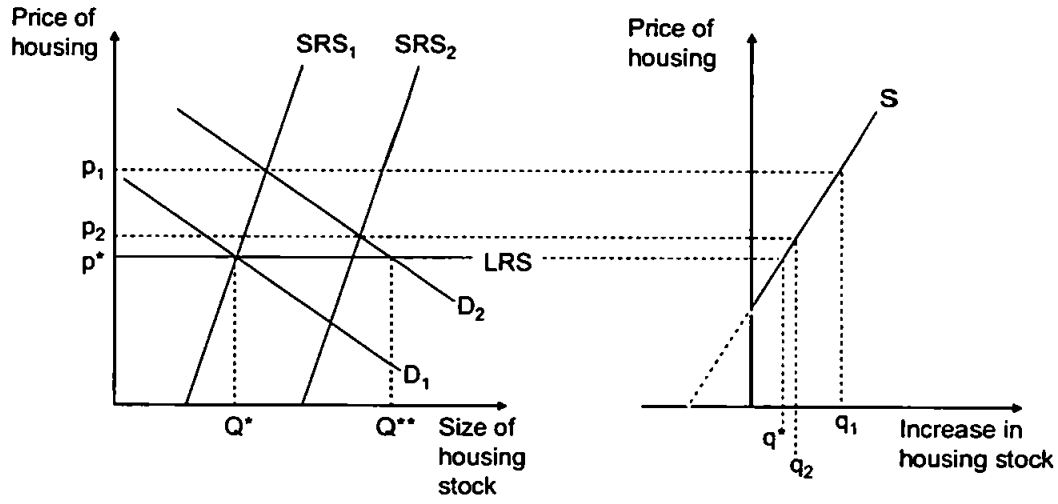
How quickly the market moves towards equilibrium will depend, at least in part, upon the time taken for both consumers and builders to respond to disequilibrium situations. The price elasticities reported earlier in this chapter would suggest that over the short term both demand

and supply are relatively unresponsive to price changes. Hence disequilibrium is a common characteristic of housing markets at least in the short term (Maclennan, 1982).

2.3.2 The Housing Market in the Long Run

During the long run, demand and supply in the housing market are more elastic. This behaviour is summarised in Figure 2-1 (Barr, 1993). Here, the left hand diagram represents the market for the stock of housing and the right hand diagram represents the flow of new housing.

FIGURE 2-1 STOCK ADJUSTMENT MODEL



In the left hand diagram, the lines D_1 and D_2 show the demand for housing as a function of the price of housing, ceteris paribus, and the lines SRS_1 and SRS_2 represent the short-run stock supply as a function of the price of housing. In the right hand diagram, the line S represents the supply of new housing as a function of price, ceteris paribus, assuming that construction depends on expectations about future prices and completions depend upon past decisions (Muth, 1960). The net addition to the stock of housing in any period is equal to total completions minus losses through depreciation and demolition.

At the initial point of equilibrium where the lines D_1 and SRS_1 cross, the stock of housing is equal to Q^* and the market-clearing price is p^*. The price p^* also induces new building at level q^* (in the right hand diagram) which is sufficient to offset the losses through depreciation. As a consequence, the net stock of housing is maintained and the market stays in equilibrium.

Assume now that there is an increase in demand, shown by the outward shift of the demand curve from D_1 to D_2, thus increasing the price of housing to p_1. This causes a change in the supply of new housing to q_1. Since q^* equals the rate of depreciation, the new housing supply exceeds the rate of depreciation and so the stock of housing increases. This shifts the short run supply curve to SRS_2 resulting in a lower market price for housing of p_2, inducing a rate of supply of new housing of q_2 which is still above the rate of depreciation. Net stock continues to increase until the price returns to p^* resulting in a long run supply curve LRS. Consequently, the new equilibrium housing stock is Q^{**}.

The stock-adjustment model, although simple, illustrates the operation of a market where supply is inelastic in the short run but elastic over the long run. In reality, however, the market does not converge to a new equilibrium smoothly for a several reasons. Firstly, the location of a house is fixed and hence supply of housing is specific to a particular area (Le Grand et al., 1992). Consequently, issues such as the local infrastructure will affect the demand for housing. For example, the establishment of a fast commuting link to a major urban centre might increase demand in a suburban centre.

The supply of land also contributes to disequilibrium in the housing market. Shortages in the supply of land and more specifically, shortages in the supply of land with appropriate planning consent constrains new house building, thus causing problems in areas of high demand (Evans, 1996). Very often the granting of planning consent is a lengthy process even if land is available, further contributing to the persistence of supply inelasticity.

2.3.3 The Effect of Exogenous Shocks on the Housing Market

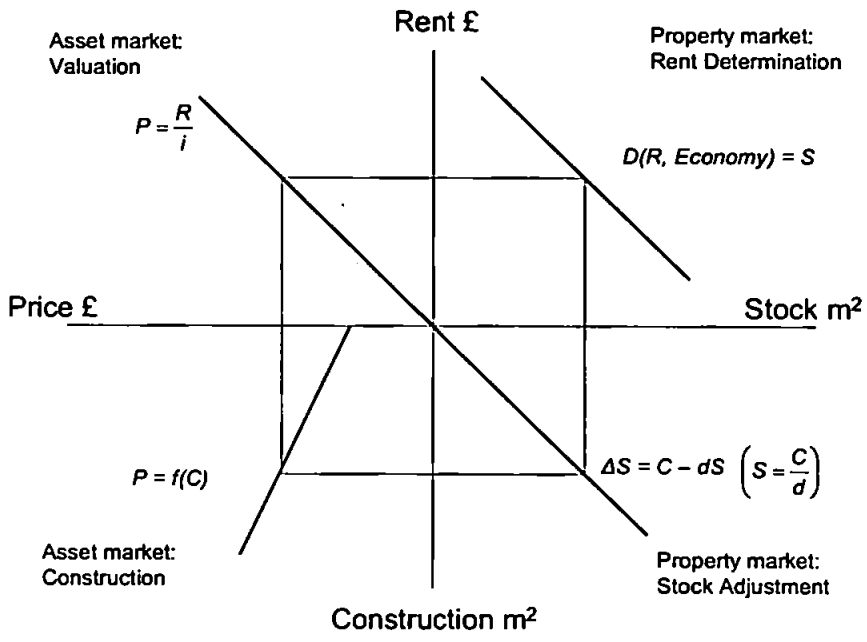
The analysis presented so far has only considered the operation of the market holding a variety of important factors constant. However, it is important to determine how the market is affected by exogenous shocks, such as changes in employment levels that will affect housing demand. The following model, first proposed by Dipasquale and Wheaton (1992), can be used to trace the effects of such exogenous shocks. This model separates the market for housing services (property market) and the market for housing assets (asset market). Rent is determined in the

property market and prices are determined in the asset market and these markets are linked in two ways:

- Rent levels are key in determining the demand for assets since the purchase of a house as an asset is essentially the purchase of a current or future income stream.
- The level of construction affects both rental and asset prices. For example, if construction increases and therefore the supply of assets grows, then both asset and rental prices are driven down.

These links can be illustrated most clearly in the following diagram.

FIGURE 2-2 PROPERTY AND ASSET MARKETS



The two right-hand quadrants represent the property market for the use of space (i.e. the market for housing services) and the two left-hand quadrants represent the asset market for the ownership of houses. In the short run, rents are determined in the NE quadrant with the two axes representing stock (per unit of space) and rent (per unit space). Demand for space is represented by the downward sloping line. In equilibrium demand D is equal to the stock S and, taking stock as given, rent R is determined such that demand and supply are equal. Demand is primarily a function of rent (price of housing services) and also other economic factors (e.g. interest rates) and hence:

D(R, Economy) = S

The NW quadrant represents the first part of the asset market and has two axes: rent and price (per unit of space). The sloping line represents the capitalisation rate for houses i.e. the yield that investors demand in order to hold housing assets. The capitalisation rate depends upon four key factors: the long-term interest rate, expected growth in rents, the risks associated with the rental income stream and the taxes that apply to housing assets. With a higher capitalisation rate, the curve would rotate clockwise, whilst a reduction in the capitalisation rate would cause an anti-clockwise rotation. In this model, the capitalisation rate is taken to be exogenous and depends upon interest rates and returns in the wider capital market for all assets. Hence the price P for housing assets is determined by R and the capitalisation rate i.

Construction levels are determined in the SW quadrant. The curve f(C) represents the replacement costs of housing assets that are assumed to increase as building activity increases. There is assumed to be a minimum price required to induce some level of construction and hence f(C) does not intersect with the horizontal axis at the origin. The slope of the line indicates the elasticity of supply; for example, scarcity of land and other impediments to supply will result in an almost horizontal curve. Asset price P, determined in the NW quadrant, establishes the level of new construction and hence

$P = f(C)$

Finally, in the SE quadrant, the level of new construction determines the overall level of stock. The change in stock ΔS in a given period is equal to new construction minus the stock lost though depreciation (ds):

$\Delta S = C - dS$

The curve in this quadrant represents the level of construction required to replace the stock lost through depreciation. At that level of stock and corresponding construction, the stock of space

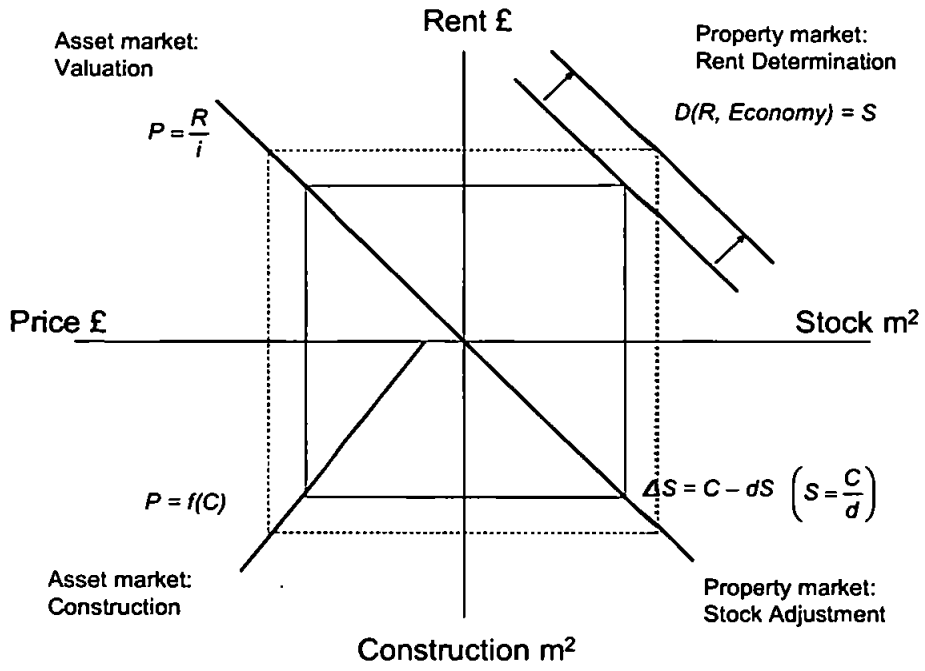
will be constant over time since the replacement levels will equal depreciation. Hence $\Delta S = 0$ which implies that $S = \frac{C}{d}$.

In summary, starting with a stock of space, the property market determines the level of rents which then get translated into prices by the asset market. These asset prices determine the level of new construction that in the property market will yield a new level of stock. The combined property and asset markets are in equilibrium when the starting and ending levels of stock are the same.

In the case of owner occupation, the four quadrants still hold but the asset and property markets are not differentiated and the determination of rents and prices occurs with a single decision as a combined market. For example, in the market for owner-occupied housing, the stock of single-family homes, the number of households and their incomes will determine an annual payment equivalent to a rent. A rise in the number of households or a fall in the available space means that to clear the property market the annual payment to occupy a house must rise. The NW quadrant translates this payment into the price paid for the home. Lower interest rates, for example, imply that that for the same annual payment (rent), households can afford to pay a higher purchase (asset) price. With owner-occupied housing, a single decision by the user/owner determines both rent and price. This decision however is influenced by the same economic and capital market conditions as with rental properties. Once the purchase price is determined then construction and eventually the equilibrium stock of space follows in the other two quadrants.

The first macroeconomic shock that will be considered is one that shifts the demand curve. This may result from changes in employment levels, the level of production or the overall numbers of households. If it is assumed that employment has increased, this will result in increased demand for housing as a direct result of increased incomes. The demand curve is shifted outward and the following would be observed:

FIGURE 2-3 EFFECTS OF A CHANGE IN DEMAND



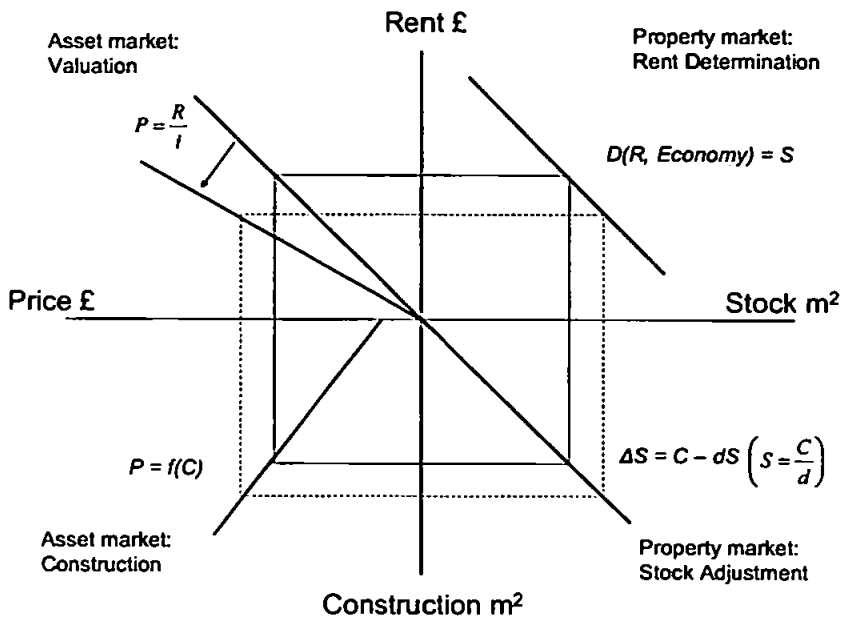
Note the changes to the equilibrium cannot be traced directly through the model since general equilibrium changes are non-linear in nature. Instead, the diagram represents the initial equilibrium and the long run equilibrium resulting from the shock.

Over the short term, the level of rent must rise (NE quadrant) since the stock cannot adjust immediately. This induces a rise in the asset price (NW quadrant). Over the longer term, this high asset price generates a greater level of construction (SW quadrant) finally leading to an increase in the overall stock (SE quadrant). The new equilibrium (denoted by the dashed line) lies outside of the original equilibrium levels and hence all levels are greater than in the original equilibrium. The actual magnitude of the increase will depend upon the slopes of the various curves. For example, if construction is elastic with respect to asset prices then the new levels of prices and rents would be only slightly greater than before whereas construction and stock would expand considerably.

So it follows that economic growth leads to increases in all equilibrium variables in the housing market. Similarly, if a contraction occurred and the demand curve shifted inwards, this would indicate a decrease in all variables in the housing market.

Now consider a shift that changes aggregate demand for owning houses. This might be caused by a reduction in interest rates in the rest of the economy such that housing becomes more attractive than alternative investments, which in turn reduces the capitalisation rate. The result is that the curve in the NW quadrant rotates anti-clockwise (see Figure 2-4).

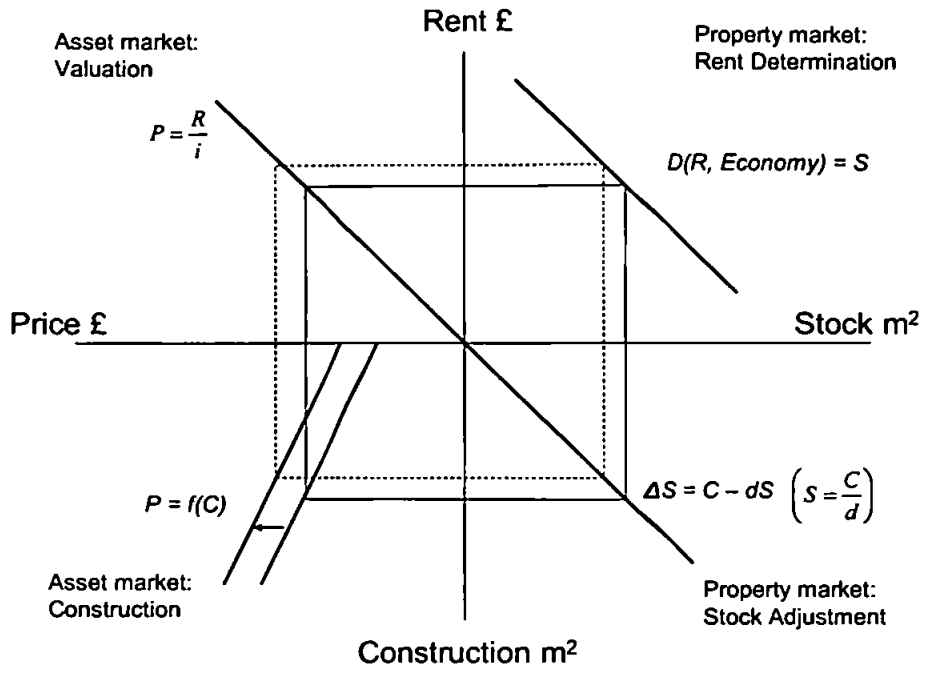
FIGURE 2-4 CHANGING AGGREGATE DEMAND FOR OWNING HOUSES



Taking the level of rent from the property market, a reduction in interest rates will cause asset prices to increase over the short term, since the curve representing the capitalisation rate has rotated anti-clockwise. Increased asset prices result in an expansion in construction (the SW quadrant) and an increase in the overall stock levels. Demand for housing services has not changed so the new level of housing stock results in lower levels of rent (NE quadrant). Equilibrium requires that initial and finishing rent levels be the same with the result that rentis lower than the original equilibrium level. By contrast, asset prices, construction levels and stock are all higher than in the original equilibrium.

The final exogenous change likely to affect the housing market is a change in the supply schedule for new construction. This may be the result of several different factors, for example, higher short-term interest rates will increase the costs for builders leading to a reduction in the level of construction. Consequently, the cost schedule shifts to the left meaning that a higher price will be required to induce the same levels of new construction (see Figure 2-5).

FIGURE 2-5 CHANGE IN THE SUPPLY OF NEW CONSTRUCTION



Assuming the level of asset price over short term, the shift in the cost schedule will reduce the level of new construction (SW quadrant) thus lowering the overall stock (SE quadrant). Since demand for space has not changed, the reduction in stock will induce a higher level of rent (NE quadrant). It then follows that the increased level of rent will result in a rise in asset price (NW quadrant). Since in equilibrium the starting and ending asset price should be the same, the final equilibrium solution will result in lower levels of both construction and stock and higher levels of both rent and asset price. Consequently, higher short-term interest rates will result in a contraction of stock.

Movements in the economy can simultaneously cause several of these types of shift. For example, as the economy enters a slow down there will be a contraction in output and employment (NE quadrant), however this will also be accompanied by an increase in short-term interest rates (SW quadrant). This combination of effects can generate any pattern of solutions that lie between those illustrated in Figure 2-3 and Figure 2-5. Although the analysis is more complicated, the equilibrium solution can always be traced through a combination of impacts from each individual change.

2.4 The Impact of the Housing Market

The housing market has significant economic effects in terms of growth, welfare (in both efficiency and distributional terms) and resource issues, specifically via the impact of relative house prices on labour mobility. Studies by Englund and Ioannides (1997), Capozza et al. (2002), Tsatsaronis and Zhu (2004) and Borio and Mcguire (2004) report significant correlations between real house price growth and variables such as real GDP, unemployment, interest rates and inflation. Previous research has found evidence of significant links between housing cycles and overall cycles of economic growth (HM Treasury, 2003; Miles, 2004; Muellbauer and Murphy, 1997). Moreover, it is likely that house prices have a direct impact on consumption via credit markets since houses can act as collateral for homeowners who are able to borrow against their property, thus fuelling consumer spending (Aoki et al., 2002). Nevertheless, the specific nature of the linkages between housing and economic growth is complex and these are now discussed.

2.4.1 Consumption and Wealth Effects

The effect of wealth on private consumption has traditionally been analysed in the framework of a life cycle model where the level of consumption depends upon permanent household income and households attempt to maximise their expected lifetime utility (Ando and Modigliani, 1963; Silos, 2007). Given expected permanent income, households are assumed to spend evenly over their life, borrowing in early age, saving during their working lives and dis-saving in later years (Boone and Girouard, 2002). The quantity of wealth allocated to housing at any point in time depends upon preferences, the stage of the life cycle and on the relative returns to housing and other assets. An expected increase in wealth should push consumers to spread the wealth gain over the remainder of their life, spending a little more and saving a little less. These factors also underpin behavioural responses to unanticipated changes in housing wealth arising from house price volatility. For example, rising house prices will tend to benefit older homeowners who have low outstanding mortgages but will be detrimental to young households who are trying to enter the home ownership market. These relative wealth effects may cause changes in saving

behaviour across households and substitution between consumption of housing and other goods. However, the net effect on consumer spending might be large or might be zero (Carroll, 2004; Case, 2000).

Empirical studies have largely confirmed that the composition of personal wealth portfolios conform to a clear life-cycle pattern (Cocco et al., 2005; Silos, 2007). In this framework, two financial channels are distinguished:

- An increase in wealth may add directly to higher consumption by households liquidating their assets
- An increase in wealth leads to greater borrowing capacity, which in turn may lead to greater spending for liquidity constrained households.

The magnitude of these two effects depends upon a number of factors including the liquidity of asset markets, the extent of regulation in financial markets and the demographic distribution of asset ownership.

Homeowners may withdraw housing equity in order to finance consumption as an alternative to maintaining equity value and using other lines of credit (Bridges et al., 2004). Re-mortgaging is the obvious route to equity withdrawal but downsizing and even shifting out of owner occupation altogether are alternatives. To the extent that housing equity withdrawal is an alternative to acquiring additional financial debts, rising housing wealth might have an offsetting impact on total financial indebtedness as well as affecting the ratio of secured to unsecured loans. Nonetheless, recent empirical evidence for the UK estimated that only 6 percent of home owners release funds from their house in any given year (Smith, 2005). Previous research has also found little difference between the marginal propensity to consume out of either financial or housing wealth, which was estimated at approximately 4 percent in a study by Boone and Girouard (2002). They also found that developments in financial wealth have been a more important driver of consumption in comparison to housing wealth since the 1990s although the importance of both has risen overall. Nonetheless, Dicks (1990) argued that housing transaction volumes are the main transmission mechanisms for housing wealth effects.

If the borrowing constraint of indebted households is tied to the value of their property, rising housing wealth underpins higher indebtedness by permitting households to increase their secured borrowing (Bridges et al., 2004). Unsecured debt, such as credit card borrowing, may also be higher if households 'feel' wealthier as a result of house price rises. Moreover, where credit providers treat home ownership and/or the value of housing equity as a signal of current and future household wealth, this permits home owners access to forms of credit that would not be available were they to rent rather than own property (Bester, 1985). Several studies have used aggregate simulations to suggest that there is a sizeable fraction of credit constrained consumers, even in deregulated financial settings, and that for these consumers the elasticity of consumption with respect to changes in house prices can exceed unity – the so-called 'financial accelerator' (Aoki et al., 2002; Iacoviello, 2004). Consequently, it has been argued that financial liberalisation rather than rising real house prices was the critical influence on changing housing-economy interactions, since housing wealth changes alone would have little effect on aggregate consumption as one household's wealth gain was simply another's loss (Miles, 1994).

Disney et al. (2003) demonstrated a relationship between changes in house price and total indebtedness for collateral constrained households who initially exhibit high levels of unsecured debt. They found a marginal propensity to increase indebtedness of 0.03, meaning that an increase in the value of housing of £1,000 would lead on average to increase debt-financed consumption by approximately £30. The Survey of English housing suggests that, after housing improvements, households report 'paying off debt' as the second most important rationale for utilising housing equity gains. This fits with the argument that exogenous housing wealth gains allow constrained households to substitute secured for unsecured debt.

2.4.2 Business Financing

There is increasing evidence indicating links between property prices and business failures. This is closely related to the issue of housing wealth since property plays such an important role as collateral for borrowing. A study by Vlieghe (2001) for the UK corporate sector found that property prices have a significant short run effect on company failures, where a fall in property prices had some effect in raising the level of liquidations. Fabling and Grimes (2005) reported similar results for New Zealand, where they found property prices together with other factors such as inflation and credit provision were significantly related to business failures.

The effect of house prices on the corporate sector arises directly through the collateral channel since rising house prices increase the amount that homeowners can borrow and may release some from binding credit constraints. A study by Black et al. (1996) estimated that a 10 percent increase in the value of net housing equity increases the number of VAT registrations by approximately 5 percent. Furthermore, when housing has been used as collateral and house prices are rising, creditors may be less pressured to force debtors into insolvency because the risk to loan repayment has been reduced (Fabling and Grimes, 2005). Finally, it is also possible that if entrepreneurs are using their own property to finance their business, they will be more inclined to ensure the business is a success.

2.4.3 Labour Market and Migration Effects

There is general agreement that high relative house prices discourage migration whilst high relative earnings and employment opportunities encourage it (Harrigan et al., 1986; Jackman and Savouri, 1992; Potepan, 1994). The effect of house prices on migration arises primarily through cost of living differentials between regions. There is also evidence to suggest that an individual's expectation of lower rates of return, higher user costs[1] or being 'priced out' of their home region acts as a significant barrier to migration (Cameron and Muellbauer, 1998). Oswald (1996) demonstrated a link between home ownership and barriers to migration, where owner-

[1] The difference between the cost of housing and the benefit of price appreciation (Barker, 2003).

occupiers are more reluctant to move to find employment in comparison to households in other modes of tenure. Other likely effects are connected with constraints on credit availability and the risks associated with high and increasing levels of indebtedness relative to both income and housing equity. All of these factors combine to reduce flexibility in the labour market, adversely affecting levels of unemployment.

Robson (2003) presented evidence pointing to lower levels of equilibrium unemployment rates in regions with relatively high levels of house prices because, for example, low unemployment may be treated as a signal of a buoyant economy thereby attracting in-migration, thus resulting in higher house prices. However, research by Cameron and Muellbauer (2001) demonstrated that, in the long run, high regional house prices are associated with high levels of unemployment, suggesting that migration effects dominate over the longer term.

Bover et al. (1989) argue housing markets influence national wages and unemployment via five key mechanisms:

- The effect of housing tenure structures on mobility rates.
- Cost of living effects on both workers and potential migrants at a regional level, thus exacerbating regional employment mismatch.
- The cost of location effect of land prices on firms and potential movers.
- The wealth effect, which occurs when houses are used as assets.
- An expectations effect that any future movements in earnings may be capitalised in future house and land prices.

Cost of living, wealth and expectations effects will be positively related to relative earnings from house prices whilst the cost of location partly offsets these. Cost of living effects may also change firms' expectations of future relative earnings levels, thereby deterring firm migration (Cameron and Muellbauer, 2001). The cost of location pushes up relative unemployment whilst the wealth effect operates in reverse. The expectations channel is ambiguous since labour costs and profit expectations have opposite effects on firms' location decisions.

The social rental sector also affects migration. There is a growing body of evidence supporting the view that social rented housing acts as an impediment to labour mobility leading to higher levels of unemployment (see Hughes and McCormick, 1981; Minford et al., 1988; Robson, 2003).

2.4.4 Welfare and Equity Effects

In terms of the individual consumer, one of the most significant impacts of the housing market is the issue of affordability[2], particularly in countries such as the UK where owner-occupation is the desired mode of tenure (Oxley, 2004). Persistently high house price to income ratios imply that some consumers may be excluded from the housing market, whilst those who are property owners will experience an appreciation in their investment (Barker, 2003). It is also likely that the overall distribution of wealth may be shifted by house price changes. For example, in the UK, absolute losses of net housing equity between 1989 and 1993 were most pronounced for social classes AB (professional home owners) and the C2 group (generally less skilled workers who were attracted into home ownership in the late 1980s) (Maclennan and Tu, 1996).

Miles (1994) argues that the aggregate effects of changes in housing wealth are likely to be modest as one person's gain is another's loss. Observed market prices generated by trades are then taken as a guide to current asset values by the stock of all home home-owners. These home-owners are the 'gainers' from price increases. The most obvious losers are first time buyers who cannot afford to start climbing the property ladder.

The overriding view is that increasing price levels in the housing market can widen the welfare gap between those who do and those who do not own dwellings and this has adverse effects on health and education (Barker, 2003; Rossi and Weber, 1996; Vostanis and Cumella, 1999). Moreover, this has an intergenerational aspect since older households are more likely to own property and therefore benefit from any rise in house prices, widening the wealth gap between generations (Barker, 2003).

[2] Affordability can be measured in several different ways, however the user cost of capital is generally considered as the best measure (Barker, 2003).

2.5 Conclusion

Housing is an important issue both in terms of the individual consumer and the economy as a whole. For the consumer, housing meets basic needs such as shelter but can also act as an investment good. In terms of the economy, the housing market has been identified as a key influence on macroeconomic volatility as well as influencing unemployment at the sub-regional level.

The housing market is distinct from other commodity markets because of the nature of the housing commodity itself. Houses are more durable than most other goods, are a significant source of wealth for homeowners, and can be used to fund other consumption by the raising of finance against the property. A high degree of price inelasticity of supply, a well-developed secondary market and the high level of informational inefficiency characterise the market for housing. Consequently, housing is a particularly complex commodity to analyse. This chapter has sought to explain the key features of the housing market, describe the way in which the market operates and identify how fluctuations in the market are translated to the wider economy.

Demand for housing is driven primarily by the price of housing, household income, interest rates and other factors such as transactions costs (Wilkinson, 1973). Theory suggests that the price of housing has several distinct effects (Harrington, 1989; Nordvik, 2001): the direct effect (increasing prices means decreasing demand), a wealth effect (increasing prices means the value of a life-time income decreases, reducing demand) and a transactions effect (high prices, reduces demand and reduces the volume of transactions). However, in reality the situation is more complex.

Empirical research suggests that increasing prices lead to greater values of housing assets for homeowners who then use this to fuel consumption by releasing the equity from their property or using their property to secure credit (Campbell and Cocco, 2007; Case et al., 2003; Muellbauer and Murphy, 1990; Ortalo-Magné and Rady, 2006). Thus rising house prices do not always lead to a reduction in housing consumption. Certainly, data shows that the volume of

transactions in the housing market increases during housing market booms due to the increased ability of home owners to make a down payment on a new property, thereby allowing them to alter or increase their level of consumption (Benito, 2006). Nevertheless, increasing house prices mean that many households will refrain from altering their level of consumption, reduce their consumption or even change tenures. Consequently, many empirical estimates of price elasticities of housing are negative. However, the absolute magnitude of these values is generally less than one in the short run and less than two in the long run, implying that demand for housing is relative unresponsive to changes in price at least in the short run (Cheshire and Sheppard, 1998; Ermisch et al., 1996; Lee and Kong, 1977; Muth, 1971).

Household incomes and interest rates also affect the demand for housing. Ceteris paribus, increasing levels of income mean increasing levels of housing demand. By contrast, high interest rates increase the cost of housing through mortgage payments, thereby reducing demand (Follain Jr, 1982; Pozdena, 1990). Moreover, high interest rates may make alternative assets more attractive than housing and hence reducing the demand for housing as an asset. Expected rates of inflation also have an effect on housing by increasing or decreasing user costs depending upon the marginal and capital tax rates.

Other important factors which affect the demand for housing include transactions costs, which can deter households from altering their level of consumption (Harmon and Potepan, 1988) and also demographics, in particular the rate of population growth and the household formation rates (Charles, 1977). Empirical research has also explored the influence of housing characteristics, either locational or structural, on the demand for houses. The existence of good schools and the quality of the neighbourhood have a significant influence on the demand for houses in urban areas (Haurin and Brasington, 1996).

Empirical research has shown that the supply of housing is relatively unresponsive to the price of housing in the short run and more responsive in the long run due to the nature of housing and the time taken for construction. Estimates of elasticity of supply have varied widely. For the UK, Malpezzi (1996) estimated a long run elasticity of supply of between 0.9 and 2.1 (using

post 1945 data) whilst estimates for English counties by Bramley (1993) ranged from 0.15 to 1.8.

The supply of housing results both from new residential construction and from existing stock. Empirical evidence for the UK has estimated that new construction accounts for relatively little market supply but the quantity of supply resulting from existing stock (resulting from upgrading and converting) is very difficult to measure (Smith et al., 1988). Nevertheless, maintenance and conversion costs have been shown to constitute a significant proportion of GDP suggesting that many households choose to alter their consumption of housing by upgrading their existing property rather than by changing properties.

Levels of new construction are influenced by the price of housing relative to construction costs, by interest rates and by expectations of the future state of the market (Fair, 1972; Follain, 1979). The availability of land and government planning policies also affect supply and relative inelasticities observed in some regions of the UK have been associated with strict planning regulations (Monk and Whitehead, 1996).

Equilibrium in the housing market implies that the quantity supplied at a given point in time will equal the quantity demanded plus the number of vacancies required for normal turnover (Fair, 1972). Disequilibrium is observed when the quantity demanded is either greater or less than the quantity supplied net of the normal level of vacancies. This is a common characteristic of the housing market due to the time taken for consumers and builders to respond to the conditions of disequilibrium (Maclennan, 1982). Over the long run, the supply and demand of housing tends to be more elastic. Nevertheless, the market does not adjust smoothly to the new equilibrium following shocks in demand or supply because of the spatial fixity of housing, the availability of land with suitable planning permission and the productivity of the construction sector (Evans, 1996; Le Grand et al., 1992).

The housing market has significant impacts on both the micro and macro economy. Previous empirical studies have found significant correlations between real house price growth and variables such as real GDP, unemployment, interest rates and inflation (Borio and McGuire,

2004; Capozza et al., 2002; Englund and Ioannides, 1997; Tsatsaronis and Zhu, 2004). For example, the mobility of workers is significantly affected by relative house price differentials between regions since high relative house prices discourage migration, thereby reducing flexibility in the labour market (Harrigan et al., 1986; Jackman and Savouri, 1992; Potepan, 1994). Moreover, rising house prices may also lead to an expectation of an increase in future wages, which has been found to depress firm migration (Cameron and Muellbauer, 2001).

There is also evidence indicating that housing cycles and overall cycles of economic growth are linked to changes in the housing market (HM Treasury, 2003; Miles, 2004; Muellbauer and Murphy, 1997). Some of this will result from the relationship between house prices and levels of consumption. Rising house prices have increased the value of housing assets from which homeowners can fund consumption by liquidating their assets or by accessing secured credit (Cocco et al., 2005; Silos, 2007). Consequently, links between rising house prices and levels of household indebtedness have also been found (Disney et al., 2003).

Fluctuations in the housing market also have significant effects upon the corporate sector. There is increasing evidence linking property prices and the rate of business failures (Vlieghe, 2001). Specifically, as house prices increase, the rates of business failures decrease. This is very likely due to the fact that many entrepreneurs fund business activities from collateral raised on their own property and in the light of increasing house prices, creditors may be less likely to force debtors into insolvency because the risk to loan repayment has been reduced (Fabling and Grimes, 2005).

There are significant welfare and distributional effects associated with changes in the price of housing with home owning households benefiting from increasing prices, whilst those who do not already own their own property find themselves with problems of affordability (Barker, 2003; Miles, 1994). Increasing price levels in the housing market may therefore result in a widening of the welfare gap between those who do and those who do not own dwellings.

The housing market is a significant driver of both national and regional economies. It has significant effects for the consumer and for business. As such, research into the housing market

has been extensive. Increasing demand for housing from population growth and an increase in the number of households prompted the current UK government to commission an investigation into the housing supply. The resulting report, *The Review of Housing Supply* (Barker, 2004) identified the undersupply of housing to be a significant contributing factor to to macroeconomic instability in the UK. This led to the focus of housing policy shifting toward increasing the supply of houses. The following chapter gives an overview of UK housing policy and discusses how economic analysis has shaped the development of these policies.

3 THE UK HOUSING MARKET

Since the middle of the last century, the number of households in Great Britain has risen from 12.5 million in 1951 to 25 million in 2006. Output from the construction of new dwellings rose from £9 billion in 1996 to almost £13 billion by 2006. Housing constituted 54 percent of the net wealth and 76 percent of liabilities of UK households in 2006 in comparison to 49 percent and 71 percent respectively in 1991. The ratio of the average dwelling price to the average income of borrowers in the UK was 2.6 in 1969, yet in 2007 this figure had risen to 4.2. Thus, there is no doubt that the housing market is of significant economic importance in the UK.

Growing numbers of households have contributed to rising house prices in the UK. Of more significance for households, the rise in dwelling prices when compared to changes in earnings has been considerable. Thus, the supply of housing has returned to the forefront of UK housing policy leading to the publication in 2004 of The *Review of Housing Supply* (Barker, 2004). Economic analysis and economic modelling played an important role in the production of this document and in the planning and policy development process as a whole.

This chapter summarises the primary trends in the UK economy, the national housing market and national housing policy over the last 70 years. Since regional housing markets share many similarities with national markets, national housing policy is often a key driver of regional policy and thus it is important to observe the close links between housing markets, the macro economy and the micro economy presented in Chapter 2.

The chapter begins with a brief history of the UK economy, housing market and housing policy over the last century. Current trends in the housing market are then presented together with an overview of the current changes in housing policy. The chapter concludes with a brief discussion of the use of economic analysis in the policy setting process, although this discussion will be extended in a later chapter.

3.1 The UK Housing Market and Housing Policy in the 20th Century

Local authorities have had the power to build houses and improve housing standards since the nineteenth century; however, the first major government intervention in the housing market occurred during the First World War (Stafford, 1978). Rent controls were imposed on all unfurnished rented accommodation, which at that time comprised 60 percent of the total stock of dwellings (all rented accommodation accounted for 90 percent of total dwellings). It was not until the middle of the last century that the UK government engaged in major intervention in the housing market when the aim was to clear slums from the inner cities and end acute housing shortages brought about by the Second World War (Bramley et al., 2004).

Since this time there have been four major stages in housing policy (Boelhouwer and van der Heijden, 1993):

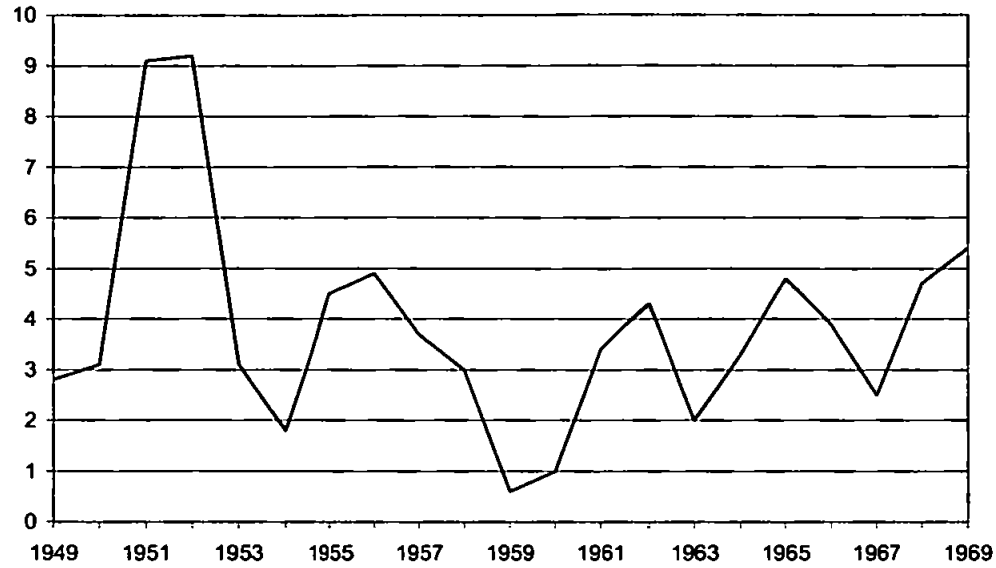
- Late 1940s to early 1950s – reduce the serious shortages caused by the war.
- Mid 1950s to the late 1960s - improve housing quality and clear slums.
- 1970s - shift of emphasis from supply-side expenditure to demand-side subsidies, benefiting those who owned housing.
- 1980s and 1990s - reduced public expenditure on the supply of new housing. In its place, housing benefits were increased to help households become owner-occupiers. During this time expenditure on housing benefits rose from £280 million in 1979/80 to £3,540 million in 1987/88. Mortgage interest relief increased from £1,639 million to £4,850 million over the same period. The Right to Buy policy was introduced and council housing stock declined from 31.5 percent to 24.4 percent over the same period.

3.1.1 The 1940s through 1960s

In the immediate post-war period through to the end of the 1960s, the UK economy experienced a period of stability. Inflation was low with prices rising by less than five percent in most years (see Figure 3-1). The only exception occurred in 1951 and 1952 when the war in Korea caused a rise in world prices and a blip in the UK inflation rate. From the 1940s to the end of the

1960s, prices in the UK rose by 70% reflecting the removal of rationing and price controls although this figure was close to the European average (Sentance, 1998).

FIGURE 3-1 INFLATION, UK (PERCENTAGE CHANGE OVER 12 MONTHS IN RPI)



Source: Office for National Statistics (2008k)

Financial stability in the UK was maintained by the exchange rate link to the low inflation dollar under the Bretton Woods system (Sentance, 1998). Whilst US inflation remained low, reflecting wider international economic stability, this link ensured that UK economic policy was consistent with low inflation. GDP grew steadily by an average of 6.5 percent per annum during this time and the UK economy was entering a period of almost full employment with the jobless total fluctuating between 1 percent and 3 percent (Buxton et al., 1998).

Nevertheless, by the middle of the 1960s the economic climate in the UK was beginning to change. Expansionary monetary policy and fiscal policies promoting employment had resulted in an upward trend in inflation (reaching 6.4 percent per annum by 1970), a current account deficit and dwindling international reserves (Bordo, 1998; O'Donoghue et al., 2006). A run on sterling followed and in an effort to avoid devaluation, the UK government arranged a loan package from the IMF. This came with rigid terms, including a substantial reduction in government borrowing, achieved by strict cuts in public spending, thus leading to a reduction in investment in local authority housing. The devaluation of sterling was nevertheless unavoidable

and the Bretton Woods system, which had helped to preserve low inflation levels in the UK, ended in 1971 (Sentance, 1998).

Housing Policy

Britain emerged from the Second World War with a housing shortage on a similar scale to that of other European countries apart from Germany (McCrone and Stephens, 1995). During the war, supply had failed to keep pace with demand and with approximately two hundred thousand houses destroyed and a quarter of a million houses damaged beyond repair, there was an estimated shortfall of two million dwellings (Holmans, 1987). Much of the available housing was of very poor quality: due to the early urbanization of Britain many of the buildings in towns and cities were substandard and urban slums were the result. Consequently, the country was facing two key housing problems, that of serious undersupply and slum clearance.

In the first two decades after the war, successive governments gave the principal role of providing new housing to local authorities. High levels of construction followed, peaking in the late 1960s (Holmans, 1987). Between the First and Second World Wars local authorities were responsible for the construction of 1.3 million dwellings, which was under half the figure achieved by the private sector (Malpass and Murie, 1999a). Yet in the twenty years after 1945, local authorities built over 2.9 million dwellings - a million more than the private sector.

There were three distinct phases of housing policy between the 1940s and late 1960s (Malpass and Murie, 1999a). The first, from 1945 to 1953, focused upon significantly increasing the supply of housing with the majority of this (over 80 percent) being supplied by local authorities. The second phase, from 1954 to 1964, also focused on supply but reversed the contribution made by the public and private sectors – local authority completions fell by more than 50 percent between 1954 and 1961 (Merrett, 1979). From the mid 1950s, the private sector was set free when the government removed the licensing system that had constrained private building since the outbreak of the Second World War. Private builders were expected to provide for general housing supply needs whilst local authorities were given the responsibility of implementing the slum clearance programme that had been re-launched, having been in

abeyance since 1939. During this period, the government encouraged local authorities to adopt levels of housing rent more closely related to market levels (Malpass, 1990). This marked a significant shift to reliance on means tested assistance for housing, and this has largely continued since that time. A relaxation of rent controls in the private sector followed with the 1957 Rent Act.

The overall aim of the final phase of housing policy, active during the mid 1960s, was the provision of half a million houses per year by 1970. This was achieved by the expansion of the public sector but only to a point of broad parity with the private sector (McCrone and Stephens, 1995). The following quote from a government housing policy document of the time demonstrates the focus on increasing the rate of owner occupation:

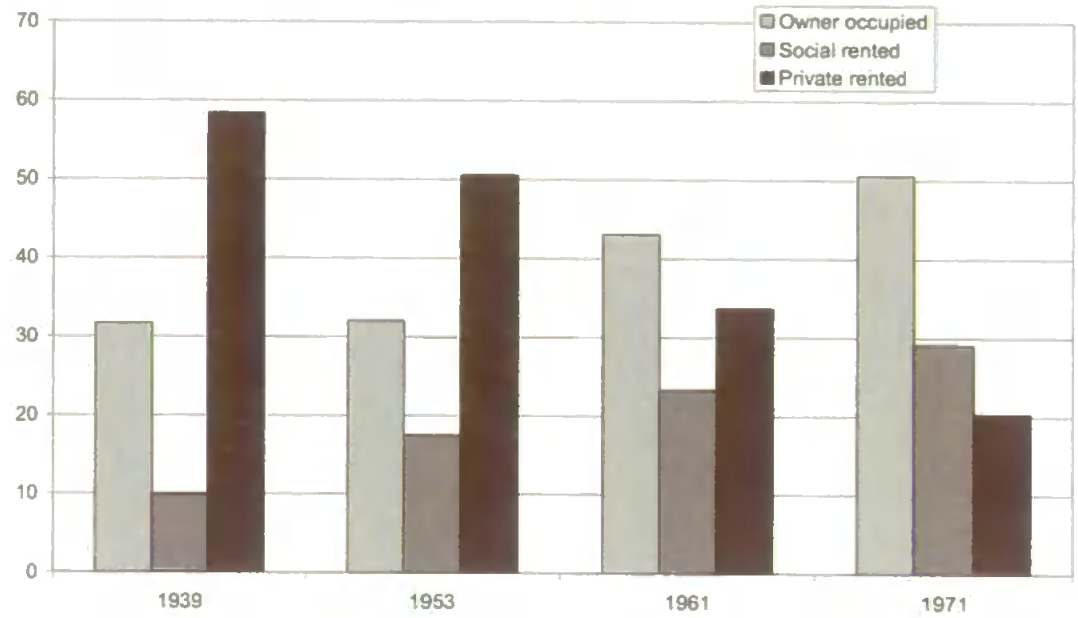
"The expansion of building for owner-occupation...is normal; it reflects a long-term social advance which should gradually pervade every region." (Ministry of Housing and Local Government, 1965: p 15).

The wider economic problems arising from the devaluation of sterling in 1967 resulted in the contraction of output, and public sector completions declined sharply after 1968 (McCrone and Stephens, 1995). Nevertheless, the severe post-war shortages had been eased and the fall in demand contributed to the reduction in output. Housing policy was re-oriented to encourage improvement rather than redevelopment, stimulated by higher levels of grant aid aimed at reducing the need for demolition and rebuilding. This was driven by a wider public dissatisfaction with high-rise housing and also with the damage that some large redevelopment had wrought (Gittus, 1976).

Housing Market

The relatively benign state of the national economy, together with government policy focused on increasing the supply of housing, ensured that owning property became a more realistic prospect for many households. In the UK in 1939, private renting was the most common form of tenure, accounting for almost 60 percent of all households (Figure 3-2). By 1971, this proportion had reduced to just over 20 percent of households and owner-occupation had become the tenure of choice for the majority of households (accounting for just over 50 percent).

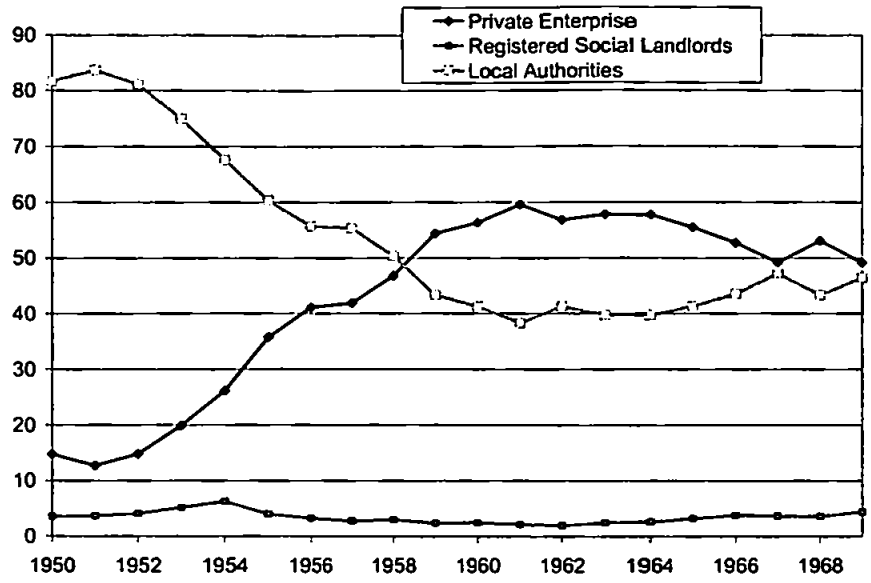
FIGURE 3-2 PATTERNS OF TENURE, UK (% OF HOUSEHOLDS)



Source: Department of Communities and Local Government (2007b)

Housing market policy aimed at increasing housing supply had the desired effect and the number of completions of permanent dwellings rose from 205,427 in 1950 to 378,325 in 1969, an increase of 84 percent based on data from the Department of Communities and Local Government (2008c). Sources of new supply began to change and with the encouragement of successive UK governments, private enterprise began to take a more significant role (see Figure 3-4). By 1959, private enterprise accounted for proportionately more completions than local authorities and this trend has continued ever since.

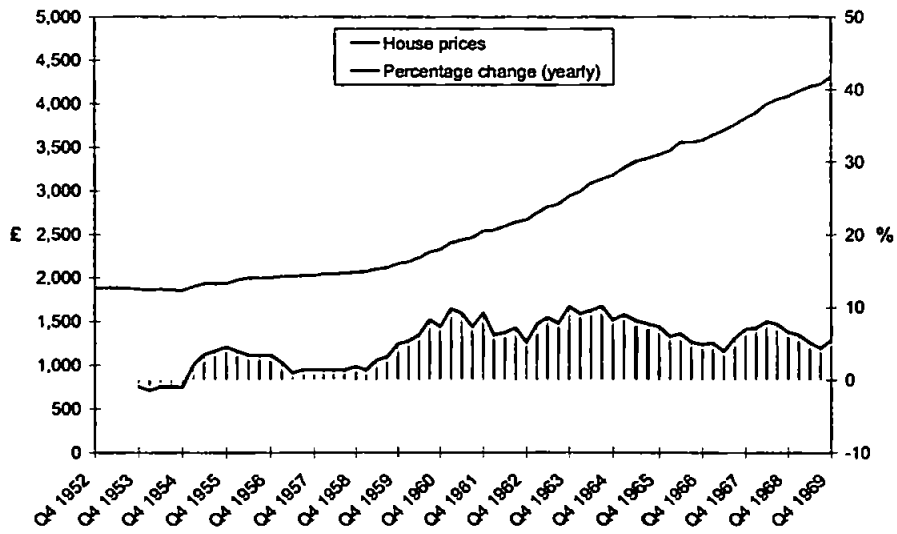
FIGURE 3-3 COMPLETIONS OF PERMANENT DWELLINGS BY TENURE, UK (%)



Source: Department of Communities and Local Government (2008c)

The general state of low inflation for much of the time from 1940 through to the mid 1960s was reflected by the behaviour in house prices, which also remained stable during this time with prices increasing by 5 percent per annum on average (Figure 3-4)

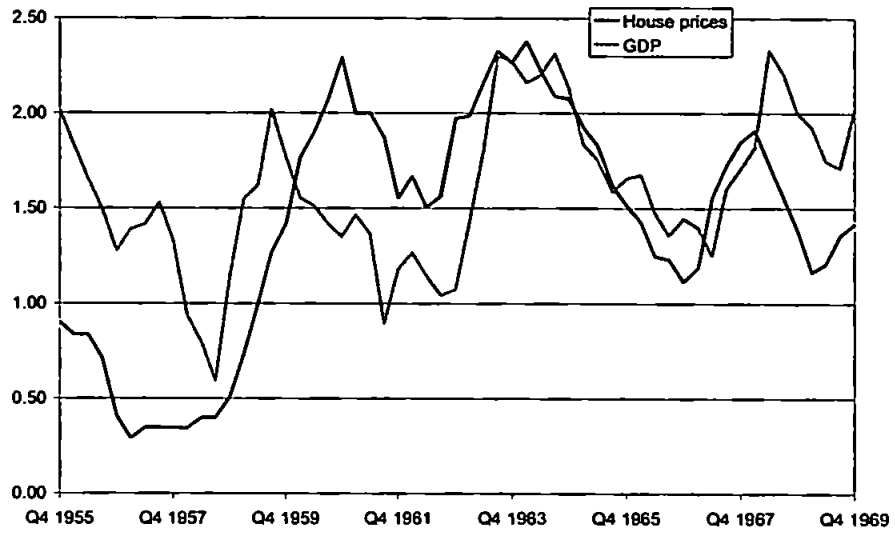
FIGURE 3-4 HOUSE PRICES (£) AND PERCENTAGE CHANGE IN HOUSE PRICES, UK



Source: Nationwide Building Society (2008)

Comparing the fluctuations in GDP with those in the housing market (see Figure 3-5), the data illustrates that fluctuations in house prices during the 1950s and 1960s largely tracked fluctuations in the wider macroeconomy.

FIGURE 3-5 PERCENTAGE CHANGE IN HOUSE PRICES AND GDP, UK (CHANGE FROM PREVIOUS QUARTER, SMOOTHED*)



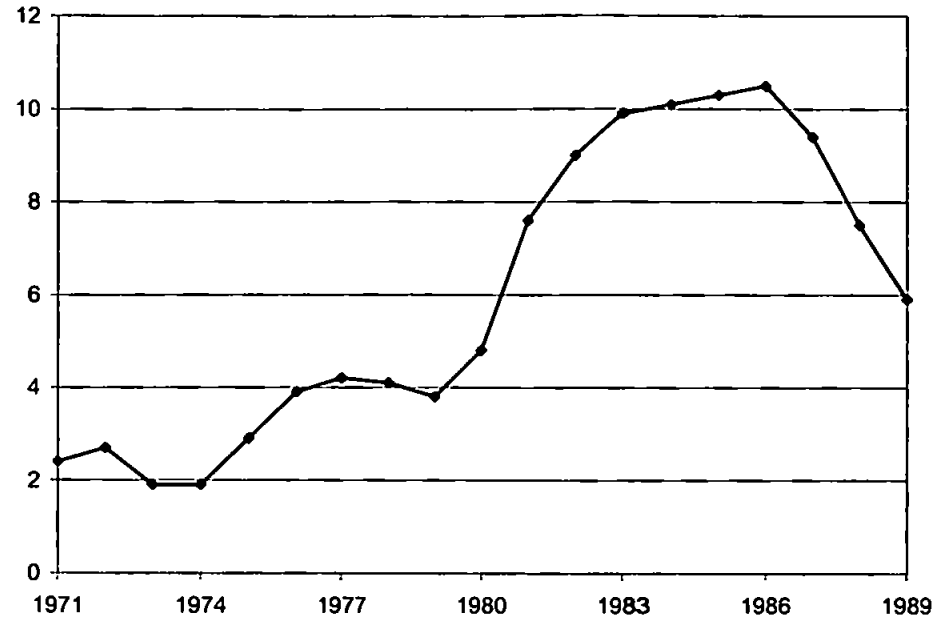
* The quarterly percentage change data was smoothed using a centred moving average of order 4 reflecting the seasonal nature of the quarterly data.
Source: Office for National Statistics (2008i) and Nationwide Building Society (2008)

3.1.2 The 1970s and 1980s

US inflation picked up in the early 1970s due to costs of financing the Vietnam War and wage increases were experienced across the industrialised world (Sentance, 1998). The long period of full employment, growing union membership and reasonably generous unemployment benefits had combined to shift the balance of power in the labour market in favour of the workers. This experience was Europe-wide; for example between 1968 and 1973, hourly earnings in the manufacturing industry rose on average, by 11.5 percent per annum in the UK, by 10.6 percent per annum in Germany, by 11.8 percent in France and by 15.3 percent in Italy (Sentance, 1998).

As a consequence of growing wage pressures, increasing inflation and general uncertainty, unemployment began to rise in the middle of the 1970s reaching a high of 10.5 percent in 1986 (Figure 3-6).

FIGURE 3-6 UNEMPLOYMENT RATE, UK (%)



Source: Office for National Statistics (2008d)

As a direct contrast to the economic stability of the previous decades, the 1970s was a period of high inflation with overall prices rising by 261 percent. Annual inflation exceeded 10 per cent in most years from 1974 to 1981 due mainly to world-wide supply shocks, such as the rapid increase in the price of crude oil during 1973 (O'Donoghue et al., 2006). Prices continued to grow throughout the 1980s when the RPI increased by 89 percent. The story for housing was particularly significant where the prices in the housing group[3] increased by 205 percent, the fastest growth of any price group.

The labour market underwent a structural change with the expansion of female employment and losses of semi-skilled and unskilled jobs (Stephens et al., 2005). With the expansion of female employment, dual earner households became more common with potential impacts on the mobility of households (Green, 1997; Jarvis, 1999). The reduction of semi-skilled and unskilled jobs had serious consequences for many low- income households whose primary earners were often employed in jobs of this type.

[3] Including mortgage interest payments, rent, depreciation costs, water, property taxes, repair and maintenance costs.

During the mid 1980s the 'corset' that had restricted bank lending was removed and the banks, keen to make up for losses they experienced from lending in the Third World, entered the domestic mortgage market (Muellbauer, 1997). The liberalisation of the housing finance market led to an increase in the average loan-to-value ratio and reduced the amount of credit rationing (Bowen, 1994). With greater access to credit via the mortgage market, household consumption increased rapidly (Attanasio and Weber, 1994; Barrell et al., 2003; HM Treasury, 2003).

By the end of the 1980s the UK economy was booming: in the three years from 1986 to 1988 the economy grew at an average rate of 4.5 percent per year and consumer spending increased by an average of 6.5 percent per year (Sentance, 1998). The numbers of unemployed dropped from 3.1 million in mid 1986 to 1.6 million in mid 1990.

The end of the 1980s saw a tightening of monetary policy in order to slow the rapid growth in the economy and the base rate increased until it reached 15 percent by 1989. The real cost of housing rose as both local taxation and mortgage interest payments had a significant impact on households. In 1989, the very unpopular Poll Tax was introduced in England and Wales in place of rates (a year after it was established in Scotland). House prices subsequently began to fall and the UK slid into recession in the early 1990s (Bowen, 1994). Negative equity became a serious issue, causing major barriers to migration and thereby reducing flexibility in the labour market. Research by Oswald (1996) suggests that patterns of home-ownership and the weakness in the private rental sector had an important role to play in accounting for disparities in regional unemployment rates.

There is a widely held belief that the changes made to the housing system in the 1980s significantly contributed to the volatility of the housing market and thereby the volatility of the wider macroeconomy (Clapham, 1996). In order to control inflation, the government elected to remove some policies that could have eased the later housing recession, such as income support payments to cover mortgage interest repayments of homeowners who lost their jobs.

Housing Policy

The housing system in the 1970s was as much determined by the need to respond to inflationary pressures and poor economic performance as by housing pressures. During the 1970s, finance replaced production in dominating the politics of housing due to the impact of inflation and rising interest rates on government assistance (Malpass and Murie, 1999a). The level of subsidy on new council houses had been raised in 1967 and in the owner-occupied category assistance in the form of tax relief on mortgage interest rose as a consequence of the growing numbers of owner-occupiers. Consequently, public attention was focused on the cost of tax relief by the unprecedented rise in house prices in 1972/73 (Boddy, 1980) and by the increase in the mortgage interest rate from 8 percent in 1971 to 11 percent in 1973. From 1967/68 to 1976/77 total relief to mortgages rose by 146 percent in real terms and subsidies in the public sector rose by 107 percent (Lansley, 1979). By the 1980s, the emphasis shifted to the control of government spending, the withdrawal of government from traditional areas of provision as well as financial and economic deregulation.

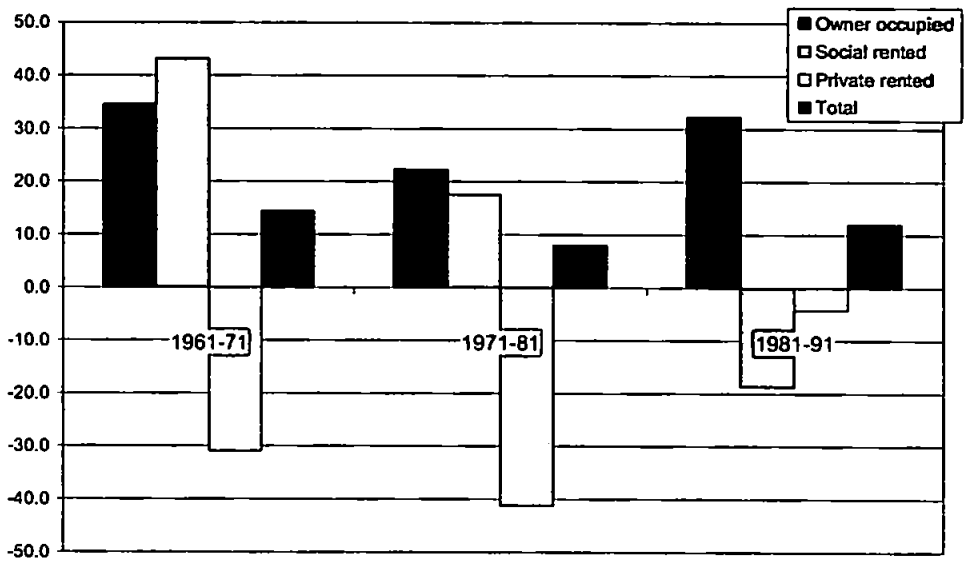
There was a systematic encouragement given to households to move to owner-occupation, specifically in the form of policies to reduce the cost of home-ownership for low-income households (Malpass and Murie, 1999a). The promotion of owner-occupation was matched by the decline of the social sector and the development of housing associations which received the majority of their funding indirectly from government but specifically from the Housing Corporation (Balchin, 1998). These housing associations were put in place to provide for those who were unable to secure local authority housing such as single-parent families.

As the council housing sector declined, housing associations were used as the primary mechanism for the provision of social rented housing. A finance system was put in place to enable housing associations to act more like private sector organisations, competing for finance and development opportunities (Clapham, 1996). Thus as the housing system became more market oriented, the provision of housing subsidies was through personal means, namely housing benefit, and supply side subsidies were reduced.

Housing market

Figure 3-7 shows the decline in local authority housing, with the numbers of households in this tenure decreasing by almost 20 percent between 1981 and 1991. Private renting decreased in the decades between 1961 and 1991, whereas owner occupation increased by over 20 percent in three decades between 1961 and 1991.

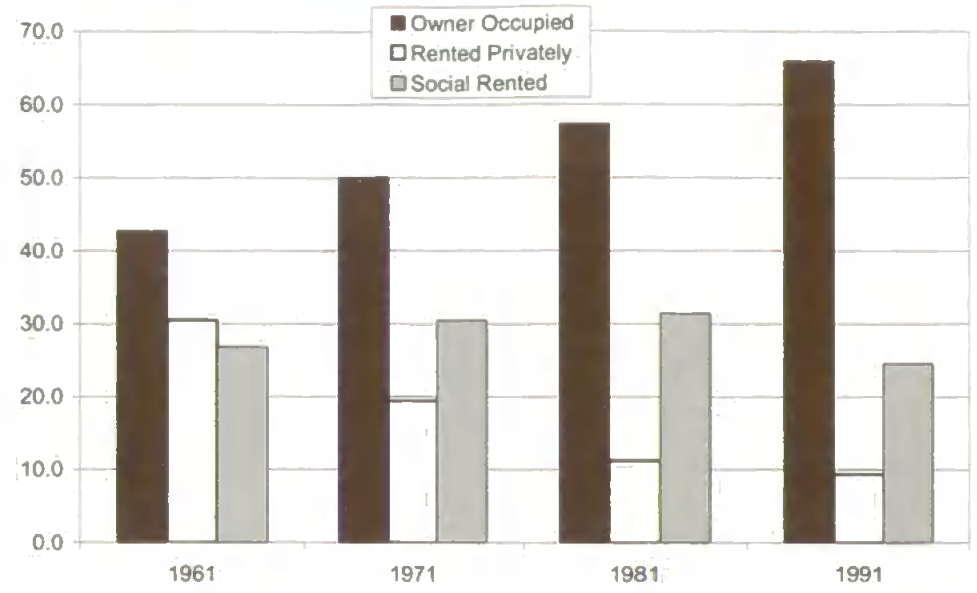
FIGURE 3-7 PERCENTAGE CHANGE IN THE NUMBER OF HOUSEHOLDS BY TENURE, GB



Source: Department of Communities and Local Government (2007b)

Data showing the stock of dwellings by tenure reflects the decline in both forms of renting (Figure 3-8). By 1991 owner occupied dwellings accounted for two thirds of the dwelling stock.

FIGURE 3-8 DWELLING STOCK BY TENURE, GB (APRIL, %)



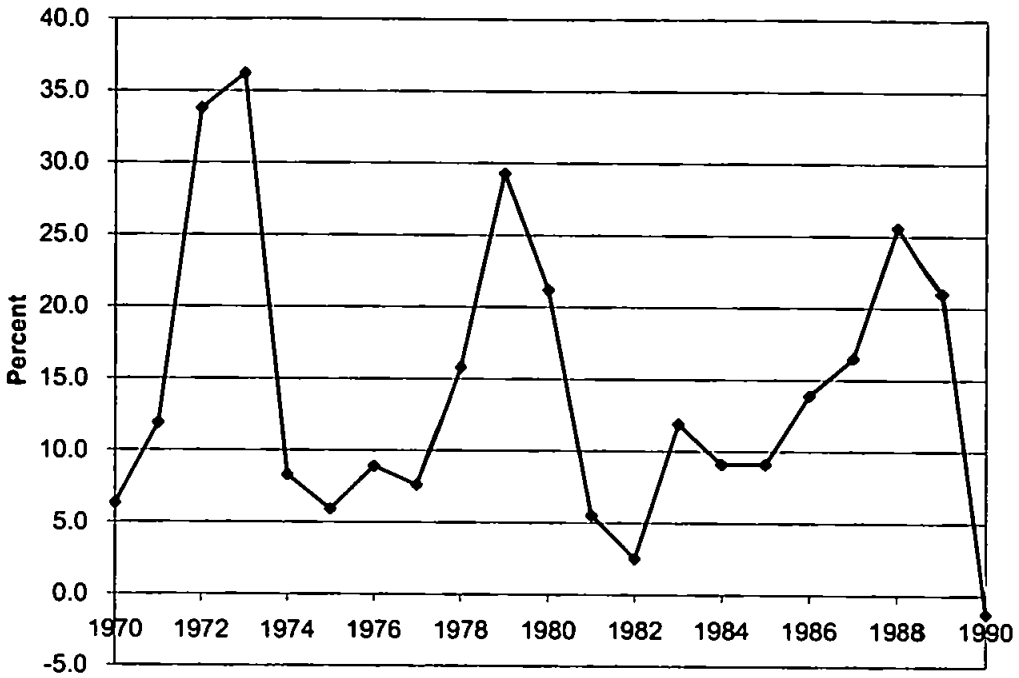
Source: Department of Communities and Local Government (2007a)

With the housing market in the UK biased towards owner occupation, the increase in interest rates experienced in the latter half of the 1980s inevitably had a significant effect via increasing mortgage interest payments and thus contributed to the recession experienced at the beginning of the 1990s.

In the face of rising levels of home ownership, government policy was aimed at increasing flexibility in the market by encouraging the private rental sector through deregulation: rent controls were lifted and tax reliefs on new investments were made available. These policies provided the framework for the Housing Act 1988; however, this failed to increase the contribution of the private rental sector overall and the sector remained relatively weak (Gallent et al., 1998).

Figure 3-9 shows the annual housing inflation rate. In the two decades prior to the 1990s, annual house price inflation remained above five percent in most years. The peaks in the late 1970s and 1980s were not as high as in the early 1970s but nevertheless reached highs of over 25 percent. In 1989, inflation was still above 20 percent but dropped rapidly to negative levels in 1990 indicating the start of the recession.

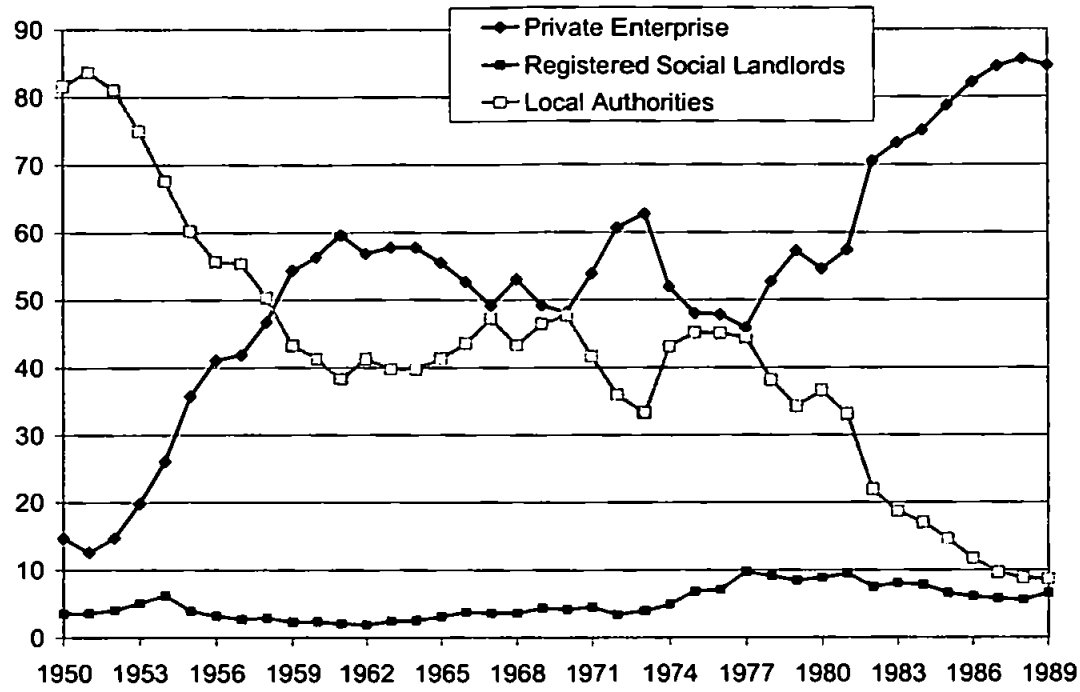
FIGURE 3-9 ANNUAL HOUSE PRICE INFLATION RATE, UK



Source: Department of Communities and Local Government (2008d)

The reduction in public spending on housing resulted in the majority of housing completions coming from the private sector by 1989 (Figure 3-10). At this time, new supply from local authorities and registered social landlords accounted for less than 20 percent of completions of all new dwellings. This situation was the result of housing policy changes driven by the Conservative government's ideology of the free market.

FIGURE 3-10 PERMANENT DWELLINGS COMPLETED BY TENURE, GB (%)



Source: Department of Communities and Local Government (2008c)

3.1.3 The 1990s

The rapid economic growth of the latter half of the 1980s came to an abrupt end in the early 1990s. In 1990 and 1991 the global economy was in decline, largely as a consequence of the panic following the stock market crash in 1987, and the UK economy was in recession by the end of 1990. Inflation had been pushed up by the boom in the late 1980s and reached a peak of 10.9 percent in the Autumn of 1990 (Sentance, 1998). The Gulf War caused a spike in oil prices, pushing up costs for oil consuming industries and thereby affecting overall prices.

During the same time, the UK government made the decision to join the Exchange Rate Mechanism (ERM) of the European Union because of the failure to control inflation during the latter stages of the 1980s. Although this caused UK inflation to fall sharply, reaching a level of 4 percent by the beginning of 1992, economic conditions in the UK and Germany were already diverging, forcing the withdrawal of the UK from the ERM in September 1992 when sterling came under severe pressure from currency speculators.

Despite the inauspicious start of the decade, the economy began a weak recovery in 1992 and grew steadily throughout the mid-1990s, with falling unemployment and inflation averaging 2.8 percent from 1993 to 1996 (Sentance, 1998). Real GDP grew by over 20 percent during the decade and by the end of the 1990s had reached £1 trillion.

This decade also saw some major parliamentary powers devolved to Scotland and Wales, including policy-setting powers for housing, planning and local government. This gave each of these countries the power to set housing agendas and UK housing policy subsequently became a more regional affair.

The latter half of the 1990s also saw a major change to monetary policy in the UK when the Bank of England was given operational independence in 1998 and the duty of setting the UK base rate became the responsibility of the Monetary Policy Committee. The consequence for the economy was that the primary method used to control inflation now became the UK base rate. The rate of owner occupation, together with the predominance of variable rate mortgages, meant that the UK housing market was particularly sensitive to changes in the interest rate, which would probably have affected the operation of monetary policy in the UK.

Housing Policy

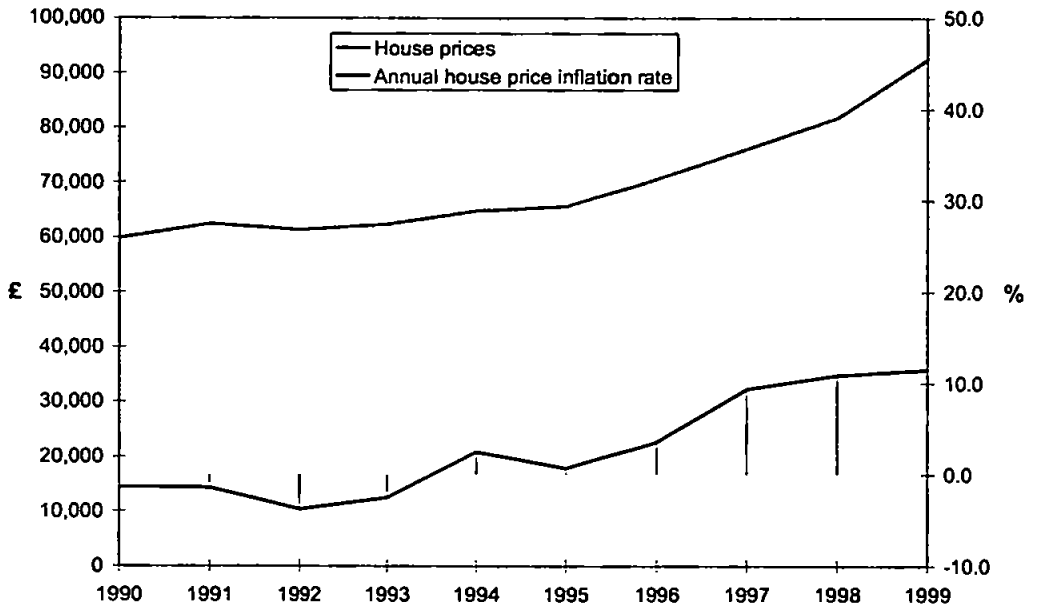
Between 1989 and 1991 the controversial Poll Tax, which was based on the number of people residing in the household, replaced the previous domestic rates based on the notional rental value of a house. Thus, there was a restructuring of household costs, with a considerable burden placed on larger households. An extremely unpopular tax, it was replaced in 1993/94 by the Community Charge which reverted to a system based on the value of the property. However, whilst it was in place, the Poll Tax increased the costs to households and may have led to a deepening of the slump in the housing market.

The overall policy concerns of the 1990s were driven partially by the recession during the early part of the decade and partially by the impact of the financial liberalisation of the housing finance market in the 1980s (Malpass and Murie, 1999a). This legislation marked a shift from mortgage rationing to lending on demand with finance companies willing to lend higher

multiples of income than ever before. With more and more households able to procure mortgages and purchase property, mortgage interest tax relief was scaled back from a rate of 25 percent in 1991 to just 10 percent in 1998.

The recession in the early 1990s saw negative house price inflation (Figure 3-11). By 1994, a recovery was underway and prices began to rise again for the first time in four years. By the end of the decade, however, the housing market was booming and, indeed, prices increased by over ten percent in 1999, although the house price inflation rate never reached the peaks experienced in the previous two decades.

FIGURE 3-11 HOUSE PRICES AND THE ANNUAL HOUSE PRICE INFLATION RATE, UK



Source: Department of Communities and Local Government (2008d)

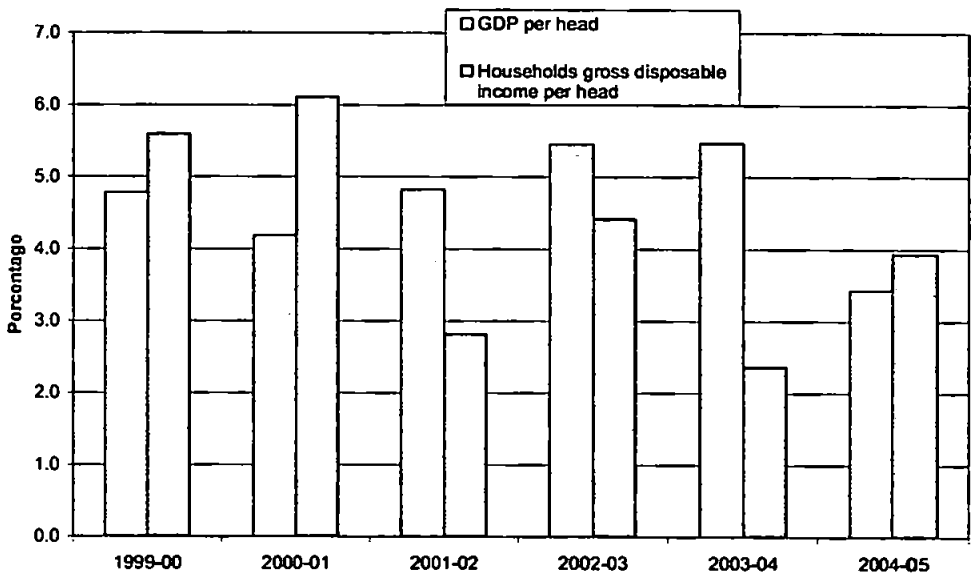
3.1.4 The housing market from 2000 to 2007

Although growth in the world economy slowed during the late 1990s, by the early part of the 21st Century most industrialised countries were reporting the beginning of a recovery. The terrorist attacks on September 11th 2001 and the subsequent wars in Afghanistan and Iraq dampened the pace of recovery (International Monetary Fund, 2003). Growth in recent years has also been affected by the rapid slowdown in the US housing market due to the sub-prime

mortgage crisis and the significant increases in oil prices. Global growth slowed from just over 5 percent in the first half of 2007 to 4.5 percent by the first quarter of 2008 (International Monetary Fund, 2008).

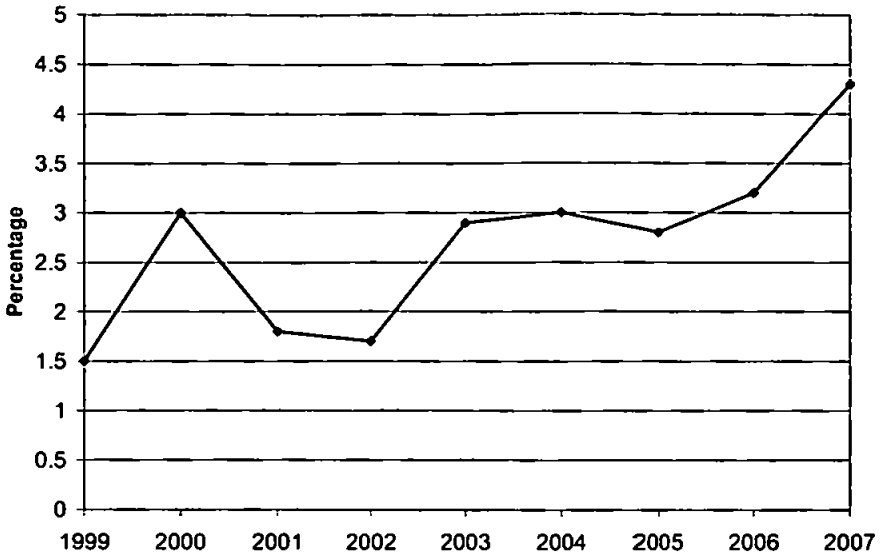
The behaviour of the UK economy has largely mirrored that of the world economy. Real GDP per head has continued to grow, increasing by an average of 4.7 percent per annum since 2000 (Figure 3-12). Unemployment has fallen and in 2007 was at it lowest level since the early 1970s. The UK inflation rate remained at around three percent or less per annum until 2006 when strong growth and rising international oil prices began to have an effect (Figure 3-13 and Figure 3-14).

FIGURE 3-12 PERCENTAGE CHANGE IN REAL GDP PER HEAD AND HOUSEHOLDS GROSS DISPOSABLE INCOME PER HEAD, UK



Source: Office for National Statistics (2006, 2008i)

FIGURE 3-13 RPI, UK (ALL ITEMS - % CHANGE OVER 12 MONTHS)



Source: Office for National Statistics (2008k)

The housing market in the UK has been buoyant since 2000. Figures from the Department of Communities and Local Government (Table 3-1) reported that annual house price inflation rates peaked in 2002 at 17 percent and have remained above 5 percent since 2000.

TABLE 3-1 UK AVERAGE HOUSE PRICES AND HOUSE PRICE INFLATION RATES

Year	Average Price	Annual Inflation Rate
2000	101,550	14.3
2001	112,835	8.4
2002	128,265	17.0
2003	155,627	15.7
2004	180,248	11.8
2005	190,760	5.6
2006	204,813	6.3
2007	221,580	10.9

Source: Department of Communities and Local Government (2008d)

Nevertheless, during the last two years the slowdown in the international economy and the housing market crisis the US have compounded the slowing of growth in the UK economy, including a sharp decline in the housing market. As Table 3-2 shows, the average UK house price declined by 0.9 percent at the end of 2007 and by 4.7 percent during the second quarter of 2008.

TABLE 3-2 RECENT CHANGES UK AVERAGE HOUSE PRICE

Year	Period	% Change	Std Price
2007	Q1	2.9	192,651
	Q2	2.5	197,562
	Q3	0.6	198,664
	Q4	-0.9	196,792
2008	Q1	-1.1	194,717
	Q2	-4.7	185,625

Source: HBOS Plc (2008b)

3.2 Major Trends in the UK Housing Market

There are three main channels through which the housing market exerts an influence on the UK economy (Meen, 2005):

- Empirical evidence suggests a link between consumer expenditure, tenure and household wealth. For many people, housing constitutes the largest component of household wealth and thus volatility in the housing market has a significant impact on households. With a relatively high proportion of owner-occupiers, the UK economy is more sensitive to variations in housing wealth. Data from the ONS indicates that in 1991 residential buildings accounted for 49 percent of the net wealth of the household sector and by 2006 this proportion had risen to 54 percent (Office for National Statistics, 2008h). The significance is that the rate of owner-occupation, together with the predominance of variable rate mortgages, implies that the UK housing market is particularly sensitive to changes in interest rates.
- The majority of mortgages in the UK are variable rate rather than fixed rate and hence homeowners are sensitive to changes in the interest rate. Variations in the costs faced by households affect both housing demand and overall consumption. The level of household mortgage debt is also important. Owner occupation has led to a rise in the debt secured on dwellings, which accounted for 76 percent of all liabilities of the household sector in 2006, a rise of 5 percent since 1991. Mortgage debt as a percentage of GDP in UK at 60 percent is higher than in any other EU country apart from the Netherlands and Denmark; the EU average is just 4 percent (HM Treasury, 2003).
- Financial liberalisation in the UK has meant that equity withdrawal from housing wealth is relatively easy, thus homeowners have greater access to credit.

Housing is also linked to the macroeconomy via output from construction. This contributed £23,009 million to total output in 2006, which was 36 percent of total construction output (Department for Business Enterprise and Regulatory Reform, 2007). Although very difficult to

estimate, the renovation and maintenance of housing is also likely to make a significant contribution to the economy (Smith et al., 1988).

In the last 50 years, the housing market has exhibited a strongly cyclical pattern. Although these cycles are closely related to those in the wider economy, housing cycles tend to have amplitudes significantly larger than the economy as a whole (Maclennan, 1997). Prior to the recent changes in the market, there have been three major housing booms in 1973, 1979 and 1988 when house prices increased by up to 30 percent in a single year (Chen and Patel, 1996). We are now entering a period where house prices have begun to fall and it possible that the housing market will soon be in a recession[4] once again (HBOS, 2008a).

In many developed countries, house prices are rising and affordability of housing is now a major issue. Many governments have made affordability the primary focus for housing policy, despite the significant increases in average household wealth and income experienced in almost all developed countries (Linneman and Megbolugbe, 1992b). Housing reforms in the United Nations Commission for Europe (UNECE) area have promoted deregulation, private sector involvement and demand-based subsidies in order to reassert market forces and reduce state intervention, the goal being to improve economic and social efficiency (Tsenkova, 2008). It appears that countries with higher home ownership rates and limited tenure choice tend to have a higher share of households experiencing affordability problems.

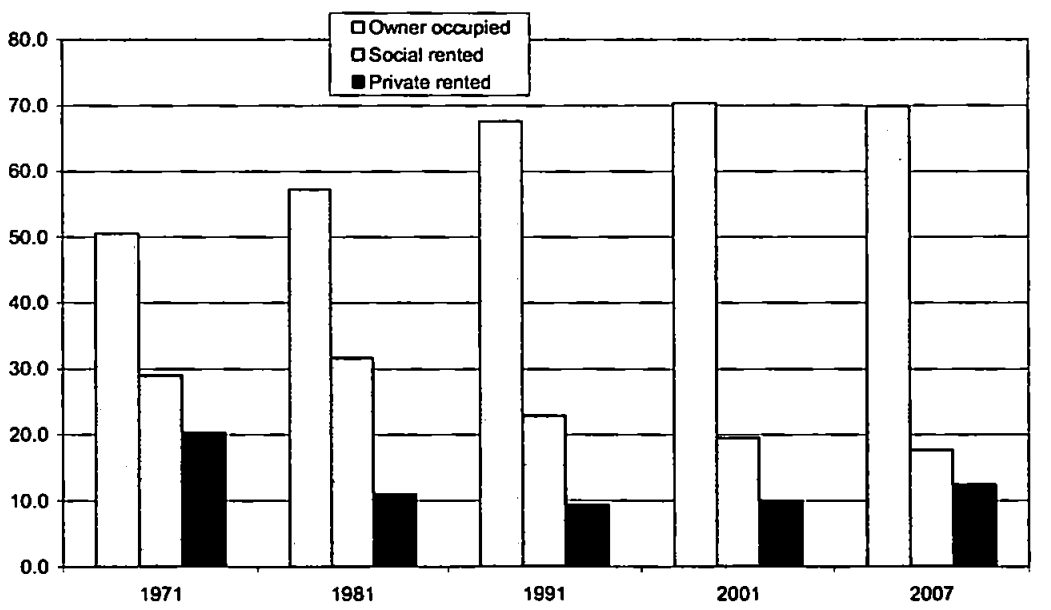
Given the relatively high proportion of owner occupiers in the UK, recent trends in the housing market have resulted in housing supply once again becoming the primary focus of UK housing policy. The next section seeks to identify the significant housing market trends observed in recent years in order to understand the motivation for the direction that the government has taken in the setting of new housing policies.

[4] Recession in the housing market refers to either reductions in private sector new housing construction output, falling nominal house prices, falling real house prices, falling numbers of transactions, rises in repossessions (Forrest and Murie, 1994; Malpass, 1996; Stephens, 1996)

Tenure, Consumption and Interest Rates

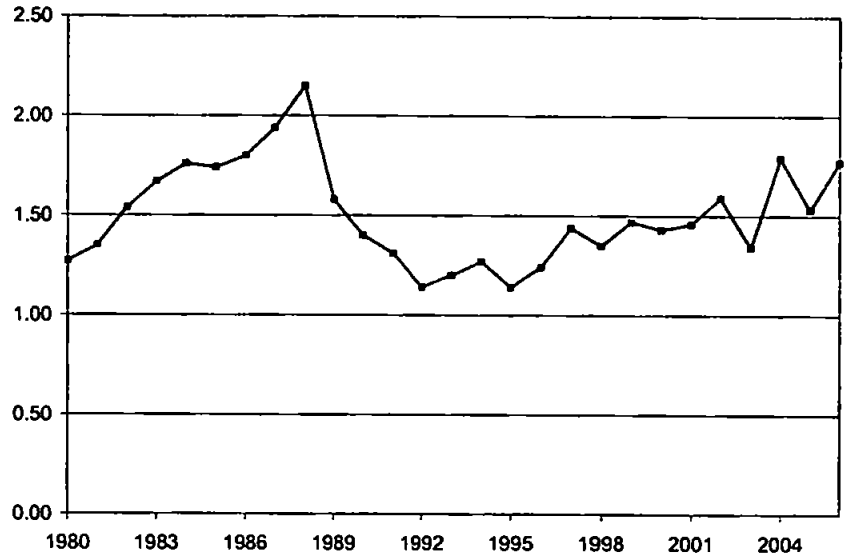
The early part of this chapter has demonstrated that much of the post war housing policy was focused on increasing the rate of owner occupation and overall this has been successful. Figure 3-14 shows that the percentage of owner-occupiers has increased from just over 50 percent in 1971 to 70 percent in 2007. A survey of news articles regarding the housing market might suggest that the private rented sector has boomed in recent years, but in reality there has been very little increase in overall proportions of households renting privately. Since 1981 the percentage of households in England choosing private renting as their mode of tenure has remained around the 10 percent level, primarily because financial liberalisation, falling interest rates and the healthy state of the national economy have made it easier for households to purchase their own home. Data from HM Revenue and Customs available for England and Wales indicate that transactions peaked in the housing boom of late 1980s and despite a dip during the recession of the early 1990s the number of transactions reached 1.77 million in 2006 (Figure 3-15).

FIGURE 3-14 TRENDS IN TENURE, UK (% OF HOUSEHOLDS)



Source: Department of Communities and Local Government (2008i)

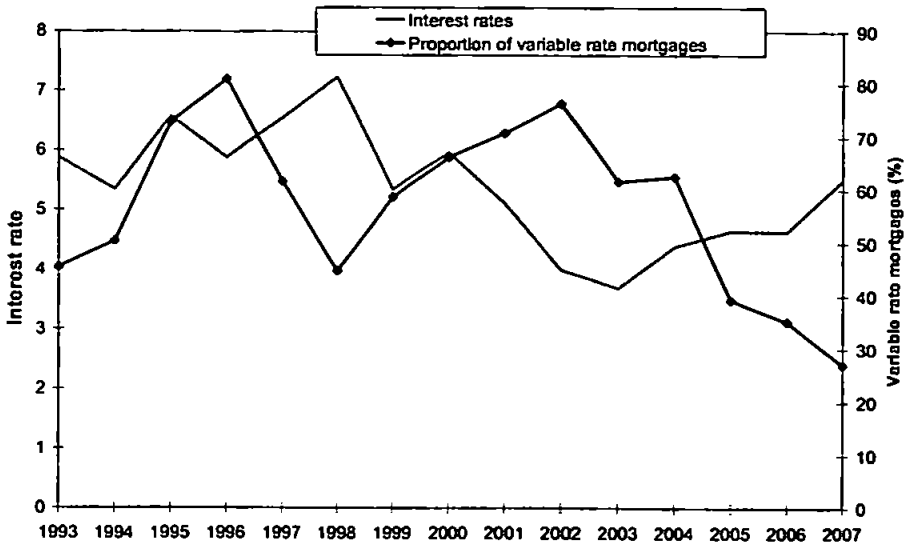
FIGURE 3-15 PROPERTY TRANSACTIONS IN ENGLAND AND WALES



Source: HM Revenue and Customs (2008)

The mortgage market in the UK relies far more on variable rate mortgages than almost any other country in the EU (HM Treasury, 2003). As Figure 3-16 shows, there is some form of relationship between the proportion of variable rate mortgages and the prevailing interest rate. During periods of low or falling interest rates, the proportion of variable rate mortgages is relatively high whilst in periods of high or rising interest rates the proportion is generally low.

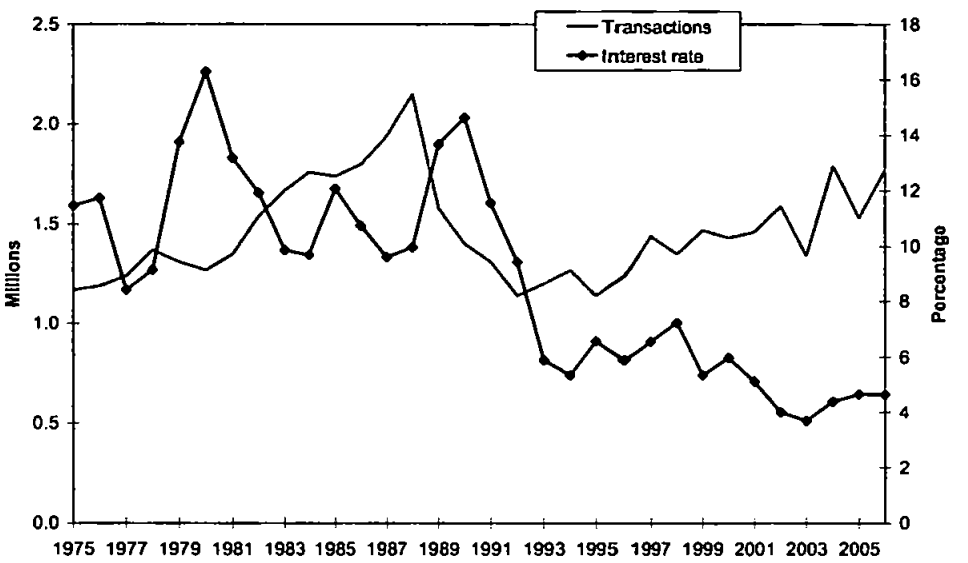
FIGURE 3-16 ANNUAL AVERAGE OF BANK RATE AND NUMBER OF VARIABLE RATE MORTGAGES AS A PERCENTAGE OF ALL MORTGAGES, UK



Source: Bank of England (2008)and Council of Mortgage Lenders(2008)

Due to the proportion of variable rate mortgages, the housing market in the UK is particularly sensitive to changes in the interest rate. As Figure 3-17 shows, the number of housing transactions in England and Wales appears to be related to the interest rate. Periods of low or falling interest rates are matched with high or increasing numbers of transactions in the market and, conversely, periods of high interest rates are matched with relatively low numbers of transactions.

FIGURE 3-17 HOUSING TRANSACTIONS (MILLIONS) AND AVERAGE ANNUAL BANK RATE (%), ENGLAND AND WALES



Source: HM Revenue and Customs (2008) and the Bank of England (2008)

The trend towards owner occupation has led households to regard housing in terms of wealth accumulation and thus housing constituted almost 45 percent of total assets for UK households in 2006 (Table 3-3). Furthermore, housing loans accounted for over 75 percent of total liabilities. In 1987 at the height of the housing boom, according to data from the Office for National Statistics (2000), residential dwellings net of loans constituted 35 percent of net wealth of households but by 2006 this figure had risen to 38 percent.

TABLE 3-3 HOUSING ASSETS AND LOANS, UK

	Value of housing assets as % of total assets	Value of Housing loans as % of total liabilities
1991	40.8	71.0
2001	38.2	72.8
2003	44.6	73.8
2004	45.7	74.7
2005	43.9	75.1
2006	44.7	76.4

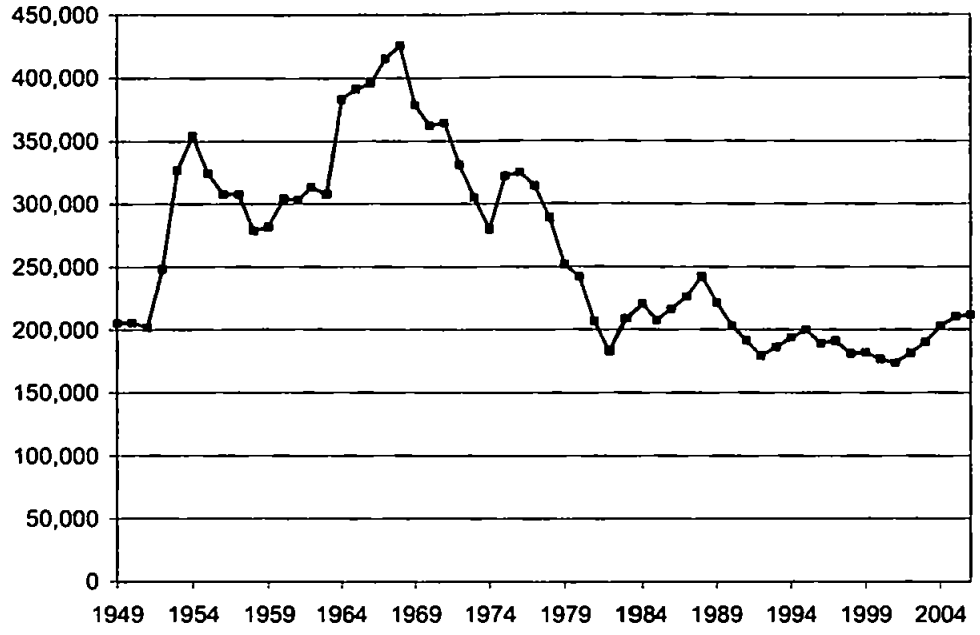
Source: Office for National Statistics (2008l)

Prior to the 1980s there is little evidence that equity withdrawal had a significant effect on consumers' expenditure (Meen, 2005). However, the financial liberalisation of the mortgage market made it much easier for households to borrow against their property and thus increase their levels of consumption. Empirical studies have estimated that in the UK the marginal propensity to consume from unanticipated changes in housing wealth is somewhere between 0.01 and 0.14 depending upon the time period and the manner of calculation (Campbell and Cocco, 2007; Carruth and Henley, 1990; Disney et al., 2003; Muellbauer and Murphy, 1995).

House Supply and Affordability

Housing supply in the UK has hardly increased over the last 10-15 years despite the rise in house prices, as Figure 3-18 shows. In 2001 the level of housing construction was at its lowest level since the Second World War and in 2002 the output of new houses was 12.5 percent lower than that for the previous decade.

FIGURE 3-18 NUMBER OF PERMANENT DWELLINGS COMPLETED, UK

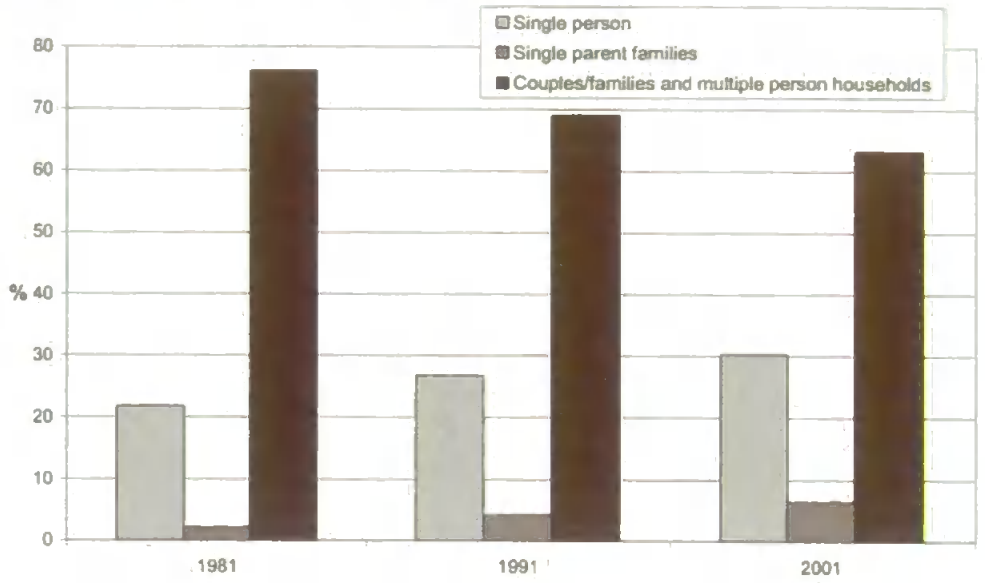


Source: Department of Communities and Local Government (2008c)

Households

Pressure in the housing market has been exacerbated by changes in the composition of households. The proportion of multiple person households (couples, families and other multiple person households) has been declining as the proportion of single person and single parent households has been increasing (Figure 3-19). In 1981 over three quarters of households were multiple person households, but by 2001 this figure had declined to 63 percent.

FIGURE 3-19 HOUSEHOLD COMPOSITION, GB

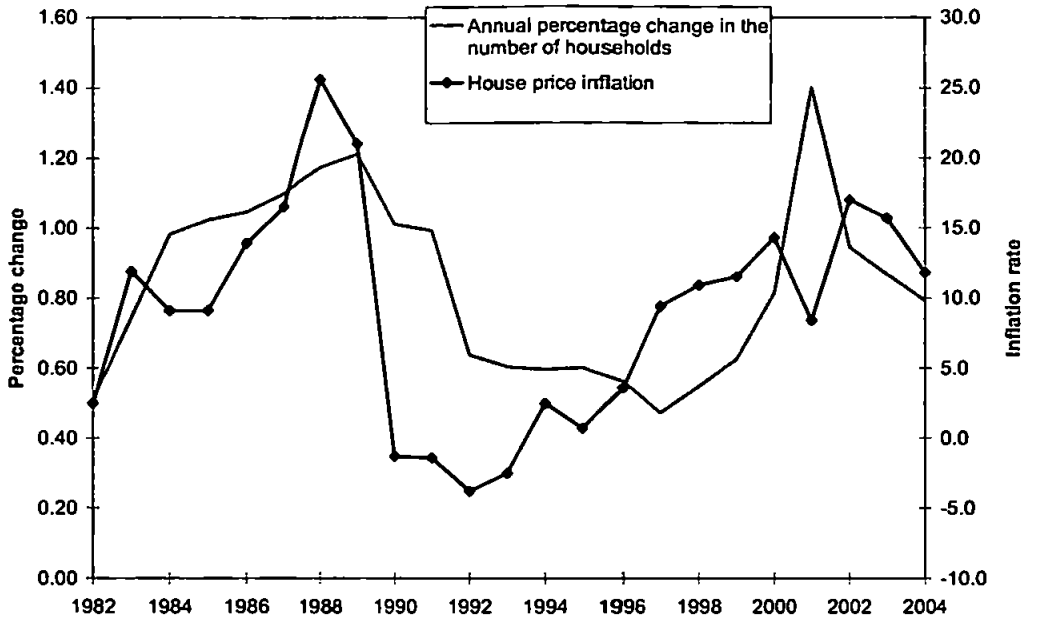


Source: Office for National Statistics (2008e), General Register Office for Scotland (2008)

In 2006 data from the Department of Communities and Local Government gave the average household size in England as 2.32 persons (Department of Communities and Local Government, 2008j). Their projections suggest that by 2011 this will have declined to 2.25 persons and by 2026 to 2.11 persons. This would suggest that the housing market is likely to face even greater pressure as the overall number of households is also set to increase.

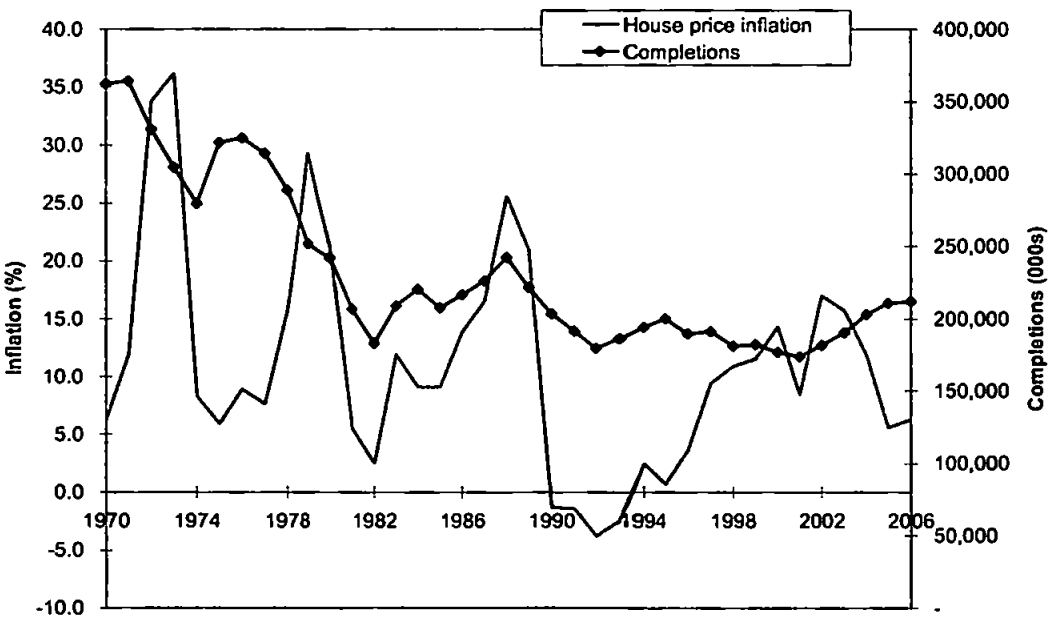
Historical data of the annual percentage change in the number of households and the annual house price inflation rate (Figure 3-20) shows that, overall, in periods when the rate of increase of the number of households was relatively high, house price inflation was also high. Yet this inflation rate has had no discernable affect on the number of completions, which have generally been in decline over the last thirty years (Figure 3-21).

FIGURE 3-20 ANNUAL PERCENTAGE CHANGE IN THE NUMBER OF HOUSEHOLDS (GB) AND ANNUAL HOUSE PRICE INFLATION (UK)



Source: Department of Communities and Local Government (2008d, i)

FIGURE 3-21 HOUSE PRICE INFLATION AND COMPLETIONS IN THE UK



Source: Department of Communities and Local Government (Department of Communities and Local Government, 2008c, d)

Housing Supply

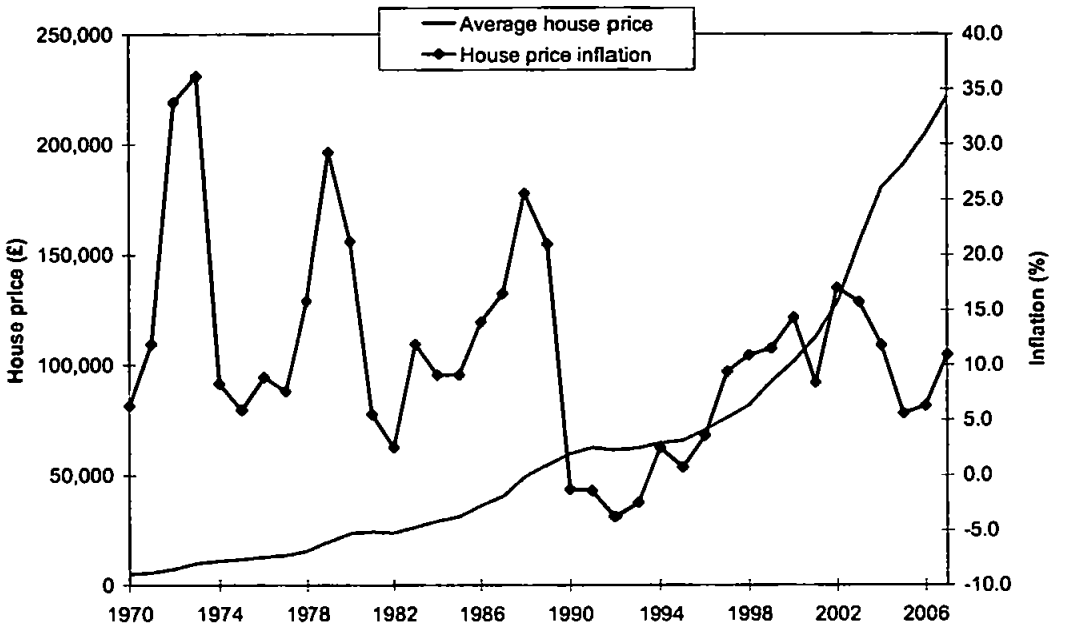
The relative long run price inelasticity of housing supply in the UK is well known and empirical estimates generally place the figure at less than one. By comparison, the estimates of the supply elasticity for the US are much higher, generally greater than one and sometimes as large as four (Dipasquale and Wheaton, 1994; Follain, 1979; Malpezzi and Maclennan, 2001; Meen, 2002; Muth, 1960; Topel and Rosen, 1988; Whitehead, 1974). In the UK, the lack of sensitivity of housing supply to changes in the market is due in the most part to three major factors (Bramley, 2007; Breheny and Hall, 1996):

- Planning regulations restrict supply by allocating insufficient land for new housing development. In the UK, there are also serious procedural delays in producing plans or approving developments. However, these restrictions may result from deliberate policy choices such as the containment of urban sprawl and the introduction of Greenbelts (Breheny and Hall, 1996; Cullingworth and Nadin, 2002; Hall et al., 1974).
- The structure of house building industry, particularly at the local level, where there may be a lack of local competition and risk aversion either in terms of investment or in terms of technological innovation.
- The scaling back of public sector investment in housing or infrastructures, a policy change put in place in an era when supply was not such a significant issue.

The effects of inelastic housing supply have manifested in volatile house prices. For the reasons described above, the supply of housing responds slowly to changes in price. For instance, in periods when demand is high, prices increase but supply responds slowly and because of unmet demand, prices increase even further. Similarly, the durability of housing and the nature of the planning process mean that supply decreases slowly in response to falling prices since houses exist for a significant number of years and once developers have secured sufficient investment, purchased land and organised appropriate planning permission, ceasing construction is almost impossible, although building can be delayed.

Figure 3-22 shows that annual house price inflation reached highs of over 36 percent in the 1970s but fell to lows of almost -4 percent in the early 1990s. Although this measure has not returned to the levels experienced in the 1970s, house price inflation has averaged approximately 11 percent per annum since 2000.

FIGURE 3-22 AVERAGE HOUSE PRICE AND HOUSE PRICE INFLATION IN THE UK

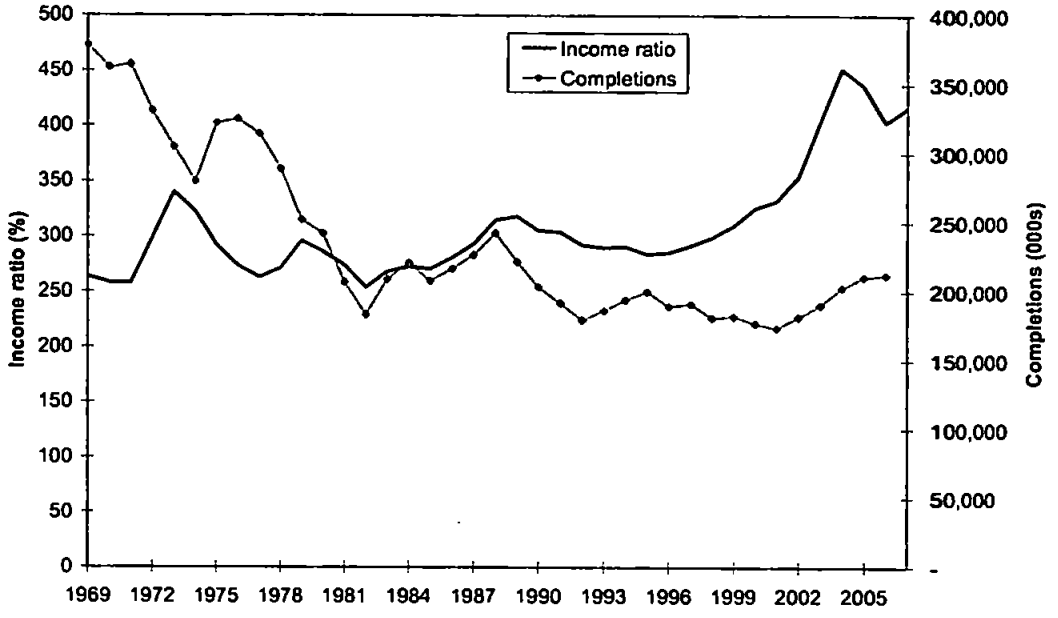


Source: Department of Communities and Local Government (2008d)

This has had a considerable impact at the household level. Figure 3-23 shows the income ratio[5], a simple measure of affordability, together with the completions of private dwellings. It is clear that as the number of completions of private dwellings in the UK has declined, the income ratio has increased. According to this measure, the average house price was over 400 percent of the average annual income of the purchaser by 2007.

[5] The income ratio is the average dwelling price as a percentage of the average recorded income of the individual financing the housing purchase. This is based on data from the Department of Communities and Local Government.

FIGURE 3-23 INCOME RATIO AND COMPLETIONS IN THE UK

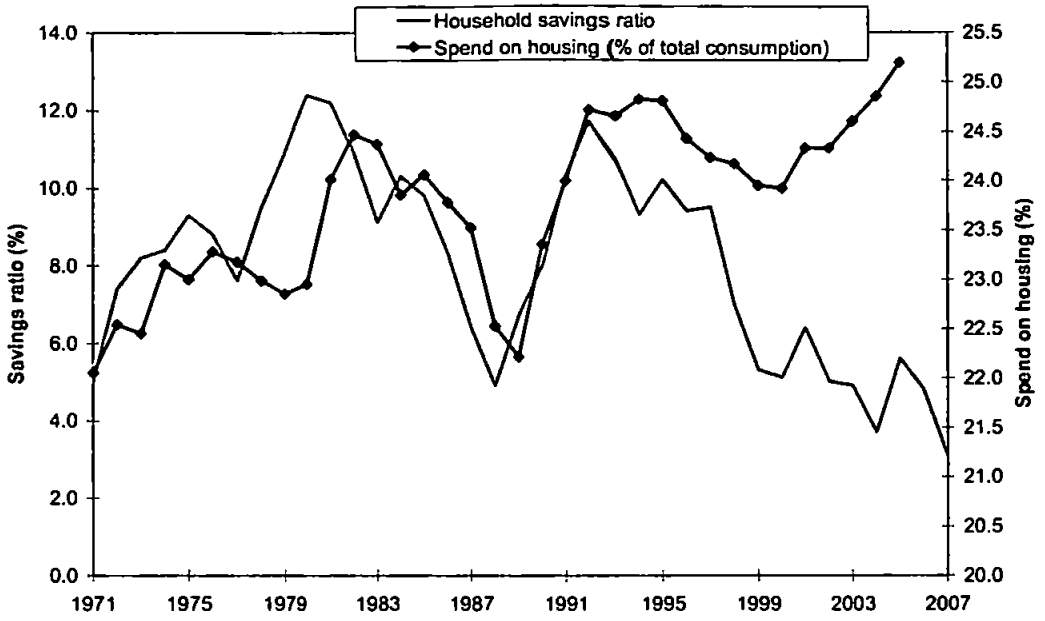


Source: Department of Communities and Local Government (2008f)

As a direct consequence of the change in prices relative to incomes, the proportion of consumption devoted to housing has also increased.

Figure 3-24 shows that as the spend on housing and household goods has increased, so the saving ratio of households has decreased. This could be for one of two main reasons. Firstly, as housing becomes more costly relative to income, there is less income available to save and secondly, households are substituting housing wealth for other forms of wealth.

FIGURE 3-24 UK HOUSEHOLD SAVINGS RATIO AND THE SPEND ON HOUSING* AS A PERCENTAGE OF TOTAL CONSUMPTION



* Includes spend on gas, electricity, fuel, furnishings and routine maintenance. Variables ADFS and ADFY were used.
Source: Office for National Statistics (2008f, g)

House Price Volatility and the Macroeconomy

Volatility of house prices has been a particular problem over recent years. Real house prices in the UK have grown by 2.5 percent per annum over the last 30 years, a figure considerably higher than the 1.1 percent experienced across the rest of Europe (Barker, 2004) and these fluctuations have contributed to wider macroeconomic instability (Cooper, 2004). The links between housing wealth, interest rates and consumption mean that the UK economy is particularly sensitive to instability in the housing market. Research by Meen (2000) indicates that because of the weakness of housing supply, the setting of interest rates necessary for stability in the housing market may not be consistent with that required to meet wider inflation targets and changes in monetary policy may destabilise the housing market as a result. There is also evidence to suggest that house prices and business rents influence wage and consumer prices (Cameron and Muellbauer, 2001).

In the UK, the structure of the housing market in terms of the relatively high proportion of owner-occupiers, the availability of credit and the high proportion of variable rate mortgages, all imply that UK households are particularly sensitive to volatile house prices. As house prices

have increased, the consumption of owner-occupiers also increased due, at least in part, to equity withdrawal (Muellbauer, 1990) or through expectations of future income increases (King, 1990). The tightening of monetary policy to control the consumption boom resulted in increased interest rates, leading directly to increased living costs for households with mortgage debt. Although this would have likely reduced consumption, it has also had consequences for wages, as workers demand wage increases in order to compensate for raised living costs (Blackaby and Manning, 1992; Bover et al., 1989; Cameron and Muellbauer, 2000).

High house prices have also affected the labour market. For example, relatively high house prices in the South East are blamed for the key worker[6] shortages experienced in this region (Monk, 2000). There is also evidence to suggest that relatively high house prices have discouraged labour mobility since households may not be able to afford to move between local labour markets, thereby contributing to tight labour markets in certain areas and persistent unemployment in others (Thomas, 1993). As noted earlier in this chapter, mortgage debt accounts for approximately three quarters of all liabilities of UK households and falling houses price will therefore mean that some households will experience negative equity. This is likely to constrain labour market mobility since negative equity means that the outstanding mortgage debt of the home-owner is greater than the value of the property (Gentle et al., 1994). Consequently, if the owner wishes to move, they will have to save up to meet the shortfall or will have to remain in their current property.

There are also links between house prices and the corporate sector. A study by Black et al. (1996) suggested that rising house prices are linked to increases in VAT registrations. Rising house prices may also mean that creditors are less likely to force debtors into insolvency due to reductions in the risk to loan repayment (Fabling and Grimes, 2005). Similarly, decreasing house prices also have an effect on the corporate sector. A study by Vlieghe (2001) found that falls in house prices were associated with increases in the level of liquidations.

[6] Key workers are public sector workers who are deemed to provide essential services. Common examples are teachers, police officers and nurses.

3.3 Recent Trends in Housing Policy

Much of the housing policy in the immediate post war period was aimed at increasing the supply of housing to address shortages resulting from damage during the war and to clear inner city slums. Once these shortages were met housing supply was no longer at the forefront of housing policy and the focus switched to the encouragement of owner occupation and the reduction of social housing. For many years housing policy in itself became a marginalised issue with the spotlight turning to health and education (Malpass and Murie, 1999a).

Recent trends have returned the supply of housing to the forefront in terms of government policy. Both the sensitivity of the housing market to changes in the prevailing interest rate and the unresponsiveness of housing supply to changes in price have already had potentially serious consequences on the UK economy. Thus in 2001 the Chancellor commissioned two reviews:

- *The Miles Review* (Miles, 2004) – investigated the ways in which fixed mortgage interest rate changes may be encouraged in order to reduce the sensitivity of the housing market to changes in interest rates.
- *The Barker Review* (Barker, 2004) – examined the ways in which housing supply may be increased in order to address issues such as affordability.

The Miles Review found that, despite the benefits of selecting fixed rate mortgages, such as stability in the levels of housing costs, the way in which borrowers select mortgages according to the weight they place on initial monthly repayments and their attitudes towards and understanding of risk, mean that many more are choosing variable rate mortgages. Consequently, Miles concluded that monetary policy would be more efficient if households were better informed. He also suggested ways in which mortgages could be modified to allow greater opportunity for borrowers to hedge risks.

The Barker Review focused upon the inelasticity of housing supply and the report identified a number of concerns, including regional disparities, issues of affordability and overall economic

competitiveness in addition to the overall issue of macroeconomic instability. Barker also identified three key objectives:

- Reduce house price volatility and thus reduce macroeconomic volatility;
- Increase labour market mobility to improve the flexibility and performance of the UK economy;
- Improve access to housing for many households.

The overall recommendation for addressing these objectives was a step change in the supply of housing with an additional 120,000 housing units per year required to achieve target levels of real house price growth. In response to this, the *Sustainable Communities: Homes for All* report (Office of the Deputy Prime Minister, 2005c) outlined the aims of the current UK government to improve the supply of new homes, improve the standard of homes, regenerate urban areas and provide affordable homes. This was followed in 2007 by the release of *Homes for the Future: More Affordable, More Sustainable* (Department for Communities and Local Government, 2007). This set supply targets of 240,000 new homes per year by 2016 and indicated the locations where growth in housing supply should be focused.

The result has been changes to the planning system to allow development on public sector land, the recycling of brownfield land and the provision of affordable housing via increased social housing and shared equity schemes. However, the main outcome has been the provision of funding to New Growth Areas[7], the intention being to deliver homes in the right locations

The focus remains firmly upon encouraging the ownership of property, whether outright or shared equity schemes. One significant problem with increasing the rate of home ownership is potential impact on labour mobility (Henley, 1998a). Consequently, this could work against improving labour market flexibility, a major aim set out in the *Barker Review*. If planners fail to choose the location of new housing to meet spatial patterns of demand, existing homeowners will be unwilling to move to areas of new supply and those who do not already own a home

[7] Areas identified by the Department of Communities and Local Government in 2005 where infrastructure initiatives were to be focused together with other projects aimed at unlocking new sites for housing and enhancing the environment ((2008)

may be unable to move due to the relative price levels. Data presented earlier in this chapter indicates that the proportion of owner-occupier households remained relatively constant over recent years, which could suggest that the housing market has reached the optimal mix of tenures. Certainly, since owner occupation can act as a barrier to labour mobility, a certain level of renting is required in order to facilitate migration (Forrest, 1987; Henley, 1998b; Hughes and McCormick, 1987; Ortalo-Magne and Rady, 2002).

The success of the latest policies hinges upon the assumption that a step change in supply is needed to reform the problems of housing supply and also that the estimates for the changes in supply provided in *The Barker Review* are accurate. Interestingly, there have been subsequent studies carried out that have disputed these figures. For instance, a study by Bramley and Leishman (2005) suggests that a 39 percent increase in the supply of housing is necessary (more than that suggested in the *Barker Review*), although delivering this level of supply would have serious consequences for the use of greenfield land and wider sustainability issues such as the problem of urban sprawl (Bramley, 2007). Research carried out by the Office of the Deputy Prime Minster (2005b) investigated the sustainability of additional housing scenarios in England. In terms of environmental impacts, the study suggests that although there is sufficient land for the current planned level of growth, some greenfield land adjacent to existing settlements will have to be used. This then raises issues concerning local infrastructure that may have knock-on effects in existing settlements. Such concerns were recognised by the government in the recent green paper, *Homes for the Future: More Affordable, More Sustainable* (Department for Communities and Local Government, 2007) that proposed new infrastructure investment.

3.3.1 A Brief Overview of International Housing Policy Trends

The major trends in housing policy in most developed economies have been broadly similar to those in the UK. After the Second World War, the primary aim in much of the developed world, including most of Europe, the US and Canada was to address the undersupply of housing that had occurred as a result of the war (Ball and Wood, 1999; Priemus and Dieleman, 1999).

Much of this demand was met through the provision of social housing and high levels of investment in the social sector continued until much of the shortage had diminished by the end of the last century. However, by the 1990s, the US government and most governments in Western Europe tried to reduce public expenditure on housing (Oxley, 2004 p 195). For instance, from 1980 to 1990 the US reduced new budgetary authority for subsidised housing by 60 percent (Burchell and Listokin, 1995). Subsequent developments emphasised the improvement of the quality of the stock and on improving the distribution of subsidies. Supply-side subsidies put in place in order to encourage new supply were then replaced with demand side subsidies aimed at relieving household budgetary pressures: in Europe and the USA, housing policies have emphasised the importance of financial instruments such as tax incentives to facilitate access to housing and greater choice. However, the primary problem is that demand side subsidies have far less impact on the residential construction market and the housing market in comparison to supply side policies (Priemus and Dieleman, 1999).

There is a growing literature suggesting that planning constraints have led to increased land prices and therefore upward pressure on house prices (Barker, 2008). There are, however, variations at the sub-national level. For example, Glaeser and Gyourko (2003) find that for the USA, although the level of affordability differs across the country, high house prices are significantly correlated with strict zoning regulations. Inflation of land and house prices and higher rates of home ownership have led to an increasing divide between household income and the cost of housing. Certainly it is generally accepted that growing populations and general trends towards owner-occupation have led to increased demand in most developed nations (Shiller, 2007). Consequently, affordability has become a key issue, certainly in the US, the UK and many European nations.

3.3.2 Measuring Affordability

'Affordability of housing remains the fastest-growing and most pervasive housing challenge in the UNECE region.' according to a report for the United Nations by Tsenkova (2008).

However, the meaning of the term 'affordability' is highly contested and the issues regarding both definition and measurement of affordability can be summarised as follows (Stone, 2006):

- The lack of a normative standard of affordability and agreement upon how to measure affordability;
- Distinguishing between housing affordability and affordable housing;
- Distinguishing between affordability and housing standards.

There have been various studies investigating affordability measures but there is no consensus with regard to which is the most appropriate (for example see Bourassa, 1996; Feins and Lane, 1981; Hulchanski, 1995; Linneman and Megbolugbe, 1992a; Stone, 2006; Whitehead, 1991; Wilcox and Homes, 1999). In general, these measures take the form of a ratio of income to housing costs but the differences lie in the forms of the income measure and the cost measure used. For instance, in order to determine affordability in a given area, it would seem feasible to use a ratio of average spend on housing to average household income. The question here is what measure of average to use. The mean might be the obvious choice but outliers affect the value of this measure. The median might therefore be more appropriate. Nevertheless, this then leads to the question of whether all households should be included in the calculation, since the implicit assumption when discussing affordability is that this is an issue affecting only low-income households. There are also arguments for using a household budget approach whereby the price of a basket of essential goods, including housing of some minimum physical standard, is specified and priced and this defines the minimal housing budget required by any household (Stone, 2006). Thus, any household whose income is above this minimum should be able to afford all of their basic needs. The difficulty here is defining the minimum standard of housing since both houses and households are highly heterogeneous.

A branch of research that takes a subjective approach to affordability assumes that households are rational utility maximisers and are therefore consuming the quantity of housing that maximises their utility subject to constraints, such as income (Stone, 2006). This would suggest that it is not desirable or indeed possible to establish a normative definition of affordability

other than an individual choice. Nonetheless, empirical evidence suggests that the level of household resources devoted to housing increases with the level of household income (Linneman and Megbolugbe, 1992a). Hence, it is highly likely that a threshold exists, below which households are not choosing freely between the consumption of housing and the consumption of other goods, and thus affordability is no longer subjective (Stone, 2006).

Closely related to the choice of affordability measure is the issue of defining the difference between what is meant by 'affordability' and by 'affordable housing'. Essentially affordability is a relationship between the cost of housing and the level of household income. In order to understand what is meant by affordable housing three questions must be answered (Stone, 2006):

- Affordable to whom?
- On what measure of affordability?
- What standard of housing?

Presumably there are some households for whom all housing is affordable, whilst there will be some who are unable to afford a house in Belgravia for instance but are nonetheless able to afford a level of housing that they deem acceptable. According to the Department of Communities and Local Government (2006) 'Affordable housing includes social rented and intermediate housing, provided to specified eligible households whose needs are not met by the market.' The implication is that affordable housing is priced below the market value and is offered to households who cannot afford the market price. There are two problems associated with this. Firstly, there is no mention of the standard of housing and secondly, there is no mention of the location of housing. Affordability is only one measure of housing deprivation and households may be living in housing that is of poor physical standard, in overcrowded conditions and in locations that are unsafe or not easily accessible. Although each of these is distinct from affordability, if households are living in these conditions it would imply that they are doing so because they cannot afford suitable housing elsewhere (Stone, 2006).

3.4 Housing Policy: The Role of Economic Analysis

Although the involvement of both economic and general quantitative analysis in the policy setting process has been a contentious issue (Cooley et al., 1984; Robert Jr, 1976), the reasons for incorporating both quantitative and qualitative data analysis in any decision making process have long been understood. The analysis of data can provide information about the past, present and future and can reduce bias in decision-making situations. This section discusses the reasons why quantitative methods are used as a decision-making tool and then focuses specifically on the use of economic analysis in the planning and policy setting process.

Heuristics are cognitive schema developed by the human brain to assist in the decision process, whether mundane daily decisions made by everyone or the complex decisions taken by economic policy makers (Bazerman, 2006). Thus, heuristics are mental short cuts that speed up the process of choosing between alternatives in order to reach an optimal outcome, although these can lead to detrimental bias in complex decision making situations (Kahneman et al., 1982; Kahneman and Tversky, 2000; Tversky and Kahneman, 1974). Biases can manifest in the ways in which individuals or groups view probabilities, differentiate between alternatives, formulate beliefs and ideas and express these beliefs and ideas. A particular concern for policy makers and planners are the biases that occur in situations of group decision making, such as false consensus, groupthink (Janis, 1982) and group polarisation. False consensus occurs when an individual assumes that their view is typical of the group, which is particularly problematic if the decision made depends upon expectancies of another's action. Groupthink arises when an interacting group tries to find unanimity at the expense of considering alternatives; thus is maintaining group cohesiveness becomes the optimal objective. Group polarisation occurs when members of a group have initially similar views; group interaction strengthens each individual's view, hence shifting the group to an extreme position.

Quantitative and qualitative data analysis helps to reduce false consensus, specifically through the application and analysis of surveys. Nevertheless, in order to address other group biases such as those described here, it would be necessary to have recourse to a rational framework, as

potential choices can be assessed in terms of both information provided by data and in terms of logicality with respect to the rational framework. Economic analysis addresses these issues by providing both a rational framework and an approach for quantitative analysis in the form of econometric techniques.

In general, approaches to decision making can be classified into one of three categories, descriptive, normative or prescriptive (Bell et al., 1988). Although the definitions of these three classifications are relatively dynamic within the research literature, they can be loosely described as follows:

- Descriptive methods analyse how decisions are taken and determine optimal choices based what is or what has been done.
- Normative methods determine what choice(s), in theory, should be taken.
- Prescriptive methods are closely related to normative methods in that they determine optimal choices in theory but these choices are constrained by limitations of what can be done in reality.

The use of economic and econometric analysis is widespread in determining the success or otherwise of policy and planning decisions at the national and international level and is used descriptively, normatively and prescriptively. The central banks of many developed nations have an economic research department. For example the US Federal Reserve has three separate departments in which research economists are employed (US Federal Reserve, 2006). The Board of Governors has been using the economic analyses and forecasts produced by these economists in order to support the setting of monetary policy in the US for over 40 years (Brayton et al., 1997). A variety of techniques have been used, many of which are econometric in nature (Brayton et al., 1997) whilst forecasts generally employ vector-autoregression techniques that attempt to capture the nature of the interdependencies between the variables.

Apart from national governments and central banks, many other international organisations have employed economic analysis techniques. For instance, researchers at the International Monetary Fund have developed the Global Economy Model (GEM). This dynamic general

equilibrium model aims to describe the behaviour of economic systems by using equations representing the micro components of the economic systems. The GEM incorporates elements that are country specific in addition to modelling the interactions between the various countries (Pesenti, 2008). This model has been used to analyse such issues as the impact of oil price movements on the global economy (Elekdag et al., 2008), the links between trade and exchange rates (Hunt and Rebucci, 2005) and the impact of structural reforms in the Euro area (Everaert and Schule, 2006).

At the national and international level economic analysis techniques are used primarily but not exclusively for the analysis of macro issues. At the sub-national level economic modelling techniques are also used to examine specific sub-regional issues such as urban segregation. For example, input-output models that detail industry inter-linkages have been developed for Scotland (Allan et al., 2007; Madden and Trigg, 1990), Washington State (OFM State of Washington, 2008), Chicago (Israilevich et al., 1997) and São Paulo (Azzoni and Kadota, 2001) amongst others. At the sub-regional level examples include studies examining migration between US cities (Alperovich et al., 1977), urban commuting in US cities (White, 1988), segregation in the housing market in San Francisco (Bayer et al., 2004) and urban land use (Anas and Kim, 1996).

3.4.1 Application to Housing Policy

The use of economic analysis to aid the planning and policy setting process is widespread; however, it has not penetrated the housing sector with such success (Oxley, 2006). One of the most substantial applications of economic analysis in the housing policy setting process has been as part of the *Review of Housing Supply* (Barker, 2004). In the interim study period, four additional reports were commissioned in order to provide quantitative information as evidence for the main report and these were:

- *Affordability and the Intermediate Market* (Bramley, 2003)
- *Increasing Housing Supply: Achieving Increases and Estimating Their Impact on Price, Affordability and Need* (Bramley, 2004)

- *The economic impact of restrictions on housing supply: an investigation for the Barker Review* (Blake, 2003)
- *Regional Housing Supply Elasticities in England* (Meen, 2003)

Each utilised some form of quantitative economic analysis. The study by Meen used econometric analysis to produce estimates of supply elasticities and both papers by Bramley employed an econometric model to estimate affordability of housing based on house prices. The study by Blake made use of a general equilibrium model to analyse the macroeconomic impact of changes in the price elasticity of private residential investment.

The *Barker Review* represents one of the first government led investigations into the housing market and planning process that has applied economic analysis both prescriptively and normatively. Cullingworth (1997) suggests that in terms of economic research, the operation of the planning system has been neglected as has any consideration of alternative development patterns. Other researchers have also identified a lack of independent scrutiny and a failure to account for the changing economic climate in forecasts of households (Baker and Wong, 1997; Bramley, 1998; Bramley and Watkins, 1995). The local planning system has also been criticised for a similar shortage of economic analysis (Coopers and Lybrand, 1985). Maclennan (1986, 1992), for instance, argued that planning and monitoring of the housing market could be significantly improved by using a more economic approach to the analysis of local markets. Moreover, Meen and Andrew (2008) suggest that "regional affordability targets do require the greater use of formal econometric models", highlighting the lack of economic analysis at the sub-national level.

3.5 Conclusion

During the early part of the last century, government policy was focused firmly at increasing the supply of housing in order to overcome shortages after the Second World War. As immediate shortages were met and inner city slums were cleared, the focus of policy initiatives shifted from supply to demand. The aim of successive UK governments in the latter half of the 20th century was the deregulation and privatisation of the housing market in an attempt to make it more efficient. The quantity of social housing was vastly reduced and households were encouraged to become owner-occupiers, through a series of policies including the liberalisation of the mortgage market. These policies have largely succeeded and the proportion of homeowners in the UK has gradually increased, reaching the point where approximately 70 percent of households are now owner-occupiers.

Rising levels of owner occupation have led to a change in the way households view housing. Home ownership is a key form of household wealth-holding in the UK: in 2003 the value of home equity accounted for 60 percent of household financial wealth (Banks et al., 2003). Since the mortgage market was liberalised, homeowners' access to credit has improved greatly and research has indicated that housing wealth is a key driver of household consumption.

Recent trends in the housing market have nonetheless generated some cause for concern. The sensitivity of the UK housing market to changes in interest rates owing to the proliferation of variable rate mortgages has serious consequences for the use of interest rates as monetary policy instrument. The relative inelasticity of housing supply has already had a serious impact on the UK economy. A study by Blake (2003) estimated that increasing the price elasticity of housing supply between 1994 and 2002 would have resulted in the following:

- An estimated 82,000 to 380,000 new houses would have been constructed;
- UK GDP would have likely increased by between £3 billion to £16 billion;
- An extra 150,000 to 650,000 new jobs would have been created.

As a consequence, housing policy is now aimed at stimulating the supply of new housing. Reforms to the planning process have been suggested, including recycling brownfield land, in addition to funding being made available for new infrastructure. The overall aim is the delivery of a step change in the supply of housing.

The resurgence of housing as a national policy issue and subsequent *Barker Review* (Barker, 2004) has brought the issue of housing the forefront of planning, not only at the national level but also at the regional level and sub-regional level. The Barker Review suggested that a step change in the supply of housing is required to address the issues of undersupply and affordability. An increase in the supply of housing in the South West had first been proposed in the *Regional Planning Guidance* (Government Office for the South West, 2001) which stated the number of additional dwellings required in each county in the region. Given the issues with the definition and measurement of affordability, this brings into question the magnitude of the changes suggested, since one of the key reasons for increasing housing supply was to address problems of affordability. Consequently, it is important to be able to gauge the wider impacts of increasing housing supply in order to assess the viability of these changes.

Although economic analysis played a key role in *The Barker Review* and the subsequent policy setting exercise, it would seem that far more could be achieved in this regard. The studies employed in the review were focused largely at the national level and very little attention has been paid to the impact of increasing housing supply at the regional or sub-regional level. Given the importance of the outcome of the decision taken, any method by which insights can be gained prior to putting these policy instruments in place should be employed. This is particularly true at the sub-regional level where the final decisions about how, where and when to supply housing are taken. Consequently, it is the aim of this study to develop a model of the South West housing market in order to analyse the consequences of increasing the supply of housing.

This chapter has established the importance of the housing market to both the macro and micro economy in the UK and discussed the need for economic analysis to develop understanding of

the operation of regional housing markets and to support the planning and policy development process. The next chapter introduces the housing market issues that are important at the regional and sub-regional and presents an overview of the market in the South West.

4 Regional Housing Markets and Housing Policy

House prices in the UK have been rising in recent years, provoking discussion in the media about the affordability of housing. However, this debate has not engaged with the key problem that the term *affordability* has no normative definition. Moreover, the price of housing varies widely, both inter-regionally and intra-regionally. According to data from the Department of Communities and Local Government, within the UK the average dwelling price in 2007 ranged from £152,295 in the North East to £342,122 in London, a difference of 125 percent. The same data showed that within the South West region in 2007 the average house price ranged from £167,233 in Plymouth to £288,793, a difference of 73 percent.

Although households experience the effects of fluctuations in house prices most immediately, the behaviour of the housing market also influences firm location decisions, national labour market mobility and national wage and unemployment levels. For instance, research indicates that restricted labour mobility is a major contributing factor to poor performance of some regional economies and also to national unemployment and wages (Bover et al., 1989; Hughes and McCormick, 1987). There is a growing belief within the UK government that interregional economic disparities in the UK harm both the social and economic welfare of the individual regions and that of the nation as a whole. This has led to the development of regional economic policies and to the devolution of primary control over regional policy to regional government bodies (Armstrong and Taylor, 2000).

In recent years, rising house prices and a perceived lack of supply have driven housing to the forefront of the regional policy debate. Regional government offices are now required to produce regional planning documents in which the quantity and location of new houses is described. In 2001 a major review of the supply of housing was commissioned by the UK government and the subsequent report by Kate Barker (2004) stressed the need for greater levels of housing supply. Nevertheless, there is some debate regarding the way extra housing demand is calculated via population projections and forecasts of household formation rates, with the potential for over or underestimating need. In response to this, Kate Barker (2008) noted the

importance of recognising the social need for additional housing together with the wider economic impacts of changes in housing supply.

Although the majority of the theory presented in Chapter 2 applies at national, regional and sub-regional levels, local housing markets are subject to slightly different pressures and this chapter presents an overview of these issues. It begins with a summary of the key characteristics of the regional housing markets in the UK and in the sub-regions of the South West. Control of housing policy has largely been devolved to the regions, with only guidelines being set at the national level and so the chapter continues with a synopsis of the devolution of housing policy to regional governance. The chapter concludes with a presentation of the key housing market policies in the South West.

4.1 Regional Housing Markets

Housing markets at the national, regional and sub-regional level are broadly similar in terms of the way the markets operate and the major influences upon those markets. Nonetheless, certain aspects of regional and sub-regional housing markets influence the national economy, such as the effect tenure patterns have on labour mobility. There are also issues that are not particularly relevant at the national level but are important at the local level, such as the existence of housing sub markets. This section presents an overview of these issues, particularly in relation to the regions of the UK.

4.1.1 Labour Market Mobility

Research has shown that local housing markets are closely linked to labour and firm mobility. In particular, both tenure patterns and the relative price of housing and land have an effect on household mobility and the location decisions of both firms and households (Bover et al., 1989; Hughes and McCormick, 1987).

The effects of tenure on household mobility arise primarily because of the relatively high transactions costs (both financial and psychological) faced by owner-occupiers when they wish to relocate, particularly in comparison to those in the private rental market (Boehm and McKenzie, 1982). There is also evidence indicating that social renting is a barrier to long distance migration (Blackaby and Manning, 1992; Boyle, 1995; Hughes and McCormick, 1981). Households in socially rented accommodation are, by definition, low income and hence have few funds to devote to household movements. There is also likely to be less desire to move, since many long distance movements are associated with career choices, which may not be so relevant to low income households (Clark and Huang, 2004).

The location decisions of both workers and firms are influenced by relative house prices via cost of living/location effects. High relative house prices deter workers and firms from migrating for several reasons, including constraints on credit availability and from risks associated with high levels of indebtedness (Ortalo-Magné and Rady, 2006). A relatively high cost of living is also

likely to encourage workers to demand higher wages and so firms locating in these areas are likely to face higher wage demands (Bover et al., 1989).

The decision to move house is a complex one and, whilst there is evidence to suggest that high house prices and tenure structure influence this choice, household circumstances and the pattern of previous household movements are also likely to have an impact. For instance, households will adjust job or residence location in order to shorten their commute (Rouwendal, 1999). Residential moves are also generated by the birth of children (Clark et al., 1984), by marriage (Odland, 1993), by divorce (Dieleman and Schouw, 1989) and by changes in job status (Clark and Huang, 2004). Furthermore, recent movers are likely to be repeat movers according to the work by Clark and Huang (2004). Specifically, households that move long distances are more likely to move again in the next two to three years, and subsequent moves are likely to be over long distances. They also found that short distance moves are likely be followed by further short distance moves, suggesting that these households are adjusting their levels of housing consumption within their local housing market.

The mobility of local residents can also be affected by in-migration as areas undergoing rapid change will increase the likelihood of movements by local households, since new construction will create greater opportunities for locals to change their consumption of housing (Clark and Huang, 2004). Thus, the composition of the area adjusts to in-migration and generates further moves by locals (Stone, 1971). In particular, empirical research has identified strong links between in-migration and mobility in metropolitan areas, where the structure of the area influences the strength of the links. Specifically, areas that are more 'open' exhibit stronger links between in-migration and mobility rates (Moore and Clark, 1990).

The overriding view at the national level is that a weak private rental market and a relatively large social rented sector have led to inefficiency in the UK labour market, resulting in persistent unemployment differentials (Cameron and Muellbauer, 2001; Hughes and McCormick, 1994; McCormick, 1997; Minford et al., 1987). Nonetheless, there are those who believe that migration will gradually reduce these differences (Cameron and Muellbauer, 2001;

Creedy, 1974; Elias and Molho, 1982; Gordon, 1985; Pissarides and McMaster, 1990). Hence, the influence of local labour markets is complex and operates on the decisions of both households and firms.

4.1.2 Earnings and Unemployment

Sub-national housing markets influence national wage levels since high relative house prices could shift earnings upwards as compensation for increased living expenses (Blackaby and Manning, 1992). There is also evidence indicating that high house prices fuel expectations of future increases in earnings (Bover et al., 1989). However, high levels of house prices will also increase location costs thereby raising barriers to in-migration of firms. This will constrain the demand for labour and will moderate potential wage rises.

In terms of unemployment, research indicates that higher regional house prices are linked to lower levels of regional unemployment (Blackaby and Manning, 1992; Robson, 2003). This occurs primarily through cost of living effects since a higher cost of living is likely to act as a barrier to migration for credit-constrained households, thus dampening potential increases in the available workforce (Hughes and McCormick, 1987). High house prices are also associated with high levels of housing wealth, which in turn may decrease unemployment by reducing credit constraints on small businesses and allowing these firms to expand. Nevertheless, there is the potential for cost of living effects to constrain in-migration of firms, thus putting upwards pressure on unemployment (Robson, 2003).

4.1.3 Urban Population

The theory presented in Chapter 2 indicates that increased demand for housing is often the result of an increase in population. However, at the sub-regional level, if housing supply is relatively elastic, an increase in demand is likely to result in an increase in population (Glaeser et al., 2006). For instance, consider an increase in the local demand for labour resulting from a positive shock to productivity. This gives rise to an increase in population providing housing supply can respond quickly enough, since workers will generally aim to locate their residence

close to their place of work. An elastic housing supply also ensures that the increase in labour demand resulting from the construction of new houses will not result in significantly higher wages, since an elastic supply of housing helps to create an elastic supply of labour. If housing supply is inelastic, an increase in productivity will have a muted effect on the population since there will be only a small increase in the number of houses. In this case, wages will also increase since an inelastic housing supply implies an inelastic labour market. If the increase in demand for housing is not a result of increased productivity but is generated by an improvement in the amenity level (desirability) of the area, nominal wages will remain unchanged and any rise in house prices then implies a reduction in the real wage.

Empirical research provides evidence for links between sub-regional population and housing levels. For example, the study by Glaeser et al. (2006), for metropolitan areas in the USA, found a significant correlation between the change in the logarithm of population and the change in the logarithm of the number of housing units with values of R^2 ranging from 0.81 to 0.95. These results suggest that urban expansion is likely to be related to the elasticity of the supply of housing.

4.1.4 House Prices and the Ripple Effect

Changes in the housing market are felt predominantly at the local level, yet it has been observed that the timings and magnitudes of these effects vary between regions for two main reasons (Meen, 2001):

- Regional determinants of house prices differ, for example incomes are growing at different rates;
- Regions respond differently to national changes, particularly interest rates.

Studies have shown that regional house prices are subject to a "ripple effect" where house prices changes in Greater London and the South East tend to lead house prices in the other UK regions (Cameron et al., 2005; Meen, 1999). Hence, a shock that hits the South East will have no effect on other regions initially but will eventually filter outwards with both the timing and magnitude

of the resulting effects varying by region. Various causal mechanisms have been suggested including differing supply elasticities (Giussani and Hadjimatheou, 1991a, b) and other regional structural differences such as differences in the composition and behaviour of households and differences in the rates of return from owner-occupation (Meen, 1999; Muellbauer and Murphy, 1994). Others have found cointegrating relationships in regional house prices, suggesting that past values are a significant influence on current regional prices (Alexander and Barrow, 1994; Cook, 2003). However, research also exists refuting the existence of a strong ripple effect and it remains a contested issue (Drake, 1995; Wood, 2003).

4.1.5 Vacant and Second Homes

The South West is one of the more rural regions in the UK and one of the key issues for the development and maintenance of communities in rural areas is the degree to which housing stock is fully utilised. Dwellings may be empty or not regularly occupied for a variety of reasons, such as when properties are undergoing renovations and a certain level of vacant property is necessary for flexibility within the housing market. It is therefore important to distinguish between houses that are vacant due to natural changes in the housing market and properties that are termed problematic vacants, that may be left empty for substantial periods of time and may also be of poor quality (Fielder and Smith, 1996).

As the economy in the UK has prospered and technological advances leave workers with more leisure time, many households are choosing to purchase a second property either as a holiday home, as an investment or when planning for retirement. Second homes are often located in rural areas and thus the market for second homes has a highly localised impact, sometimes leading to 'micro crises' in local housing markets where concentrations of second homes are particularly high (Gallent et al., 2002). This is partly a result of increased demand and partly a result of significant differentials in income and wealth between second homeowners and much of the local rural population (Wallace et al., 2005). Nevertheless, second homes are not the only source of external demand in rural areas and in-migration resulting from retirement or commuting purposes are likely to create more pressure (Tewdwr-Jones et al., 2002).

There is a widely held belief that rural depopulation is a direct result of the inability of local residents to compete with second homeowners. However, research has shown that out-migration of young people and young families is much more likely to result from a lack of suitable employment opportunities and also from education and lifestyle opportunities (Capstick, 1987; Johnston, 2003; Shucksmith, 1991; Tewdwr-Jones et al., 2002). Gallent et al. (2002) suggest that attitudes towards and perceptions of second home ownership are related to the economic cycle, the disposable income of new residents and the attractiveness of second home living. In a study of rural Wales, Johnston (2003) found that there was a consensus of opinion amongst locals that in-migrants were the only ones able to afford local housing and this was a significant source of resentment.

Despite the obvious problems, there are also potential gains to be made from in-migrants. For locally owned properties or new build developments funded by local investors, money from the sale of these properties may accrue to the local economy depending on how the owners spend the funds (Wallace et al., 2005). Spending on renovation and modernisation of second homes may bring funds into the local economy, improve the quality of local housing, stimulate the creation of jobs particularly those related to building and renovation and bolster the sustainability of local communities since it may stimulate demand for local infrastructure and amenities thus making them more viable. There are no data regarding the possible magnitude of these benefits so it is impossible to judge how this balances with the negative impacts of external demand.

The government has already acknowledged the potential negative effects on small communities of properties that are vacant for much of the year. This resulted in a change of policy whereby the government devolved the control of council tax relief on second homes (amounting to a discount of 50 percent) to local authorities and permitted them to reduce the discount. In the case of Cornwall and Devon, the money raised from second homeowners has been used to fund development of affordable homes (Commission for Rural Communities, 2006a, b).

4.1.6 Submarkets

Research investigating the mechanisms driving regional house prices draws on work from many fields including marketing where the notion of *market segmentation* has been used to development the idea of housing submarkets (Jones et al., 2004). The suggestion that a housing market can be characterised by a set of interrelated categories between which both houses and households can move, was an idea first proposed in the 1950s (Fisher and Fisher, 1954; Rapkin and Grigsby, 1960). For instance, a study by Rapkin et al. (1953) used the idea of substitutability and required that consumers be relatively indifferent between the bundle of physical, locational and neighbourhood quality attributes characterising the competing housing units. Thus, prices for equivalent housing within a submarket were the same.

Both the structural characteristics of a dwelling and its location are very important in determining the submarket. The relative significance of the spatial aspect is very difficult to measure or rather choosing the measure of the spatial characteristic has proved problematic in the past. However, recent research suggests that geography and transactions costs, in addition to search costs and imperfect information all have an influence on the formation of submarkets (Jones et al., 2004).

In the past, there has been some debate regarding the existence of housing submarkets, although many now believe that they are of analytical significance (Goodman and Thibodeau, 1998; Whitehead, 1999). For instance, Hancock and Maclennan (1989) suggest that planners must understand the structure of and linkages between submarkets prior to making any decisions regarding levels of land supplied for development and before any decisions are made regarding the location of new housing development. This is of particular importance for issues of sustainability and Adair et al. (2000) suggest that submarket structure is an important factor that needs to be considered when analysing issues such as urban transportation links.

Empirical studies suggest that submarkets are very difficult to identify in practice and are usually defined in terms of geographical areas or the physical characteristics of the dwellings (Jones et al., 2003). When spatial dimensions are used, segmentation can rely on pre-existing

geographic or political boundaries (Goodman and Kawai, 1982; Schnare and Struyk, 1976) or spatial partitions based on socio-economic or environmental characteristics (Galster, 1997). Another way of delineating submarkets in spatial terms is offered by Palm (1976) who argued that information constraints and search costs may segment an urban housing market into different submarkets. Thus, submarkets can be delineated by different real estate agents (Michaels and Smith, 1990). Physical characteristics can also be used, including the number of rooms (Schnare and Struyk, 1976), lot and floor area (Bajic, 1984), or the type of property, such as detached versus attached (Adair et al., 1996).

The study of submarkets has been vital in understanding the operation of local housing markets. This research has led to the development of an economic modelling technique that aims to capture and price the key characteristics of submarkets. This approach, known as hedonic pricing, is discussed in more detail in Chapter 6.

4.2 UK Regional Housing Markets

4.2.1 Tenure, Prices and the Labour Market

Theory suggests that tenure has a significant influence on the mobility of labour markets, which in turn is likely to have a negative effect on the efficiency of the UK labour market. The proportion of owner-occupiers increased across all regions between 1995 and 2005 and accounted for at least two thirds of all households in every region apart from London (Table 4-1). Private renters comprised less than 20 percent of all households and for several regions, including the North East and Scotland, this figure was less than 10 percent. Theory suggests that this will have had a detrimental effect upon the mobility of the UK labour market and the data certainly suggest that this might be the case. For example, households in London should be more mobile than households in the West Midlands since the former region has a relatively low level of owner-occupation and a relatively high level of households renting privately in comparison to the latter region. Looking at the data for out-migrants as a percentage of total population (Table 4-1), the percentage for London is higher than that for the West Midlands suggesting that the population in London is indeed relatively more mobile.

Nevertheless, these patterns are not universal. Take, for example, the case of Scotland. At 67 percent, this region has one of the lowest proportions of owner-occupiers, yet it also appears to have a less mobile population: in 2006 the region had the second lowest value for the number of out migrants as a percentage of population. One possible explanation is that Scotland also has a relatively high proportion of households in socially rented accommodation, which has been linked to low levels of household mobility (Barcelo, 2006; Hughes and McCormick, 1987).

TABLE 4-1 TENURE PATTERNS AND MIGRATION (%)

	Owner occupied		Rented from local authority or RSL		Rented from private landlords or with job or business		Total out migrants as a percentage of population	
	1995	2005	1995	2005	1995	2005	1998	2006
North East	61	66	32	25	7	9	1.70	1.57
North West	68	71	24	20	8	9	1.65	1.50
Yorkshire and the Humber	64	70	25	19	11	11	1.94	1.83
East Midlands	70	74	21	17	10	9	2.35	2.25
West Midlands	67	72	25	20	8	8	1.88	1.86
East	72	74	18	16	10	10	2.34	2.27
London	56	58	27	24	17	18	3.01	3.27
South East	75	75	15	14	11	12	2.59	2.43
South West	73	73	15	13	12	13	2.29	2.09
England	67	70	22	18	11	11	-	-
Wales	71	73	20	17	8	10	1.81	1.69
Scotland	58	67	35	25	7	7	1.04	0.92
Northern Ireland	69	72	28	18	4	10	0.77	0.69

Source: Office for National Statistics (2008c)

TABLE 4-2 AVERAGE DWELLING PRICE (£ AND INDEX)

	1990		2000		2007	
	£	Index	£	Index	£	Index
United Kingdom	59,785	100	101,550	100	223,405	100
North East	41,374	69	63,921	63	152,295	68
North West	50,361	84	77,913	77	170,072	76
Yorkshire And The Humber	47,231	79	72,176	71	170,203	76
East Midlands	52,620	88	79,323	78	176,255	79
West Midlands	54,694	91	88,431	87	185,048	83
East	71,671	120	111,813	110	238,147	107
London	83,821	140	163,577	161	342,122	153
South East	81,638	137	142,790	141	278,054	124
South West	65,378	109	104,233	103	230,885	103
England	63,173	106	106,998	105	232,054	104
Wales	46,464	78	72,285	71	169,848	76
Scotland	41,744	70	69,961	69	158,798	71
Northern Ireland	31,849	53	72,514	71	229,701	103

Source: Department for Communities and Local Government (2008e)

In recent years, Scotland has reported one of the lowest average dwellings prices in the UK (Table 4-1). In 2007, the average price in Scotland was only 71 percent of the UK average and only the North East had a lower average price. This suggests that homeowners in Scotland had relatively low levels of housing wealth and this has likely acted as a barrier to household migration. By contrast, London experienced the highest average house prices, which will have probably have had two effects. Firstly, housing costs will have been relatively high, thus

encouraging out-migration of households. Secondly, owner-occupiers will have experienced relatively high levels of housing wealth meaning that they can increase their consumption of housing services by moving to a region with lower house prices.

Although prices vary widely across the UK, all regions have experienced rising house prices and all regions, with the exception of the South East, reported increases of over 100 percent between 2000 and 2007. In fact, prices in Northern Ireland tripled during this period, although it is likely that this was as a direct result of the political stability brought about by the Good Friday Agreement (Paris et al., 2003).

Economic theory implies that net migration flows are likely to be from regions with high house prices to regions with low house prices. The South East for example, should therefore only experience a net gain in population at the expense of London. Table 4-3 and Table 4-4 indicate that in 1998 and in 2006, the South East did indeed gain a significant proportion of in-migrants from London. Nevertheless, in 1998 the South East also gained population from the North East, the North West and the East and in 2006 just from the East. However, location decisions are not solely dependent upon house prices and other significant factors include employment opportunities and potential earnings.

TABLE 4-3 NET INTER-REGIONAL IN-MIGRATION, 1998 (000S)

	Origin:											
Destination:	NE	NW	Y&H	EM	WM	E	L	SE	SW	W	S	NI
North East	-	0	-2	-1	-1	0	-1	-1	-1	0	0	1
North West	0	-	0	-1	0	0	-4	-2	-2	-2	0	1
Yorkshire and the Humber	2	0	-	-2	0	0	-3	0	-1	0	0	0
East Midlands	1	1	2	-	2	2	0	3	-1	0	0	0
West Midlands	1	0	0	-2	-	0	-1	0	-3	-1	0	0
East	0	0	0	-2	0	-	23	-1	-3	0	0	0
London	1	4	3	0	1	-23	-	-28	-3	1	1	0
South East	1	2	0	-3	0	1	28	-	-11	-1	0	0
South West	1	2	1	1	3	3	3	11	-	1	0	0
Wales	0	2	0	0	1	0	-1	1	-1	-	0	0
Scotland	0	0	0	0	0	0	-1	0	0	0	-	0
Northern Ireland	-1	-1	0	0	0	0	0	0	0	0	0	-

Source: Office for National Statistics (2008b)

TABLE 4-4 NET INTER-REGIONAL IN-MIGRATION, 2006 (000S)

	Origin:											
Destination:	NE	NW	Y&H	EM	WM	E	L	SE	SW	W	S	NI
North East	-	0	0	0	0	0	-1	0	0	0	0	0
North West	0	-	0	0	0	0	0	0	-2	-2	0	0
Yorkshire and the Humber	0	0	-	-2	1	1	-1	1	0	0	-1	0
East Midlands	0	0	2	-	2	4	1	2	-2	0	0	0
West Midlands	0	0	-1	-2	-	1	-1	1	-4	-1	0	0
East	0	0	-1	-4	-1	-	32	-3	-4	-1	-1	0
London	1	0	1	-1	1	-32	-	-40	-7	0	0	-1
South East	0	0	-1	-2	-1	3	40	-	-11	-2	-2	0
South West	0	2	0	2	4	4	7	11	-	0	0	0
Wales	0	2	0	0	1	1	0	2	0	-	0	0
Scotland	0	0	1	0	0	1	0	2	0	0	-	-1
Northern Ireland	0	0	0	0	0	0	1	0	0	0	1	-

Source: Office for National Statistics (2008b)

Taking gross weekly pay and unemployment rates (Table 4-5) into consideration means that net migration gains made by London are more understandable. For example, workers in London have enjoyed significantly higher levels of pay than in any other region and although the unemployment levels are relatively high, the incentive to relocate from areas such as the North East is driven by the expectation of higher pay and greater opportunities.

TABLE 4-5 MEDIAN GROSS WEEKLY PAY (INDEX UK =100) AND APRIL UNEMPLOYMENT RATE (SEASONALLY ADJUSTED)

	Median gross weekly pay			April unemployment rate		
	1998	2002	2007	1998	2002	2007
United Kingdom	100	100	100	2.4	3.8	2.6
North East	90.3	88.2	88.2	3.2	5.4	3.8
North West	94.9	94.3	95.1	2.6	4	2.9
Yorkshire and The Humber	93.7	92.1	92.5	2.6	4.5	2.9
East Midlands	93.2	92.7	92	2.2	3.2	2.3
West Midlands	95.7	93.8	94.2	3.2	3.8	2.9
East	100.6	100.4	98.5	1.8	2.6	1.7
London	125.1	128.2	127.2	3	5.1	3.4
South East	104.6	107.4	105.3	1.5	2.2	1.4
South West	94	93.3	93.7	1.4	3	1.7
England	101.3	101.4	101.2	2.3	3.7	2.5
Wales	92.2	89.4	88.6	2.3	4	2.7
Scotland	93.7	95.1	96.7	2.5	4.4	3.3
Northern Ireland	89	87.5	88	2.3	5.7	3.6

Source: Office for National Statistics (2008a)

TABLE 4-6 AVERAGE LOAN TO VALUE RATIOS

	2000		2006	
	First time buyers	Existing owner occupiers	First time buyers	Existing owner occupiers
United Kingdom	79.7	64.3	83.6	64.6
North East	82.9	71.1	87.0	66.8
North West	82.7	69.4	81.9	62.7
Yorkshire and the Humber	82.7	69.5	85.5	66.7
East Midlands	82.2	68.4	85.6	65.9
West Midlands	81.2	66.0	81.1	66.2
East	79.4	62.8	85.2	65.3
London	77.9	61.3	84.3	64.7
South East	77.3	60.5	82.6	61.0
South West	76.2	62.3	83.5	62.3
England	79.4	63.7	83.5	64.1
Wales	82.8	69.8	84.7	63.9
Scotland	82.2	73.0	84.9	71.1
Northern Ireland	80.1	61.7	78.0	61.8

Source: Department of Communities and Local Government (2008f)

Incomes and availability of credit also influence household mobility since the opportunity to take out a mortgage and the amount of household debt will likely affect the decision to relocate. Table 4-6 shows the average loan to value ratios of the UK regions. This ratio indicates the total value of a mortgage loan as a percentage of the total value of the property; however, lenders cap the loan to value ratio in order to reduce their risk, thereby limiting the maximum value of the ratio. Consequently, some of the variations observed between 2000 and 2006 will be the result of changes in the circumstances of households and some will be the result of changes in the circumstances of lenders. Closely related to the loan to value ratio is the ratio of average household income to average house price, shown in Table 4-7.

TABLE 4-7 AVERAGE RECORDED INCOME OF BORROWERS AS A PERCENTAGE OF AVERAGE DWELLING PRICE

	Average Recorded Income of Borrowers as a Percentage of Average Dwelling Price				Average Mortgage Advances as a Percentage of Average Income of borrower			
	1990	2000	2007	Change 2000 – 07	1990	2000	2007	Change 2000 - 07
United Kingdom	32.7	30.7	24	-6.7	210	226	281	71
North East	38.1	39.1	27.1	-12	185	195	265	80
North West	34.9	35.4	26	-9.5	197	209	273	76
Yorkshire And the Humber	34.7	36	25.5	-10.4	195	207	272	77
East Midlands	33.4	34.1	25.2	-8.9	211	214	273	62
West Midlands	32.4	32	24.3	-7.6	209	221	282	73
East	30.8	29.4	23.2	-6.3	223	232	283	60
London	31.7	27	23.8	-3.2	223	252	290	67
South East	28.9	26.6	22.4	-4.2	229	244	288	59
South West	30.6	28.8	22.6	-6.2	218	230	280	62
England	31.9	30	23.8	-6.2	214	230	282	68
Wales	36.2	36.1	25.7	-10.4	198	207	265	67
Scotland	40.9	38.4	26.9	-11.5	173	199	266	93
Northern Ireland	45.8	33.4	20.3	-13.1	166	212	284	118

Source: Department of Communities and Local Government (2008f)

House prices have increased in all regions and this suggests that lenders will now be increasing loan to value ratios. Nevertheless, the north of England, Scotland and Wales have all experienced a fall in the average loan to value ratio. The data in Table 4-7 indicate that these areas also saw the largest declines in the ratio of average household income to average property price. By contrast, average loan to value ratios in the South East, East and London are typically lower than those in the north of England and Scotland but have nevertheless increased between 2000 and 2006. Although incomes in these areas have declined relative to house prices, they have not declined as rapidly as those in the north of the UK.

Regions with the lowest income to house price ratios also reported the highest loans to income ratios (Table 4-7). Consequently, in-migrants to these areas are more likely to face constraints resulting from ceilings placed on loan to value ratios by lenders and households will be more sensitive to changes in mortgage interest rates. In the UK, the average mortgage is 2.8 times the average income of borrowers and this figure is over 2.5 for all regions. Eighteen years ago, the average income in the UK constituted just under a third of the average house price but by 2006 this value had declined to less than a quarter. The North East reported the highest ratio of

income to house prices at 27 percent, however this region experienced the second largest decline in terms of this measure.

4.2.2 Supply

The stock of housing in all regions of the UK increased from 1995 to 2006 (Table 4-8). Northern Ireland experienced the largest increase in dwelling stock from 1995 to 2006, probably as a direct result of the calming in the political situation in that region.

Despite increases in stock, supply has not kept pace with demand and thus house prices have risen, most likely because of increasing pressure from changes in the numbers of households and the use of housing as an investment. This situation could be self-reinforcing since increasing demand results in higher house prices, making housing seem more attractive as an investment, thereby further increasing demand.

TABLE 4-8 STOCK OF DWELLINGS AND CHANGE IN PRICES

	Stock (000s)			Percentage change in	
	1995	2000	2006	stock 1995 - 2006	prices 1990 - 2007
United Kingdom	23,115	24,014	26,416	14.3	274
North East	1,091	1,112	1,137	4.2	268
North West	2,855	2,934	3,027	6.0	238
Yorkshire and The Humber	2,076	2,144	2,218	6.8	260
East Midlands	1,700	1,782	1,880	10.6	235
West Midlands	2,141	2,211	2,293	7.1	238
East	2,182	2,290	2,414	10.6	232
London	2,990	3,074	3,192	6.8	308
South East	3,219	3,366	3,536	9.8	241
South West	2,051	2,161	2,291	11.7	253
England	20,305	21,075	21,989	8.3	267
Wales	1,224	1,267	1,314	7.4	266
Scotland	2,210	2,303	2,407	8.9	280
Northern Ireland	600	636	706	17.7	621

Source: Office for National Statistics (2008c)

TABLE 4-9 HOUSEHOLD AND DWELLING BALANCE, ENGLAND

	Households (000s)			Stocks (000s)			Balance as % of households		
	1991	2001	2006	1991	2001	2006	1991	2001	2006
England	19,213	20,451	21,518	19,670	21,208	21,989	2.4	3.7	2.2
North East	1,048	1,066	1,107	1,072	1,115	1,137	2.3	4.6	2.7
North West	2,720	2,813	2,940	2,792	2,945	3,027	2.6	4.7	3.0
Yorks and Humberside	1,993	2,065	2,178	2,021	2,155	2,218	1.4	4.4	1.8
East Midlands	1,596	1,732	1,848	1,634	1,797	1,880	2.4	3.8	1.7
West Midlands	2,042	2,154	2,239	2,079	2,225	2,293	1.8	3.3	2.4
East	2,035	2,232	2,372	2,093	2,308	2,414	2.9	3.4	1.8
London	2,841	3,016	3,175	2,912	3,090	3,192	2.5	2.5	0.5
South East	3,034	3,287	3,443	3,099	3,392	3,536	2.1	3.2	2.7
South West	1,903	2,086	2,214	1,968	2,181	2,291	3.4	4.6	3.5

Source: Office for National Statistics (2008e) and Department of Communities and Local Government (2008b)

Comparing the stock of dwellings to the number of households, all English regions reported a positive balance since 1991. The balance as a percentage of the number of households increased in all areas between 1991 and 2001, with the exception of London, implying that supply was outstripping the rate of household formation in this region. Nevertheless, from 2001 and 2006 the slack in the housing market declined in all areas. In 2006, London had the smallest relative balance with only enough spare stock to accommodate a 0.5 percent increase in the number of households.

According to previous research, household formation rates and population levels in sub-national areas are linked to the availability of housing (Garasky et al., 2001; Haurin et al., 1996). If stock is relatively plentiful in a particular area, it may lead to an increase in household formation rates since there is greater opportunity to acquire housing.

TABLE 4-10 COMPLETIONS OF DWELLINGS (000S)

	Private enterprise		Register social landlords		Local authorities		Total	
	1995/96	2005/06	1995/96	2005/06	1995/96	2005/06	1995/96	2005/06
United Kingdom	156.7	188.9	38.5	24.4	3	0.3	198.2	213.6
North East	5.7	7.1	1.1	0.4	0	0.1	6.8	7.6
North West	15.7	19.9	4.8	0.8	0	0	20.5	20.7
Yorkshire and The Humber	11.6	15.8	3.2	0.3	0.1	0	14.9	16.1
East Midlands	13.8	15.6	2.2	1.2	0.2	0.1	16.2	16.9
West Midlands	12.2	14.9	2.5	1.3	0.1	0	14.8	16.2
East	17.8	17.6	3.3	2.6	0.1	0	21.2	20.2
London	11.2	13.6	5	5.2	0	0	16.2	18.8
South East	21.7	23.6	5.2	4.6	0.1	0	27	28.2
South West	13.8	16.9	2.9	1.8	0.2	0	16.9	18.7
England	123.6	144.9	30.2	18.2	0.8	0.3	154.6	163.4
Wales	7.3	7.9	2.5	0.3	0.2	0	10	8.2
Scotland	19	19.5	4.7	5.1	0.7	0	24.4	24.6
Northern Ireland	6.8	16.6	1	0.8	1.4	0	9.2	17.4

Source: Office for National Statistics (2008c)

As Table 4-10 shows, the number of completions in all areas, except the East, increased between the 1990s and mid 2000s. Nevertheless, the household formation rate was greater than the rate at which new properties were developed, leading to the pattern of stock and household balances observed in Table 4-9. This will have also been a contributing factor to the increase in prices observed in London, the South East, the East and the South West (apart from 1997), which all reported house prices above the UK average. The other regions saw house prices below the UK average and some regions, such as the North West for example, declined relative to the UK.

An additional source of demand for housing arises from second home ownership. However, as Table 4-11 shows, second homes constitute only a very small percentage of dwellings in any of the regions. The highest percentages of second homes were reported in London and the South West where approximately two in every hundred properties was a second home in 2005. Nevertheless, these figures increased between 2003 and 2005 and in many areas the percentage of second homes more than doubled, which could become a significant issue if this trend continues. These figures also hide a problem that is experienced largely at the local level. This is a particularly significant issue for some areas in the South West and will be discussed in more detail in the next section.

TABLE 4-11 SECOND HOMES AS A PERCENTAGE OF ALL DWELLINGS

	2003	2005
England	0.5	1.0
North East	0.1	0.6
North West	0.1	0.3
Yorkshire and The Humber	0.3	0.8
East Midlands	0.2	0.3
West Midlands	0.3	0.3
East of England	0.4	1.3
London	0.6	2.0
South East	0.9	1.0
South West	1.1	2.2

Source: Department of Communities and Local Government (2008k)

Projections for the number of households (Table 4-12) show that between 2006 and 2016 the greatest increases are likely to be experienced in the South West: by 2031 the number of households in the region is expected to be almost 30 percent more than in 2006. This will probably be due to increases in population and to the popularity of the South West as a place of residence.

TABLE 4-12 ESTIMATED HOUSEHOLD FORECASTS BY ENGLISH REGION (MILLIONS)

					% change		
	2006	2016	2026	2031	2006-16	2006-26	2006-31
North East	1.11	1.16	1.19	1.19	4.9	7.4	7.5
North West	2.94	3.17	3.37	3.42	7.9	14.5	16.2
Yorkshire & the Humber	2.18	2.39	2.58	2.65	9.6	18.6	21.8
East Midlands	1.85	2.08	2.30	2.39	12.4	24.4	29.1
West Midlands	2.24	2.43	2.61	2.67	8.7	16.7	19.2
East of England	2.37	2.67	2.95	3.05	12.4	24.2	28.8
Greater London	3.18	3.57	3.92	4.06	12.3	23.5	27.7
South East	3.44	3.86	4.27	4.42	12.0	23.9	28.3
South West	2.21	2.50	2.77	2.87	12.8	25.0	29.5

Source: Experian (2008)

Overall, the picture for the UK regions is broadly similar to that of the country as a whole. House prices have been increasing, as have the number of households. Whilst the number of completions has also increased, there has been a reduction in household and stock balances. Nevertheless, at the regional level at least there are still enough houses for the number of households.

Many of the effects of changes in the housing market are felt primarily at the local level and the next section discusses the nature of the housing market in the South West and its constituent counties and unitary authority areas.

4.3 The South West Housing Market

The South West is a diverse region both geographically and economically. It covers the areas of Bristol, Bath and North East Somerset, South Gloucestershire, North Somerset, Wiltshire, Swindon, Gloucestershire in the north and Cornwall, Plymouth, Torbay, Devon, Poole, Bournemouth, Dorset and Somerset in the south. According to the South West Housing Body's *Annual Monitoring and Implementation Report* (2008: p 7), the South West "is one of the most desirable parts of the country in which to live." Consequently, the region is experiencing growing pressure on the housing market caused by population growth, net inward migration and second home ownership.

4.3.1 Tenure and Migration

There are a greater proportion of owner-occupiers and private renters in the South West than in England, Wales, Scotland and Northern Ireland (Table 4-13). Consequently, the region has a relatively low proportion of households renting from local authorities. Such a high proportion of owner-occupiers suggests that once settled households are less likely to migrate out of the region. Moreover, there will be a greater level of housing wealth in the region relative to other areas in the UK.

TABLE 4-13 TENURE (%)

	Owner occupied			Rented from local authority			Rented from registered social landlord			Rented from private landlords or with job or business		
	1995	2000	2005	1995	2000	2005	1995	2000	2005	1995	2000	2005
South West	73	75	73	12	8	6	3	6	7	12	11	13
England	67	69	70	18	14	10	4	6	8	11	10	11
Wales	71	71	73	17	15	12	3	4	5	8	9	10
Scotland	58	63	67	31	24	15	4	6	10	7	7	7
Northern Ireland	69	73	72	26	19	15	2	3	3	4	5	10

Source: Office for National Statistics (2008c)

Research into the life cycle of the consumer indicates that older households own a greater proportion of housing wealth in comparison to younger households (Cocco et al., 2005). This would explain the pattern of tenure and migration in the South West where population gains from net in-migration are primarily from the age groups above 25 (Table 4-14) and the resident population is weighted towards the older age groups (Table 4-15).

TABLE 4-14 SOUTH WEST NET INWARD MIGRATION BY AGE (000S)

	1998	2000	2003
Under 15	8.6	7.2	8.0
15 to 24	3.7	5.7	-2.0
25 to 34	0.6	4.3	6.3
35 to 44	6.3	7.8	7.0
45 to 54	5.0	4.6	4.6
55 to 64	4.2	5.5	4.7
65 to 74	1.5	1.0	1.9
75 and over	1.5	1.3	1.4
all ages	31.5	37.3	33.6

Source: Office for National Statistics (2005a)

TABLE 4-15 AGE STRUCTURE OF POPULATION (%)

	South West		UK	
	1998	2006	1998	2006
0 to 15	19.3	18.0	20.4	19.1
16 to 24	10.1	11.3	10.9	11.9
25 to 44	28.2	25.8	29.9	28.3
45 to 64	23.9	26.1	23.1	24.7
65 and over	18.6	18.7	15.6	16.0
	100	100	100	100

Source: Office for National Statistics (2008b)

Looking at the age structure of migrants (Table 4-14) we see that people aged 30 to 44 accounted for the largest share of the region's net gain from migration. The South West also made significant gains among children of school age (aged 5 to 15) indicating that a significant proportion of migration resulted from the movement of families. However, the region experienced a loss amongst the younger working-age categories (aged 16 to 29). Possible suggestions for this have been the lack of job opportunities, migration for higher education and a movement to larger urban areas as a lifestyle change. Price rises resulting from the level of second home ownership have also been blamed for the significant out-migration of younger households. Nevertheless, at the regional level this is unlikely to be the case since just over two

percent of the region's dwellings are second homes, a figure unlikely to have caused significant price rises.

The South West made net gains in population from most areas in most years. Table 4-16 indicates that the majority of in-migrants originated in the South East and the majority of out-migrants moved to the South East. Nevertheless, the South West gained overall and fewer migrants came from or went to the more geographically distant regions.

TABLE 4-16 INTER-REGIONAL MIGRATION

	To South West:			From South West			Net inter regional in-migration to SW		
	1998	2002	2006	1998	2002	2006	1998	2002	2006
UK	139	146	136	111	111	108	28	35	28
England	-	132	121	-	94	93	-	38	28
North East	3	2	2	2	2	2	1	0	0
North West	10	9	9	8	8	7	2	1	2
Yorkshire and the Humber	7	6	6	6	6	6	1	0	0
East Midlands	9	9	9	8	8	7	1	1	2
West Midlands	16	16	16	13	13	12	3	3	4
East	13	14	13	10	9	9	3	5	4
London	20	25	23	17	15	16	3	10	7
South East	45	50	44	34	33	33	11	17	11
Wales	10	9	10	9	12	10	1	-3	0
Scotland	4	4	4	4	4	4	0	0	0
Northern Ireland	1	1	1	1	1	1	0	0	0

Source: Office for National Statistics (2008b)

One of the possible reasons why the South West region is popular for households choosing to relocate is that the area is predominantly rural yet has relatively large urban centres and is also adjacent to the South East.

Table 4-17 shows that the South West is much less densely populated than England or the UK. Within the region, Devon and Wiltshire are the least densely populated areas, whilst Bristol and .Bournemouth have the highest population densities.

TABLE 4-17 POPULATION DENSITY, HOUSE PRICES AND UNEMPLOYMENT RATE

	Population density (persons per km^2)		Unemployment rate (July, NSA)		Mean house price (index, England =100)	
	1999	2006	1999	2006	1999	2006
United Kingdom	245	250	3.5	2.5	-	-
South West	207	215	2.5	1.6	93	102
Bath and North East Somerset UA	480	508	2.1	1.1	116	124
Bournemouth UA	3,533	3,490	3.5	2.1	90	100
Bristol, City of UA	3,684	3,745	3.7	2.4	87	93
North Somerset UA	509	539	1.8	1.2	91	97
Plymouth UA	3,165	3,110	4.2	2.5	58	76
Poole UA	2,166	2,114	1.9	1.2	120	129
South Gloucestershire UA	492	512	1.3	1.1	88	94
Swindon UA	788	811	2.2	2.2	84	80
Torbay UA	1,970	2,118	4.1	2.6	77	88
Cornwall	139	148	3.7	1.7	80	104
Devon	106	113	2.5	1.3	90	108
Dorset	153	159	1.6	1.0	111	117
Gloucestershire	212	218	2.3	1.7	100	103
Somerset	143	150	2.2	1.3	88	96
Wiltshire	132	138	1.4	1.0	111	109
England	381	390	3.4	2.5	100	100
Wales	141	143	3.7	2.4	64	74
Scotland	66	66	4.4	2.9	-	-
Northern Ireland	125	128	5.2	2.7	-	-

Source: Office for National Statistics (2008b), Department for Communities and Local Government (2008e)

Unemployment levels in the region are generally much lower than the UK average. Research suggests that areas of low unemployment are also likely to be areas with relatively high house prices and this would appear to be the case in the South West. Taking Dorset as an example, it had one of the lowest unemployment rates in 2006 and one of the highest average house prices, which was 17 percent above the UK average, although there are other factors influencing the house prices, such as population density. Nevertheless, in many areas in the South West unemployment levels were relatively low and house prices were relatively high.

4.3.2 Population

Further pressure in the South West housing market has come from increasing population numbers. The region has experienced a significant growth in the number of inhabitants in recent decades: from 1981 to 2006 the region's population grew by 16.9 percent (see Table 4-18). This level of growth was greater than that experienced by any of the other UK regions and

the rate of change in the UK as a whole was only 7.5 percent. Projections from the Office for National Statistics (ONS) suggest that the number of people in the South West will continue to rise, with recent estimations indicating that the region's population will reach 5.4 million by 2016. This estimated growth rate of over 7 percent outstrips the national projections for population growth in the same period by almost two percent.

TABLE 4-18 .POPULATION IN THE SOUTH WEST

	Total population (000s)		Percentage change			Projections	
	1999	2006	1981-1999	1999-2006	1981-2006	2016	2026
UK	59,501	60,587	5.6	1.8	7.5	-	-
South West	4,936	5,124	12.7	3.8	16.9	5,440	5,775
Bath and North East Somerset UA	169	176	4.4	4.1	8.8	184	193
Bournemouth UA	163	161	13.3	-1.2	12.4	171	178
Bristol, City of UA	405	411	1.0	1.5	2.3	419	438
North Somerset UA	190	201	16.5	5.8	23.7	213	229
Plymouth UA	253	248	-0.1	-2.0	-2.1	256	265
Poole UA	141	137	17.0	-2.8	13.8	137	140
South Gloucestershire UA	244	254	20.4	4.1	25.2	263	277
Swindon UA	181	187	19.5	3.3	23.1	190	197
Torbay UA	124	133	9.7	7.3	17.7	150	163
Cornwall and the Isles of Scilly	495	526	16.0	6.3	23.4	575	621
Devon County	698	741	16.4	6.2	23.6	809	876
Dorset County	389	403	16.2	3.6	20.3	428	454
Gloucestershire	562	579	11.0	3.0	14.3	600	625
Somerset	493	519	14.5	5.3	20.4	563	605
Wiltshire County	429	449	14.9	4.7	19.6	483	514

Source: Office for National Statistics (2005a, 2008b)

At the sub-regional level, areas in the south of the region (Cornwall, Devon, Somerset, North Somerset and Torbay) experienced the largest increases in residents between 1999 and 2006. It is interesting to note that the only areas to have a negative change in population are the urban areas of Bournemouth, Poole and Plymouth. The ONS predict that over the next decade the fastest growing areas will be Torbay, Devon and Cornwall, all with forecasted growth rates of more than 9 percent. However, all areas in the region are predicted to experience population growth with the exception of Poole, which is forecast to see its population remain constant over the next decade.

With the exception of Torbay and Bournemouth, traditional urban retirement locations, the areas that made the largest gains in terms of net migration were the mainly rural areas of Devon, Cornwall and Somerset (Table 4-19). In the region as a whole, the positive change in population was due entirely to net in-migration. Net out-migration in Bristol and Plymouth, the largest urban areas in the South West, is a particular issue for planners since urban regeneration has been a part of government housing policy since 1980 (Stephens et al., 2005).

TABLE 4-19 SUB-REGIONAL COMPONENTS OF POPULATION CHANGE

	population mid 1993	net natural change	Net migration and other changes	population mid 2003	net migration as % of population mid 2003
South West	4,733.60	-30.1	295.7	4,999.30	5.9
Bath and North East Somerset UA	162.2	-0.6	9.3	170.9	5.4
Bournemouth UA	158.4	-7.8	13.1	163.7	8.0
Bristol, City of UA	390.6	9.2	-8.3	391.5	-2.1
North Somerset UA	181.1	-3.5	13.9	191.4	7.3
Plymouth UA	253.8	1.8	-14.1	241.5	-5.8
Poole UA	135.8	-1.7	3.5	137.5	2.5
South Gloucestershire UA	228.7	10.9	7.3	246.8	3.0
Swindon UA	172.2	7.8	1.3	181.2	0.7
Torbay UA	121.5	-6.7	16.4	131.3	12.5
Cornwall	474.7	-12	50.7	513.5	9.9
Devon	665.4	-19.4	69	714.9	9.7
Dorset	369	-13.2	42.5	398.2	10.7
Gloucestershire	541.3	3.2	24	568.5	4.2
Somerset	471.9	-5.8	41.4	507.5	8.2
Wiltshire	407.3	7.7	25.8	440.8	5.9

Source: Office for National Statistics (2005a)

Looking at sub-regional changes in population from 2005 to 2006, all areas in the South West reported net in-migration including Bristol, the only area to have reported net out-migration between 1993 and 2003. It is possible that the urban regeneration plans undertaken in recent years are now beginning to have a positive effect on in-migration to the cities within the South West.

TABLE 4-20 SUB-REGIONAL CHANGES IN POPULATION, 2005 TO 2006

	mid 2005 - mid 2006				
	Net natural change	Net migration and other changes	Total changes	Population 2006	Net migration and other changes as % of pop 06
South West	1	36.3	37.3	5124.1	0.71
Bath and North East Somerset UA	0.2	0.6	0.7	175.6	0.34
Bournemouth UA	-0.3	0.5	0.2	161.2	0.31
Bristol UA	1.9	2.9	4.8	410.5	0.71
North Somerset UA	0	2.9	2.8	201.4	1.44
Plymouth UA	0.5	1.6	2.1	248.1	0.64
Poole UA	-0.1	0.4	0.2	136.9	0.29
South Gloucestershire UA	1	0.3	1.3	254.4	0.12
Swindon UA	0.9	1.2	2.1	186.6	0.64
Torbay UA	-0.5	0.8	0.3	133.2	0.60
Cornwall and the Isles of Scilly	-0.8	5.6	4.8	526.4	1.06
Devon	-1.3	9.5	8.2	740.9	1.28
Dorset	-1.3	3.4	2	403.1	0.84
Gloucestershire	0.3	2.7	3	578.6	0.47
Somerset	-0.3	3.1	2.7	518.6	0.60
Wiltshire	0.8	1	1.9	448.7	0.22

Source: Office for National Statistics (2008j)

4.3.3 Second Homes

According to the report *Housing In England 2004/05* (Department for Communities and Local Government, 2006), the South West is the most popular location for second homes. Although the region accounts for only 10 percent of all households in England, it accounts for a quarter of all second homes and there are approximately 50,000 such properties in the region. Of the top 20 local authorities in England in terms of stocks of second homes, four of those areas are in the South West. The South Hams with 4,400 such properties, ranks 5th, North Cornwall, with 3,800 second homes, ranks 7th, Penwith with 2,700 ranks 16th and West Dorset with 2,500 ranks 18th. In the case of the South Hams, this means that approximately 1 in 10 dwellings is a second home and North Cornwall reported a similar value (Table 4-21). Thus, these figures suggest that second homes are likely to be causing significant pressures in some local housing markets.

TABLE 4-21 SECOND HOMES (% OF ALL DWELLINGS)

		2003	2005
Bath and North East Somerset		0.2	-
Bristol, City of		0.2	0.7
South Gloucestershire		0.2	0.2
Plymouth		2.4	1.2
Torbay		2.6	2.5
Bournemouth		2.1	-
Swindon		-	0.1
Cornwall	Caradon	3.3	5
	Carrick	-	4.5
	Kerrier	-	3.3
	North Cornwall	-	10.1
Devon	East Devon	-	3.9
	Exeter	-	0.9
	North Devon	-	3.5
	South Hams	-	10.6
	Teignbridge	1.9	2.2
	Torridge	-	2.1
	West Devon	-	2.6
Dorset	Christchurch	3	-
	East Dorset	-	-
	North Dorset	2	1.9
	Purbeck	7.2	7
	West Dorset	3.8	5.3
	Cheltenham	0.9	1.1
	Cotswold	-	3.3
	Forest of Dean	0.8	-
Gloucestershire	Gloucester	-	0.3
	Stroud	-	0.8
	Tewkesbury	0.5	0.6
Somerset	Mendip	-	1
	Sedgemoor	0.8	-
	South Somerset	-	1.2
	Taunton Deane	0.8	0.7
	West Somerset	-	5.8
Wiltshire	Kennet	1.5	-
	North Wiltshire	0.9	0.9
	Salisbury	-	1.1
	West Wiltshire	-	0.4

Source: Department of Communities and Local Government (2008k)

4.3.4 House prices, Incomes and Output

Changes in house prices are a key influence on the patterns of migration seen within the region (see Table 4-22). The largest increases over the period 1996 to 2000 were seen in Poole and Bath and North East Somerset, where prices increased by over 70 percent. By contrast, house prices in Plymouth increased by only 30 percent during the same period. This picture is reversed, however, when looking at the period from 2000 to 2007: house prices in Plymouth increased by almost 160 percent whilst prices in Poole and in Bath and North East Somerset increased by just over 100 percent. This is possibly a result of increased household numbers since population levels in Plymouth have declined since the early 1980s.

TABLE 4-22 PERCENTAGE CHANGE IN AVERAGE HOUSE PRICE

	1996 to 2000	2000 to 2007
South West	53	116
Bath and North East Somerset UA	71	102
Bournemouth UA	66	108
Bristol, City of UA	62	116
North Somerset UA	53	108
Plymouth UA	30	159
Poole UA	79	104
South Gloucestershire UA	53	109
Swindon UA	56	76
Torbay UA	43	132
Cornwall and the Isles of Scilly	51	156
Devon	47	137
Dorset	62	106
Gloucestershire	53	105
Somerset	52	114
Wiltshire	56	89

Source: Department of Communities and Local Government (2008b)

Cornwall, Devon and Torbay also experienced significant changes in house prices between 2000 and 2007 possibly as a result net in-migration from 1993 through to 2006.

Affordability is one of the key housing policy issues for countries, regions and sub-regions alike. Table 4-23 shows the ratio of average house price of the lowest quartile of house prices to the average yearly earnings of the lowest quartile earnings group. From 1997 to 2007 the ratio of price to earnings has increased in all areas in the South West, with the largest change occurring in Devon. In 2007, the average house price in Cornwall was over ten times the value

of the average income and the same was true of average house prices in Bath and North East Somerset, Poole and Dorset. The lowest value was reported in Swindon, although even in this case, the average house price was almost seven times the value of average earnings.

TABLE 4-23 RATIO OF LOWER QUARTILE HOUSE PRICE TO LOWER QUARTILE YEARLY EARNINGS

	1997	2000	2004	2007
South West	4.07	4.81	8.17	8.96
Bath and North East Somerset UA	4.76	6.21	9.24	10.02
Bournemouth UA	4.65	5.25	9.77	9.71
Bristol, City of UA	3.31	4.47	6.97	7.84
North Somerset UA	4.06	4.81	7.36	8.07
Plymouth UA	3.32	3.19	5.76	7.24
Poole UA	4.78	6.13	10.13	10.10
South Gloucestershire UA	3.73	4.91	7.22	8.75
Swindon UA	3.21	4.80	6.33	6.93
Torbay UA	3.97	5.22	9.31	9.76
Cornwall and the Isles of Scilly	4.30	5.03	9.55	10.47
Devon	4.40	5.04	9.20	9.93
Dorset	5.10	6.51	10.32	10.96
Gloucestershire	3.96	4.49	7.62	8.44
Somerset	4.10	4.89	8.21	8.90
Wiltshire	4.80	5.87	8.84	9.16

Source: Department of Communities and Local Government (2008g)

Although median gross weekly pay increased in all areas of the South West between 1998 and 2007 (Table 4-24), it is clear that earnings and income have not kept pace with changes in house prices. For instance, in Cornwall the median gross weekly pay of full time workers increased by almost 50 percent between 1998 and 2007 and the pay of part time workers increased by over 70 percent, yet the ratio of median house prices to median earnings more than doubled between 1997 and 2007 (Table 4-25).

TABLE 4-24 MEDIAN GROSS WEEKLY PAY

	1998		2007	
	FT Workers	PT worker	FT Workers	PT worker
South West	314.8	95.3	427.8	144.7
Bath and North East Somerset UA	326.3	89.3	463.8	144.3
Bournemouth UA	278.8	89.5	403.3	145.9
Bristol, City of UA	343.5	96.7	460.1	152.2
North Somerset UA	318.8	94.4	468.7	148.9
Plymouth UA	292.8	110.3	425.0	156.6
Poole UA	341.2	112.7	446.9	139.9
South Gloucestershire UA	365.1	97.5	480.2	146.3
Swindon UA	362.7	107.9	493.2	152.2
Torbay UA	238.7	97.8	365.6	133.7
Cornwall and the Isles of Scilly	253.4	80.5	373.3	140.4
Devon	282.0	83.6	381.2	148.5
Dorset	308.3	85.3	400.3	146.0
Gloucestershire	330.5	102.9	451.0	142.9
Somerset	311.5	100.4	419.3	137.6
Wiltshire	294.3	97.6	435.1	132.7

Source: Office for National Statistics (2008a)

TABLE 4-25 RATIO OF MEDIAN HOUSE PRICE TO MEDIAN EARNINGS

	1997	2000	2004	2007
England	3.54	4.21	6.58	7.26
South West	3.78	4.68	7.71	8.38
Bath and North East Somerset UA	4.62	5.94	8.69	9.38
Bournemouth UA	4.44	5.28	9.93	9.17
Bristol, City of UA	3.06	4.05	6.26	7.08
North Somerset UA	3.66	4.56	6.73	7.48
Plymouth UA	2.99	2.95	5.55	6.76
Poole UA	4.06	5.40	8.82	9.22
South Gloucestershire UA	3.32	4.24	6.27	7.30
Swindon UA	3.00	4.18	5.62	6.10
Torbay UA	3.83	4.74	8.39	8.96
Cornwall	4.14	5.00	9.32	10.01
Devon	4.22	4.96	8.81	10.00
Dorset	4.83	5.93	9.60	10.96
Gloucestershire	3.65	4.53	7.23	7.84
Somerset	3.67	4.66	7.74	8.09
Wiltshire	4.32	5.50	8.21	8.59

Source: Department of Communities and Local Government (2008h)

The result of rising house prices is clear from Table 4-25. Average house prices in Cornwall, Devon and Dorset were over 10 times the median yearly earnings in those areas, a figure significantly higher than that for England. This is likely to be a specific problem for younger households as the purchase of property will require higher deposits and greater levels of

indebtedness. Thus, the region is likely to continue to see net out-migration of younger working age population.

The highest house prices tend to be found in the rural parts of the South West and this might suggest that these areas should be prosperous, but data showing average gross weekly pay (Table 4-24) indicate that workers in these areas are some of the most poorly paid in the region. This is also reflected in the data for GVA (Table 4-26). In terms of this measure, the most prosperous parts of the region are Bristol and Swindon, unsurprising since these large urban areas will constitute a significant proportion of the region's industry. Workers in these areas are the best paid in the region along with those in South Gloucestershire and North Somerset (Table 4-24). Interestingly, house prices in these areas have been consistently below the regional average possibly reflecting the fact that people work in Bristol and Swindon and commute to work from other rural areas. For example, house prices in the wider Wiltshire area but within commuting distance of Swindon, are higher than the regional average, as are those in Bath and North East Somerset, which is within commuting distance of Bristol.

TABLE 4-26 GVA PER HEAD (INDEX UK = 100) – NUTS REGIONS

	1996	2000	2004
South West	93	93	94
Gloucestershire, Wiltshire and North Somerset	110	113	117
Bristol, City of	133	138	140
North and North East Somerset, South Gloucestershire	101	105	113
Gloucestershire	99	104	113
Swindon	155	161	157
Wiltshire CC	98	91	90
Dorset and Somerset	83	84	81
Bournemouth and Poole	88	98	96
Dorset CC	77	74	72
Somerset	85	84	80
Cornwall and Isles of Scilly3	62	62	65
Devon	85	78	77
Plymouth	93	86	84
Torbay	82	70	62
Devon CC	83	77	78

Source: Office for National Statistics (Office for National Statistics, 2005b)

4.4 Regional Housing Market Policy

Although dedicated regional housing policy set by regional bodies is a relatively recent phenomenon in the UK, local authorities have been involved in the development of housing policy since the 1940s. Local authorities have long been responsible for the provision of social housing and providing the planning framework, infrastructure and social amenities necessary in order to facilitate the supply of private housing. During the latter half of the 20th century, the responsibility of the delivery of housing policy in England and Wales underwent several reforms in the guise of changes to the duties of local authorities and district councils. The Local Government Act of 1972 placed responsibility for housing with district authorities and a government white paper of the time gives the following justification:

"One of the most important functions of local government is housing. The government believe that the accurate assessment of housing requirements and the provision of housing and housing advice to the individual is of such paramount importance that the service should be operated as close to the citizen as possible." (Department of the Environment, 1971)

Scotland underwent a similar process of reorganisation with the implementation of a two-tier system of regions and districts everywhere except the three island areas. Districts and island authorities were then given overall responsibility for housing. The duties given to authorities with respect to housing were not only to manage local authority housing but also to have some power over private housing, especially where it was unfit for habitation or in need of repair or improvement (Malpass and Murie, 1999b p 147).

Despite responsibility for the provision of social housing lying with local authorities, the market was seen as the primary delivery mechanism to deal with regional planning and housing issues. Nevertheless, there were concerns over the spread and impact of new housing developments. Furthermore, it was suggested that the lack of strategic planning at the regional level would lead to insufficient provision of land for future development. This led to the publication of the government White Paper, *The Future of Development Plans* (Department of the Environment, 1989). One of the most important outcomes of this report was the recommendation of the

provision of regional planning guidance (Alden and Offord, 1996). The White Paper was followed by the publication of *PPG15 Regional Planning Guidance* in 1990 and *PPG12 Development Plans and Regional Guidance* in 1992; however the coverage was limited to land use issues (Counsell and Haughton, 2002). Local authorities were encouraged to work together to advise the Secretary of State about local issues, which would then be used to produce the *Regional Planning Guidance* for each of the eight English regions.

Government offices for the regions were first established in 1994 in order that central government activity could be coordinated within the regions of the UK (Slocombe, 2003). The process of devolution was taken a step further when the current Labour government sanctioned the establishment of a separate parliament in Scotland and national assemblies in both Wales and Northern Ireland in the late 1990s. Each of these bodies was given control over devolved budgets and, in addition, the Scottish Parliament was given some tax raising powers and the power to enact primary legislation. Each of these governmental organisations now has various policy setting powers including responsibility for the setting and implementation of housing policy.

In the English regions, housing became the responsibility of government offices and the Housing Corporation[8]. By 2001 these bodies were required to produce an annual regional housing statement in consultation with other stakeholders such as local authorities. The official aim of these documents was the identification of significant housing issues within the region and sub-regions. This was essentially a top-down exercise designed to filter national housing policy initiatives down to the regions, whilst retaining a significant amount of control with central government (Cole, 2003). Nevertheless, by 2003 the government recognised the need to develop local housing policy tailored to the specific requirements of different markets within the regions and this was evidenced by the release of the government's sustainable communities plan (Office of the Deputy Prime Minister, 2003). This led to the introduction of regional housing strategies, designed to

[8] Established in 1964 to fund and manage housing corporations in England.

"...identify key priorities in each region, ensure a link with regional economic and spatial strategies, identify sub-regional themes, and provide a basis on which decisions on housing capital investment can be made." (Department of Communities and Local Government, 2008a)

In a wider context, the sustainable communities plan marked the beginning of a new era of planning emphasising the development of spatial rather than purely land-use plans. The *Planning and Compulsory Purchase Act 2004*, made it a legal requirement that all English regions prepare regional spatial strategies and also placed a duty on the Welsh Assembly to produce a Welsh Spatial Plan. These regional strategy documents replaced regional planning guidance and integrated strategies for both planning and transport. Moreover, these documents contain the quantity of new housing supply that is required in order to meet the policy objectives outlined in the regional housing strategy. This move to a more integrated regional planning framework was in line with proposals in the European Spatial Development Perspective (European Commission, 2000) and from the demands of structural funds allocation (Tewdwr-Jones and Williams, 2001).

In broad terms, the national housing policies for Scotland, Wales and Northern Ireland do not differ significantly from those for England. For example, the recent national housing strategy for Wales has identified that the Assembly aims to engage in a 'Barker' style review of housing supply and needs to "increase housing supply to meet future needs." (Chartered Institute of Housing Cymru, 2005). At the regional level, there are some policies that are specific to particular types of regions. For example, in areas where the ethnic mix of the population is more varied, such as the West Midlands and North West, the housing strategy includes some reference to creating and supporting mixed and diverse communities. In areas like Yorkshire and the Humber that have experienced a significant decline in traditional industries (coal mining etc.), housing strategies have included an intention to address inner-city decline, whilst the housing strategies of regions that contain large urban areas include policies that attempt to address problems of homelessness. Nevertheless, there are similarities between regional housing strategies across the UK. Improving quality and affordability of housing are issues common to all areas. This is not limited to the UK, however, as affordability has become a key

focus of housing policy in both the US and countries in Western Europe. As discussed in the previous chapter, the problem with addressing affordability is the lack of a normative definition and therefore no standard method of calculating how affordable housing in any given area actually is.

Household Projections

The regional spatial strategies map out how many houses need to be built and these figures are based on population projections and subsequent estimations of the number of households. These projections are generated by first splitting the base population of the given area into gender and age cohorts (Gallent, 2005). This means that changes in the numbers in each of the cohorts can be forecasted based on assumptions regarding mortality, fertility and inward and outward migration rates that affect the individual cohorts. From the overall trends in the data for the components of population change, the population is forecasted into the future but with declining statistical confidence as the timescale of the future forecast increases. The derived population forecasts are transformed into projections on household numbers by making various assumptions regarding the formation rate of the different types and sizes of households, again assuming past trends as being indicative of future patterns.

Forecasting population changes is, however, an uncertain process. For example, projections made at the height of the baby boom in 1965 over-predicted the population in 2000 by 16 million (Shaw, 2007). For instance, assuming a constant household size for England of 2.25 suggests an average over estimation of 185,000 households after 8 years (Barker, 2008). Adams and Watkins (2002, pp 103 - 109) suggest that an inherent problem with these projections is that they are based on trends which are difficult to predict. For example, the propensity to live alone may accelerate or decelerate but the rate of this change will not necessarily be detected in published statistics; thus there is the potential for overestimation of growth (Gallent, 2005). Other commentators suggest, however, that projections may have been underestimated because the importance and rate of reductions in household house have been underestimated (see Holmans, 2001)

Both over estimating and under estimating the number of houses required could have significant repercussions in the regional economy: not enough and the needs of the region's households will not be met, too many may result in vacant properties with all the associated impacts on local communities or may result in the local infrastructure being overwhelmed. Although affordability is essentially a social issue, there are economic consequences such as the effect prices will have on labour mobility in the UK.

4.5 South West Housing Policy

Planning priorities in the South West are more complex than in many other English regions due to the widely differing development pressures and economic circumstances occurring in the region. Managing growth is seen as a priority by many local authorities in the north and east of the region, where they are subject to similar development pressures as in the South East of England (Counsell and Haughton, 2002). Regeneration is a higher priority in many urban areas and in parts of rural Cornwall, yet environmental protection is generally given a high priority because of the South West's reliance on the attractiveness of its countryside and coast for tourism. Another key planning priority, particularly in the far south west, is to secure improvements in transport infrastructure to reduce the impact of issues associated with peripherality.

The Regional Development Agency for the South West published its first regional economic strategy in 1999. The primary aim was to increase the competitiveness of the region both within Europe and further afield in order to increase the sustainable prosperity for the region (Counsell and Haughton, 2002). There was also a focus on sustainability and this was followed with the RPG10, published in 1999 by the South West Regional Planning Conference (the then regional planning body), which again was aimed at encouraging sustainable development whilst protecting the environment and providing prosperity for communities.

One of the primary purposes of regional planning guidance was to determine the region's housing needs. This was achieved using figures derived from national projections, which were then allocated to strategic planning authorities within the South West. Discussions over suitable supply levels dominated the process of preparing the planning guidance in the region (Counsell and Haughton, 2002). Pro-development organisations criticised the draft guidance for constraining levels of growth and those representing the house builders attempted to propose levels of supply in the range 480,000 to 506,850 houses in comparison to the 367,000 houses recommended by the regional planning body. Much of the disagreement derived from the issue of in-migration and as can be seen from the data presented earlier in the chapter, this has a

marked effect on housing demand in Devon, Dorset, Cornwall and Somerset. During the public consultation phase, the examination panel recommended an increase to 407,000 houses, 40,000 more than in the draft document but substantially less than was being promoted by the pro-development organisations. This new figure was then accepted in the 'proposed changes'. However, the regional planning body subsequently rejected the revised figure suggesting that it was not justified and did not fit with national policy on urban renaissance. The final agreed figure was 404,000 (20,200 per annum) and this was published in the RPG10 document.

The distribution of new housing was also a contentious issue. The public examination panel recommended that much of this new housing be sited in Gloucestershire, Wiltshire and the former county of Avon, to meet expected increases in jobs in these areas and which were seen as economic drivers of the region (Counsell and Haughton, 2002). Nonetheless, this was met with very strong opposition and South Gloucestershire local authority attempted to disassociate itself from the draft regional planning guidance.

Regional planning guidance documents have now been supplanted by regional spatial strategies as discussed in the previous section. The *South West Regional Housing Strategy 2005-2016* (South West Housing Body, 2005), identifies ways in which increased demand for housing can be addressed. It focuses largely on the provision of affordable housing and sets out a framework for regional housing investment. This document supports both the report from the Regional Development Agency detailing the development of sustainable communities (Regional Development Agency, 2006) and also the *Regional Planning Guidance for the South West* (Department for Transport, Local Government and the Regions, 2001). The regional spatial strategy has now passed through the draft stage and the Secretary of State has issued proposed changes that are in the public examination phase but have not yet been formally approved.

The plan for sustainable communities titled *The Way Ahead* (South West Regional Development Agency, 2006) was developed principally to achieve a better balance between the location of housing and the location of jobs. However, residential location decisions are complex and are influenced not just by proximity to jobs and amenities but are also linked to

issues such as quality of life and whether it is a dual career household (Jarvis, 2003; Green, 1997). Thus, it is extremely difficult to anticipate where future development should take place and at what level. The *Sustainable Communities Plan* (South West Regional Development Agency, 2006) suggests that physical and economic growth should be focussed in the principal urban areas of the South West, which are detailed in Table 4-27. This is primarily to address sustainability issues in addition to preparing for continued growth within the region.

Developing urban areas largely avoids issues of building new infrastructure and amenities and development can be encouraged on brownfield as opposed to greenfield sites. However, there appears to be little evidence indicating whether there will be demand for urban housing. Indeed, the population figures presented earlier in the chapter indicate that the only two areas to lose population in the period 1981 to 2005 were Bristol and Plymouth.

TABLE 4-27 SUB-REGIONS AND PUAS IDENTIFIED IN THE REGIONAL PLANNING GUIDANCE

Sub-region	Main County Areas	Principal Urban Areas in Sub-region
Northern	Former Avon, Gloucestershire, Wiltshire (except south)	Bristol, Bath, Western-super-Mare, Cheltenham, Swindon
South-Eastern	Dorset, southern Wiltshire	Bournemouth, Poole
Central	Eastern Devon, Somerset	Taunton, Exeter, Torbay
Western	Cornwall, northern and western Devon, Isles of Scilly	Plymouth

Source: DTLR (2001)

The Regional Planning Guidance (DTLR, 2001), outlines the levels of additional housing supply that are estimated to meet the needs of the growing regional population. These levels are given in Table 4-28.

TABLE 4-28 PROJECTED ADDITIONAL DWELLINGS PER ANNUM

County	Numbers
Avon	3,700
Cornwall	2,050
Devon	4,300
Dorset	2,650
Gloucs	2,400
Somerset	2,100
Wiltshire	3,000
South West	20,200

Source: DTLR(2001)

4.5.1 Sustainability in the South West

Whilst regional policy has engendered mixed reactions with regard to its effectiveness, it is generally accepted that economic development must be sustainable in the long term in order to avoid economic decline in the future. However, the exact meaning of the term 'sustainable' has been and continues to be the subject of much debate, leading to a degree of vagueness in much of the sustainability policy that has been put forward.

According to projections from the ONS, the South West population is set to grow by 16 percent over the next 25 years, the second highest growth rate of all UK regions. The issue is where they will go, for government sustainability policy focuses on the development of contained communities where people work, live and play and where the use of public transport is maximised (Department for the Environment Food and Rural Affairs, 2005). However, around 33 percent of the region's population lives in what are classed as "rural" areas, the highest percentage of any region in England (South West Regional Development Agency, 2007). It is these rural areas that have seen the largest growth in population over the last 20 years. Furthermore, current research indicates that contained urban communities may not be so easily achieved. Residential location decisions are particularly complex and transcend straightforward spatial concentration of everyday activities. Choosing where to live is not a simple case of reducing commuting distances. Partly because of the increased affordability of private transport, the choice of where to live has become more dependent upon quality of life issues and less dependent upon the location of the workplace (Jarvis, 2003). Even where workplace is an important factor, the fact that many households are dual career households, has made the residential decision making process even more complex (Green, 1997).

An additional concern for the South West is the growth in single occupancy households. The region already has the smallest average household size in the UK and also has a high proportion of residential properties with 4 or more bedrooms (South West Regional Development Agency, 2007). Many are under utilised given the age structure of the regional population, meaning that more new housing will be needed than if the market allocated scarce property more efficiently.

4.6 Conclusion

Regional housing markets have a significant influence on the UK economy, primarily via the effects of tenure structure and price differentials on labour mobility, which in turn affects national levels of unemployment and wages. At the local level, housing markets can influence local levels of population, unemployment and migration of both firms and households.

Regional housing markets in the UK are relatively diverse with large differences in house prices between and within regions. In general, housing in the south and west of England tends to be more expensive than that in the rest of the UK with the least expensive housing found in the North East. Tenure structure, relative house prices and employment opportunities influence the migration of households with flows tending to move from regions with high house prices to regions with lower house prices. Households in areas with relatively high proportions of owner-occupiers and/or relatively high proportions of social renters tend to be less mobile than in areas with a relatively high proportion of private renters. Supply has not matched demand, and thus house prices have risen and the ratio of house prices to average income has increased in all areas.

The impact of regional economic disparities on the UK economy at national, regional and sub-regional level has been the subject of both academic research and government policy since the early part of the last century. Nonetheless, regional housing policy set by regional housing bodies is a fairly recent phenomenon, becoming part of the UK policy framework in the 1990s. Since this time regional governments have been required to produce planning documents that set out the location and quantity of new housing development.

The South West is growing, both in terms of the size of the population and the number of households. This is a particularly significant issue for the regional housing market and the *Regional Planning Guidance for the South West* (Government Office for the South West, 2001) set out levels of net additional housing required in the region in order to meet increasing demand and to address the issue of undersupply. These calculations are based on population projections and forecasts of household formation rates and have been called into doubt due to

the possibilities of over or underestimation (Gallent, 2005). Either situation would have serious consequences for the region with under estimation resulting in insufficient housing and high prices, and over estimation resulting in vacant properties or local infrastructure being overwhelmed. Therefore, assessing the economic impact of the impact of changes in demand and changes in supply is an important part of the process in determining changes to regional housing policy.

Although the impact of increasing housing supply levels have been examined as part of the *Barker Review of Housing Supply* (Barker, 2004), there are no regional or sub-regional analyses. Given the importance of the housing market and the likely increases in the South West population, it is important to understand the implications of increasing supply and also the likely outcomes if the issue of under-supply is not addressed. Moreover, since the housing market has both micro and macro impacts, it is useful to have some idea of the distribution of the impacts of changes in supply. Thus, the aim of this study is the construction of an economic model that will help to improve understanding of the operation of the South West housing market. More specifically, the model will be used to investigate the wider economic impact of demographic changes, proposed changes in the level of housing supply as outlined in the RPG document and what impact consumer preferences for housing compared to other non-housing products has on the market.

The regional spatial strategy outlined the areas for new housing development and divided the region into four distinct areas: Northern, South-Eastern, Central and Western. In terms of model development, the problem with the geography was two-fold. Firstly, these four areas cross standard county boundaries. For example, the South-Eastern region includes southern Wiltshire but excludes all other areas of Wiltshire and which are included in the Northern area. Given that economic models rely on current data to produce impact estimates, it is necessary to allocate data to the areas being modelled. This becomes problematic if, as in this case, the boundaries cross standard geographic boundaries used by data publication agencies. It would have been possible to use district level data for some of variables but such data was not available for all variables. An additional problem would have also arisen from the fact that the

RPG report gives the levels of new supply for counties in the South West and not districts and allocating the additional supply to districts would be arbitrary.

A second problem arose from the software chosen to facilitate model development. The mathematical algorithms used within the software were sensitive to differences in the relative magnitudes of the variables used in the model, particularly if the absolute magnitude of some of the variables was less than one whilst others were greater than ten. Since for the variables chosen, the absolute magnitudes differed significantly between the four sub-regions it was necessary to aggregate not only the variables but also the sub-regions. Thus, the geographic areas included in the model were designated North and South: North comprised the Northern and South-Eastern sub-regions identified in the Regional Spatial Strategy and the South comprised the Central and Western sub-regions.

This chapter has established the nature of both regional and sub-regional housing markets in the UK with specific focus on the South West. It has also identified the reasons why it is important to understand the wider economic impact of any changes in these markets, very often the driving force behind the development of economic models. Thus, the next chapter describes the techniques that can be used to construct such economic models.

5 REGIONAL ECONOMIC MODELLING

"...we can't pretend to have a complete understanding of real economies until we can show that the detailed implications of our theories provide sufficiently accurate representations of the real world that we could take our models seriously for forecasting and policy analysis." (Rust, 1997)

One or more of the following reasons generally drive the creation of any economic model:

- To illustrate or test economic theory pertaining to inter-relationships of economic variables;
- To forecast values of economic variables but without necessarily generating understanding of the system;
- To analyse the impact of potential or proposed changes to the economic system.

The primary aim of this study is the development of a regional economic model to assess the impact of increasing the supply of housing in the South West region. Economic modelling has been used as an aid to decision making in the UK planning and policy setting process since the 1960s, although there is still debate regarding the role it should play (Meen and Meen, 2003). One of the most common criticisms of economic modelling is that the mathematical and statistical methods involved are so complex that any resulting model is a 'black box' and thus it is very difficult to trace impacts through the model framework. Yet other commentators suggest that parsimonious models are not necessarily desirable (Hirschman, 1997). This tension indicates that perhaps there is a middle way – a lack of complexity and the model will not capture the inter-linkages, yet too complex and it becomes almost impossible for anyone other than the model builder to understand the mechanics of the model.

There is a high degree of interdependence between regional economies. Specifically,

- Regional economies are often more specialised than national economies;
- They are far more open with less barriers to trade such as tariffs or different currencies;
- Labour and capital are far more mobile at regional level given the lack of legal, political and language barriers.

There are far fewer regional models in comparison to the number of national scale models because access to detailed data is imperative in capturing the inter-linkages between regions and until relatively recently, suitable data was not widely available. For many years, the cost of building regional economic models was prohibitive, limiting their use to governments and other large organisations such as the European Union. With advances in modelling research and increasing availability of computer hardware, models of small regions are becoming more economically viable. The use of regional economic models to support decision-making at a sub-national level is becoming increasingly common. For example, the allocation of European structural funds requires potential recipients to prepare application documents and impact models can be used in a forecasting role to support the applicants' case.

There are now a number of research centres specialising in the construction of regional models, for example, the Welsh Economy Research Unit at the University of Cardiff and the Fraser of Allander Institute at the University of Strathclyde. This has made the use of economic models for impact analysis an affordable option for an increasing range of organisations.

The benefits of using economic models for impact analysis are widely accepted by much of the planning community. Nevertheless, models are approximations of reality and in order to be useful in the assessment of the effectiveness and efficiency of regional policy and/or to assess the impact of expenditure injections, regional economic models must meet the following criteria (Armstrong and Taylor, 2000):

- They must be internally consistent;
- The region must be treated as a set of interdependent elements in order that the full effects of any exogenous shocks on the system can be estimated;
- They need to be sufficiently detailed.

If the model were to be used in the analysis of regional economic development policy, a detailed industrial breakdown of the impact on output and employment would also be required.

The construction of economic models necessitates the selection of simplifying assumptions. The choice of assumption is driven by the nature of the economy, the purpose for which the model is being constructed and the economic view point of the model builder. Since the process of making assumptions means that some of the subtle complexities involved in the operation of economies will inevitably be missing, the choice and justification of assumptions is a vital part of any modelling process. The links between policy variables and the outcomes of the model should be transparent, thus allowing the validity of the results to be assessed (Devarajan and Robinson, 2002). There is also the issue of model selection. This is often driven by the desired outcome of the study or by the form of any existing models since it is very much easier and less expensive to modify an existing model than create a new one, rather than by the characteristics of the situation or the region of interest (Loveridge, 2004).

In summary, for economic impact models to be useful as policy and planning tools, certain features are desirable (Devarajan and Robinson, 2002):

- Policy relevance – models should be able to link values of policy variables to those economic outcomes of interest to policy makers.
- Transparency – links between policy variables and outcomes should be easy to trace and explain.
- Timeliness – policy models should be based on relevant data, implying that they must be implemented with recent data if they are to be used in ongoing policy debates.
- Validation and estimation – estimated model parameters and model behaviour need to be validated for the "domain of application" of the model. That is, the model should achieve accurate results for the domain of potential policy choices under consideration.
- Diversity of approaches – validating results from policy models is greatly strengthened by analysis using a variety of models and at different levels of aggregation. Such diversity tests the robustness of the result and the importance of assumptions made in the various approaches.

The remainder of this chapter presents an overview of the five most common regional modelling techniques and these are Keynesian multipliers, econometric models, input-output tables, social accounting matrices and computable general equilibrium models. The chapter describes both the implementation and the key characteristics of each of the techniques, including an indication of the circumstances in which each is most appropriate and the limitations of each approach. The chapter discusses the reasons for the choice of computable general equilibrium modelling for the development of the South West model, concluding with an overview of available software used in the construction of such models.

5.1 Keynesian Multiplier Analysis

The impact of any economic shock will have a variety of effects on the local economy. Consider, for example, the construction of a new manufacturing plant. It would have short-run effects during its construction and long-term effects during its operation. These impacts can be classified into three main categories:

- the direct effect arising from income accruing to individuals employed in the sector/organisation;
- the indirect effect arising from income accruing from the activities of the sector/organisation but to individuals not directly employed in the sector/organisation;
- the induced effect arising from the expenditure of individuals receiving direct or indirect income from the sector/organisation.

The total effect on the economy is given by the sum of the three effects. Hence, the total effect of the expenditure injection is some multiple of the original expenditure. Rather than approximate each effect individually, the Keynesian multiplier estimates the overall value by which the original expenditure is multiplied to give the total impact.

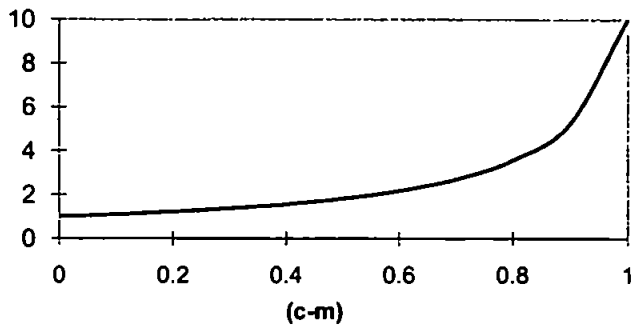
The multiplier is given by the following equation

$$k = \frac{1}{1-(c-m)(1-t)}$$

where (c - m) is the marginal propensity to consume local goods and t is the rate of income tax (Armstrong and Taylor, 2000).

The regional multiplier is highly dependent on the value of (c - m). Even if it is assumed that the tax rate is as low as 10 percent, a small value of (c - m), i.e. 0.1 or less, will result in a multiplier of value slightly greater than one. However, if we increase the marginal propensity to consume local goods to 0.4 (assuming t = 0.1) the multiplier increases to over 1.5 (see Figure 5-1).

FIGURE 5-1 THE REGIONAL MULTIPLIER



The dependency of regional multipliers on the value of the propensity to consume local goods and services is problematic given that there is little regional trade data available. To overcome this problem, the modeller could carry out a survey of the sector(s) of interest or use published data and informed judgement to allocate spending and employment to the appropriate categories (Schaffer, 1999). The former is prohibitively expensive and such sensitive data is rarely given freely, whereas the latter suffers from inherent risk of large errors. Thus, when the impact study must be inexpensive and completed within a short period of time, the most common approach is to utilise multipliers from previous studies, for an example see Bishop (1998).

Although regional multiplier models have proved useful for predicting the effects of investment projects on regional income and employment levels, the approach does have significant weaknesses:

- possible capacity constraints are not accounted for, meaning impacts may be overestimated;
- interregional feedback effects arising from additional income generated by interregional trade are ignored;
- the effects of money and savings are also generally ignored;
- the time frame of income changes is usually not accounted for;
- the approach is highly aggregative, meaning the effects of an expenditure injection on specific sectors cannot be ascertained.

Despite these weaknesses, the Keynesian multiplier method is extremely useful for 'quick and dirty' impact studies when speed and economy are of paramount importance. Regional multiplier models are particularly useful for estimating impacts of expenditure injections on regional income and employment. Nonetheless, policy makers and planners often require detailed predictions in order to assess the efficiency and effectiveness of regional policy decisions and it is in these circumstances that multiplier analysis would be ineffective.

Given the requirements of this study, Keynesian multiplier analysis is not suitable since it only captures the effects of an expenditure injection and is able to model distributional effects in a very limited fashion. It would only be suitable if the aim of this study was to estimate the impact of an expenditure in the new housing construction sector. However, this would provide a very limited picture of the operation housing market since, for example, it does not account for the second hand market or any potential migration effects. A more sophisticated approach to regional modelling uses econometric equations that approximate the behaviour of the major components of the economy. A discussion of this approach follows in the next section.

5.2 Regional Econometric Models

Econometric models comprise a set of structural equations based on economic theory pertaining to the operation of the entire economy or some part of the economy. These models simulate a counterfactual situation and measure the deviation from a baseline, thus evaluating net effects on most of the key macro-economic variables, including growth, employment, investment and trade. Econometric equations are formulated to describe production, demand, prices, wages, trade and so on. The nature of econometric models means that the coefficients and parameters of the structural equations are estimated by means of statistical methods that use either appropriate regional data, data derived from previous studies or data fixed by economic theory (European Commission, 2007). Existing models are frequently adapted as a least-cost approach and thus there are a large number of such models.

The simplest form of econometric model is a basic linear model, such as that given by the following equation:

$$Y_i = \alpha + \beta x_i + e_i$$

for $i = 1,2...N$ observations and where Y_i is the dependent variable, x_i the independent variable and e is an independent error sequence (Bennett and Hordijk, 1986). The independent or exogenous variables on the right-hand side of the equation can be economic, such as the national wage rate or national output, or demographic, such as birth or death rates. Thus, the possibility of incorporating a wide variety of variables raises this technique above the simple Keynesian multiplier.

The simple linear form is generally used for studies with a relatively narrow scope. For example, Coates and Humphreys (2002) developed a model to estimate the economic impact on US cities of postseason matches in professional sports and the following model was the result:

$$y_{it} = \beta x_{it} + \gamma z_{it} + \delta ps_{it} + \mu_{it}$$

where:

- y_{it} is real per capita income in city i in year t,
- x_{it} is a vector of variables that reflect exogenous economic and demographic factors that affect the level of real per capita income in city i in year t,
- z_{it} is a vector variables that reflect the "sports environment" in city i in year t,
- ps_{it} is a vector of variables reflecting postseason appearance by professional sports team located in city i in year t,
- β, γ and δ are vectors of unknown parameters to be estimated
- μ it is a disturbance term.

Although this equation captures the key channels through which sports events are likely to affect the city, the overall impact is estimated for per capita income only. Consequently, the impacts on different industrial sectors and on households cannot be determined from this equation. This is of little concern in this study as only the overall impacts of the sporting events were required. Nevertheless, a model providing such aggregated results is of limited benefit to planners and policy makers as it provides no distributional detail.

An example of an econometric model used by planners and policy makers is the HERMIN model, a macro-econometric model for the regions of the European Union. The overall framework of this model has been applied to many EU regions including Poland and Ireland, where it was used to evaluate the impact of structural funds (Bradley et al., 2003; Bradley and Zaleski, 2003). Unlike the previous example, this model comprises blocks of structural equations: a supply block, an absorption block and an income distribution block. The equations describe each element and the nature of the inter-relationships between them. The supply block, for example, comprises four sectors: manufacturing (a mainly traded sector), market services (a mainly non-traded sector), agriculture and government (or non-market) services. The model is Keynesian, thus the expenditure and income distribution sub-components generate the standard income and expenditure mechanisms of the model. However, the supply block is neoclassical and therefore supply is not driven purely by demand but is also influenced by price and cost competitiveness, where firm location decisions are driven by cost-minimisation considerations

(Bradley and Fitzgerald, 1988). Demand for factors in the manufacturing and market services sectors are derived using a production function, where the capital/labour ratio is sensitive to relative factor prices. Other relative price effects are captured by the incorporation of a structural Phillips curve mechanism in the wage bargaining mechanism.

The remit of the HERMIN model is to provide a tool for the evaluation of the impact of regional EU policy, particularly the impact of the allocation of structural funds. Since structural funds are used for a wide variety of projects across the EU, the manner in which these expenditure injections filter through the economies is complex. Consequently, the flexibility required to model such impacts inevitably leads to a greater degree of complexity than in the model of the impact of sports events, where the expenditure injection was of the same type and only the characteristics of the city varied. It is a general rule of thumb that the greater the degree of detail required in the impact estimates and the more general the remit of the model, the more complex the model will need to be. The size of the model also tends to reflect other concerns such as the availability of suitable data and the time taken to monitor and modify the equations in the model (Whitley, 1994).

Regional econometric models nevertheless avoid many of the limitations of Keynesian multiplier models. For example, more detail can be incorporated into econometric models, both in terms of the level of aggregation of industries and in the nature of the variables incorporated into the model. For example, Keynesian multipliers provide an estimate of the overall value of an impact once indirect and induced effects are accounted for, whereas econometric models trace the impact via producers and households separately. Econometric models will likely provide better estimates as it is possible to match the structure of the regional economy more closely.

There are however weaknesses in the econometric approach. Although more detailed than Keynesian multiplier models, macro-econometric models tend to lack detail on the microeconomic side of the economy. Thus, production, investment and consumption functions may be poor representations of the microeconomic structure of the economy and thus are largely

incapable of providing detailed distributions of the effects of policy shocks (Armstrong and Taylor, 2000). Furthermore, the aggregate relationships represented by the structural equations are not built from consistent demand and cost functions that retain the properties desirable in economic theory (European Commission, 2007). Hence the modeller must choose an underlying theoretical structure for the model. This is a key reason for the greater popularity of other techniques such as regional input-output models, where the theoretical basis of the model is inseparable from the framework (Rey, 2000).

Econometric models are better suited to the analysis of the housing market given their increased level of sophistication. Moreover, they are able to incorporate dynamic elements, an advantage when modelling the housing market. Certainly, these techniques are used for a variety of studies, including models of the UK housing market, with one of the earliest examples developed by Whitehead (1974). Although econometric models are, in principal, a possible choice for this study, the aim was the development of a model to estimate the overall impact of the increase in housing supply in addition to providing an indication of the distribution of this impact. The econometric approach can address part of this remit, but the approach is not particularly suited to providing micro economic detail. This issue can largely be overcome by combining econometric equations with another type of regional model, namely the input output model that is able to provide a greater degree of microeconomic detail. These models are discussed in the following section.

5.3 Regional Input-Output Models

The input-output (IO) approach is based upon a transactions table detailing the economic linkages between industrial sectors, households and the government. The transactions table provides information about the structure of an economy during any given period, although the usual period is a year. From the transaction table, multipliers are calculated and these form the basis of the IO model.

Shown in Figure 5-2 is the general framework of a transaction table.

FIGURE 5-2 INPUT-OUTPUT TRANSACTIONS TABLE

<table>
<tr><td></td><td>Inter-industry transactions</td><td>Consumption</td><td>Investment</td><td>Government</td><td>Exports</td><td>TOTAL OUTPUT</td></tr>
<tr><td>Inter-industry transactions</td><td>Intermediate demand</td><td colspan="4">Final demand</td><td>Total Domestic production</td></tr>
<tr><td>Wages & Salaries</td><td>Compensation of employees</td><td colspan="5" rowspan="4"></td></tr>
<tr><td>Taxes</td><td></td></tr>
<tr><td>Imports</td><td></td></tr>
<tr><td>TOTAL INPUT</td><td></td></tr>
</table>

The inter-industry section of this table shows the sales and purchases of intermediate goods by each industry sector. In this sub-matrix, a typical row, i, shows the sales made by industry i to all other sectors and a typical column, j, details the purchases made by industry j from all other industries. The 'final demand' section itemises the sales of final demand goods made to consumers, the government, investment and export. Other purchases made by industries are labour, capital (detailed in the 'wages and salaries' and 'profits' rows) and imports. Summing across the rows gives gross output for each industrial sector and summing over the columns gives gross inputs (Hewings and Jensen, 1986). The double-accounting system developed by Leontief (1986), requires that gross outputs equal gross inputs. Provided one assumes that production technologies are in fixed proportions and that there are no production capacity

constraints, the transactions table can be used to calculate detailed multipliers (Armstrong and Taylor, 2000).

The following equation describes the IO model:

$$x_i = \sum_{j=1}^{N} a_{ij} x_j + f_i$$

where x_i and x_j represent the output of sectors i and j respectively and a_{ij} are the input-output coefficients. Therefore $a_{ij}x_j$ is the amount of sector i's output required for the production of sector j's output and f_i is final demand. This can be re-written in matrix form and re-arranged to give:

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f}$$

where **x** is the vector of outputs, **f** is the vector of final demands and **A** is the matrix of input-output coefficients. The inverse matrix $(\mathbf{I} - \mathbf{A})^{-1}$ represents a multiplier used to calculate the effect changes in demand have on output.

The sectors included in the model determine whether the model is Type I or Type II. Type I models are those where only the productive industries are considered to be endogenous (West, 1995). If households are assumed to be endogenous, selling labour and buying locally produced goods and services, the IO transaction table is extended to include a household sector. Additional rows and columns to represent households and this is then known as a Type II model. Furthermore, Type I models generate only type I multipliers, i.e. the sum of the direct and indirect effects, whilst Type II models can generate both Type I multipliers and also Type II multipliers that sum the direct, indirect and induced effects (Conway Jr, 1977).

The IO model is highly dependent upon the transactions table and the required data can be sourced in a variety of ways:

- Primary survey;
- Non-survey econometric estimation;

- Hybrid – a combination of primary survey data and non-survey estimation.

Survey-based construction produces a transactions table containing primary data with the advantage that the model is tailored specifically for the region under consideration (Hewings and Jensen, 1988). However, surveys are time consuming and prohibitively expensive, particularly for small studies where funding is limited. Past estimates suggest that this 'bottom-up' survey approach can be up to 20 times more expensive than non-survey techniques (Mattas et al., 1984). Even with the necessary resources, the collection of good quality data cannot be guaranteed and the response rate to survey instruments is frequently poor, resulting in inaccurate transactions tables.

Non-survey methods make use of national input-output tables scaled according to the region in question and are much less expensive than the primary survey approach. This method suffers in the respect that the accuracy of the model will depend upon the degree to which the regional economy differs from that of the national economy (Hewings and Jensen, 1986). Non-survey techniques also tend to undervalue regional trade and the dependence of a region on imports can often be underestimated (Harris and Liu, 1998).

The hybrid approach combines both national tables and regional survey data. In general, this method is implemented by using national level coefficients for those regional sectors that are relatively small and by collecting primary survey data for the major inter-industry transactions (Jensen, 1980). These models have the basic IO table at their core but are supplemented with econometrically estimated variables and Hunt et al., (1996) review many of the econometric techniques used in this manner. The hybrid approach addresses the issue of the expense of primary surveys. Moreover, there is evidence suggesting that incorporating econometric estimation with the IO technique provides more effective forecasts than traditional structural econometric models (Rey, 2000).

Although the construction of the transaction table is a major issue, it does not necessarily follow that a finer degree of disaggregation leads to a better model and previous studies have shown that the utility of input-output models is not necessarily improved with an increase in the

number of sectors (Hewings, 1970). Furthermore, the burden of data collection reduces after the initial construction phase. Research carried out on the Scottish input-output tables by Dewhurst (1992), found that the collection of primary data suffers from diminishing returns, suggesting that once a table has been constructed it can be updated at relatively low cost by only collecting information for the major transactions.

The input-output approach has some key advantages over the standard Keynesian multiplier technique. For example, the internal consistency and the incorporation of detailed industrial linkage data mean that all effects of changes in final demand are taken into account and impacts can be traced through specific sectors. In particular, the advantage of the IO approach is the incorporation of industry detail. Thus, input-output models are most suited to situations where decision-makers need to understand how impacts affect specific industry sectors. Unlike econometric methods, input-output models have clear microeconomic foundations, avoiding the need for the modeller to choose the economic framework of the model.

The IO approach requires that equilibrium is maintained between quantities demanded and quantities supplied and the following assumptions are imposed in order to ensure this:

- prices are assumed constant;
- changes in demand are matched by equivalent changes in supply. Thus there are no limits on supply;
- technology is fixed and production uncertainties are ignored;
- households spend their income in fixed proportions;
- the production technology is assumed to be linear.

Although these assumptions are necessary for the operation of the model, they place relatively strict boundaries on the applicability of the technique. The first assumption implies that estimates produced by the model say nothing about the way prices change following an exogenous shock. Many analysts apply prevailing prices to the volumes produced by the model, but a problem arises in that if prices are adjusting rapidly, the assumption may not hold. The second assumption implies that the supply of inputs is elastic and infinite and hence there

are no supply side constraints, thus ruling out the IO approach as a possibility for this study since the aim is to model changes in the supply of housing. The third assumption implies that production remains constant provided demand does not change and thus capacity constraints are ignored. The fourth assumption implies that household spending patterns are unaffected by income levels, hence if income doubles, the amount that households spend on commodities will also double (Vukina et al., 1995). The final assumption implies that there are no economies or diseconomies of scale (Rey, 2000). The last two are not necessarily a significant problem provided changes in output are marginal. If, for example, a large manufacturing plant opens in a relatively rural area, production input ratios are very likely to change, thus violating the fixed proportion assumption. In reality, this type of event is rare and errors resulting from estimating data in the transactions table will likely have a greater effect on the results of the analysis (Loveridge, 2004).

In order to address some of the limitations of the IO technique, such as the inability to incorporate supply side constraints, econometric methods and IO models have been combined. One particular aim of these econometric IO models is to incorporate dynamic elements. The next section presents a brief overview of this approach.

5.3.1 Econometric Input Output models

The primary aim of building an integrated model is to benefit from the strengths of both approaches whilst simultaneously addressing their respective limitations. The development of econometric input-output models draws its motivation from theoretical as well as practical concerns. For example, inherent in the standard IO model is the assumption of a linear production technology. However, more flexible production functions may be estimated by utilising econometric techniques (Rey, 2000). Similarly, in the standard IO approach there is no feedback mechanism between factor inputs and final demand, yet this can also be achieved by incorporating econometric equations (Dewhurst and West, 1990; West, 1995). Moreover, this type of closure can capture dynamic aspects of the effect of an external shock.

One of the more common mechanisms of model integration has focused on personal consumption. In regional IO models, consumption has either been exogenous in the Type I models or endogenous in the Type II models. A number of modellers have endogenised consumption using econometric equations (Treyz, 1993; West, 1994) and econometric IO models can relax the assumption of income homogeneity thereby allowing for the possibility of different spending patterns (Batey and Weeks, 1989).

Econometric IO models have distinct advantages over models of both types used in isolation. Nevertheless, there are circumstances where integrating the two techniques causes further complications. Of particular relevance to this study is an issue related to the treatment of multiregional linkages. Both IO and econometric models are capable of representing multiregional linkages. Within integrated models, however, both representations cannot coexist and decisions about how best to model these linkages must be made. This is a particularly significant issue for modelling small open areas.

The inability to model supply shocks ruled out the use of an input-output model in this study as the aim is to estimate the impact of an increase in the supply of housing. It would be possible to overcome this issue by incorporating econometric equations but this brings the added burden of choosing an appropriate theoretical framework for the model.

A modelling technique, closely related to econometric IO modelling, that avoids both these issues is the computable general equilibrium approach. This technique is based upon a transactions table known as a social accounting matrix (SAM) that is very similar to an IO table. Although SAMs can be used to generate multipliers and thereby directly model economic impacts, they are frequently used to provide a benchmark data set for computable general equilibrium (CGE) models. These are based on the general equilibrium framework and provide a method of closure for the SAM in much the same way as econometric methods are used to create feedback mechanisms for input-output tables. The next section gives a brief overview of social accounting matrices and that is followed by a description of the CGE approach.

5.4 Social Accounting Matrices

"The most important feature of a social accounting matrix is that it provides a consistent and convenient approach to organising economic data for a country and it can provide a basis for descriptive analysis and economic modelling in order to answer various economic policy questions" (Pleskovic and Treviño, 1985)

Social accounting matrices (SAMs) are closely related to input output matrices and both methods are based on the same set of assumptions. Unlike IO tables, however, SAMs include detailed financial interactions between sectors and households and other final consumption (Loveridge, 2004). They are particularly suited to situations where economic development is the main concern rather than simply economic growth (Leatherman and Marcouiller, 1999). Thus, the development of social accounting matrices has two principle objectives: firstly, to organise information about the economic and social structure of an economy in a specific time period and secondly, to provide the statistical basis for the creation of economic models (King, 1985). The use of the SAM technique as a framework for the organisation of data is useful for primarily descriptive economic analyses; indicating the income distribution, institutional and industrial structure of the region under consideration (Sen, 1996). However, the SAM provides only a 'snap shot' of the overall economic structure that is essentially static and analysis of the operation of the economy and the prediction of the effects resulting from policy interventions requires more than this. Thus, SAMs are most frequently used in conjunction with other modelling techniques such as the CGE approach, which is used to provide the closure mechanism for the SAM.

Like IO tables, SAMs provide a comprehensive accounting structure of production activities. However, where IO tables are focused on industries and their respective relationships with regional output, the SAM approach is based on the household as the relevant unit of analysis and thus extends the accounts matrix to include market mechanisms associated with generating household income. Thus, the focus shifts from the production of regional output to the generation and distribution of household income. This is particularly important in regional

CGE models that focus on both production processes and the economics of household factor supply, commodity demand, and government interaction.

Since the SAM incorporates data regarding production and sales of goods and services, together with detailed household expenditures, incomes, distribution of factor endowments and exogenous sectors, a SAM will record a flow in a variety of ways (Loveridge, 2004). For example, assume that there is an exogenous increase in external demand. This would first have an impact on the production account, resulting in the need for more factors of production from the households and private corporate sectors that own them. The sale of factors to the productive process would result in more income accruing to, and subsequently more demand from, the owners of the these factors. Thus, additional demand is generated from the productive process; more direct and indirect taxes would accrue to the government; there may be more demand for imported inputs into the production process or for general consumption. The whole chain of events is thus observed 'rippling' through the economy, each change generating further changes, and so on.

The construction of the SAM is largely identical to the process followed when constructing an IO and is hence subject to the same considerations regarding the compilation of data such as the method chosen for data collection. Nevertheless, the issues of data quality and quantity are, perhaps, more pressing for the development of a SAM due to the increased number of variables included.

The key difference in the construction of an IO table and a SAM arises from the assumption that total value added for all activities (defined as gross outputs minus intermediate demands) will be equal to aggregate final demand for each commodity (Pyatt and Jeffery, 1985). Value added must be broken down into payments to the different factors and these factor incomes must be paid out to institutions according to the factor services they supply. For example, wages paid to particular types of labour go to the households that supply the corresponding labour services. Hence, total value added maps to the disposable income of each institution and this disposable

income is distributed either to current expenditures or to savings (with the assumption that in aggregate, savings are equal to investment).

One of the principal ways the information in a SAM can be used is through multiplier analysis, thus taking into account all interactions within each step of the process of linkages among incomes, expenditures, and production (King, 1985). The computation of multipliers from the SAM follows the same process as that used to calculate multipliers from IO tables. Multipliers represent one of the policy modelling applications of a SAM that is useful for short-term policy analysis (Pleskovic and Treviño, 1985).

Being similar in both structure and theoretical basis to IO tables, SAMs are based on the same assumptions and share the same limitations. Although many of these limitations can be addressed using econometric equations, the feedback mechanisms are usually implemented via a general equilibrium framework. This overcomes the need for the model builder to choose an appropriate theoretical basis for the model, an inherent problem when using econometric techniques, since the general equilibrium approach uses the price mechanism and market clearing assumptions. Moreover, unlike the IO model which is demand driven, the computable general equilibrium model contains explicit supply constraints, usually embedded in a neoclassical framework (West, 1995).

Given the distributional detail derived from SAM analysis, it is often used when available resource precludes the use of CGE models (Psaltopoulos et al., 2004). So why are CGE models used when SAM multiplier models require less resource and address many of the same distributional aspects? The main issue is that the SAM technique is essentially 'static' resulting from, for example, the assumption of constant prices (Psaltopoulos et al., 2004; Thorbecke, 2000). In practice, it is possible that some sectors in the economy operate at full capacity and some factors of production (e.g. skilled labour) are fully employed. Under these circumstances, the assumption of constant prices breaks down. The advantage of the CGE approach is that prices are endogenously determined in order to generate the set of prices that are consistent with equilibrium in the economy. When an economy is affected by an exogenous shock or a policy

change, a new set of prices is obtained, which, in turn, determine production, consumption, employment and incomes. So, CGE models enhance the SAM framework in that they capture the behaviour of the main actors in response to price changes. The chapter now continues with a discussion of the computable general equilibrium modelling technique.

5.5 Computable General Equilibrium Models

"...the virtue of using applied general equilibrium models is that, once constructed, they yield a facile tool for analysing a wide range of policy changes. Such analysis generates results that either yield an initial null hypothesis or challenge the prevailing view. It may be that subsequently the conclusions from the model are rejected as inappropriate; the assumptions may be considered unrealistic, errors may be unearthed or other factors may undermine confidence in the results. But there will be situations in which the modeller and those involved in the policy decision process will have gained new perspectives as a result of using the model." (Shoven and Whalley, 1992)

The theory of general equilibrium has been a core research area for much of the last century (Greenaway et al., 1993). Walrasian market equilibrium and the conditions for the existence of such an equilibrium are clearly understood and are key to understanding the properties of a market economy. Translating the theory of Walrasian general equilibrium theory into an empirical context and further into a determinative modelling technique took a considerable amount of time, primarily because most general equilibrium models are almost impossible to solve analytically unless extreme simplifying assumptions are employed. Consequently, the solution of empirical general equilibrium models required the development of computational solution algorithms that in turn required suitable software and hardware in order to implement these solutions.

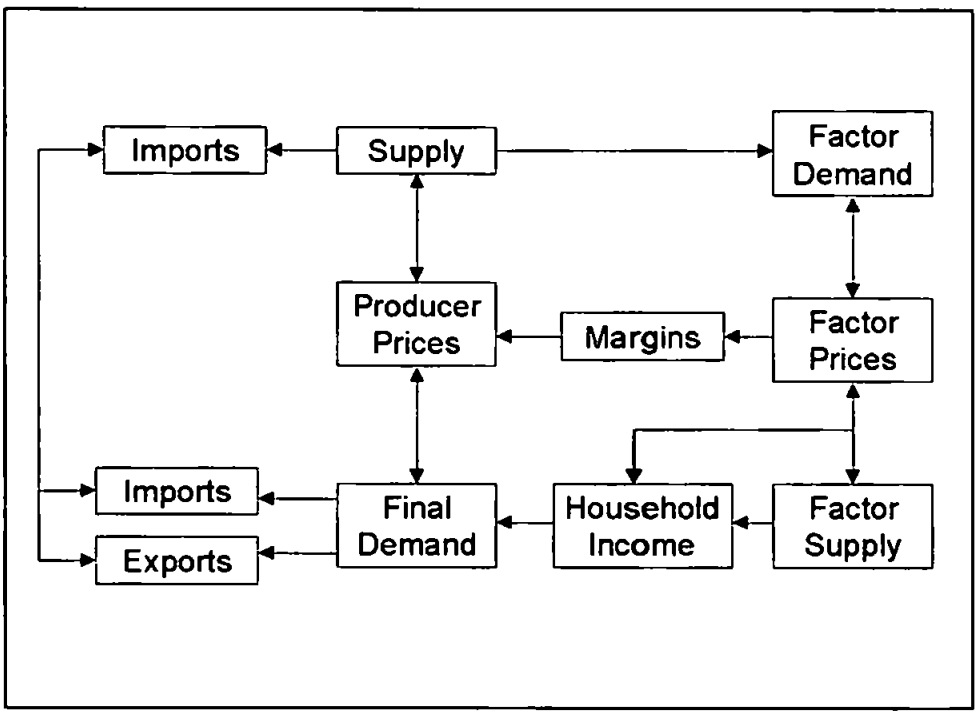
A computable general equilibrium (CGE) model simulates the working of an economy in which prices and quantities adjust to clear all markets. It specifies the behaviour of consumers and producers while including the government as an agent and capturing all transactions in a circular flow of income (Robinson et al., 1990). Hence, the CGE approach is essentially an optimisation technique; it estimates the optimal mix of endogenous variables in response to an exogenous shock. Thus, the process of creating such models involves building an analytically consistent mathematical model of an economy based upon the principle that productive sectors will maximise profits and households will maximise utility. The solution of the model is a set of

prices that ensures equilibrium in all markets (Greenaway et al., 1993). CGE models can incorporate both capacity constraints and dynamic elements and technology coefficients are not fixed. Production is modelled using different functional forms that can incorporate a variety of elasticities of substitution between factors, intermediate inputs and imports, allowing for a greater level of flexibility for specifying production than fixed coefficient approaches.

One of the key advantages of the CGE technique is the detail and flexibility incorporated into the specification of households and household spending. Like production, household consumption is modelled using different functional forms, which is of particular importance when examining issues that have significant consequences for households or are closely related to consumer spending.

The general structure of a regional CGE model is shown in Figure 5-3.

FIGURE 5-3 STRUCTURE OF A REGIONAL CGE MODEL



Source: (Partridge and Rickman, 1998)

Following Figure 5-3, production creates demand for both value-added factors and goods and services used as intermediate inputs. Intermediate inputs consist of both locally produced and imported goods and services. Demand for value-added factors interacts with available supplies

to determine factors prices. In addition, margins such as taxes and transportation costs increase factor costs to firms, thereby increasing product prices. Factor returns and ownership of factor supplies determine personal income. In turn, through various channels, income influences demands for imports and locally produced goods. Equilibrium occurs at prices that equate the demand for goods with the available supplies. It is possible to apply alternative market closures depending on the nature of the economy involved (Partridge and Rickman, 1998). To summarise, a basic CGE must include components representing the linkages between

- production/output and product markets,
- households and factor markets, and
- the government.

The model builder must select the most suitable mathematical equations that match the behaviour of the system and then solve the model simultaneously in order to estimate the set of equilibrium prices. By altering these equations to simulate a change in policy and then solving the system again, the likely effect of the proposed change can be forecasted.

Since this technique is based on the theory of general equilibrium, the framework of empirical CGE models is largely the same regardless of the purpose of the model. For example, the production and household optimisation process is often described using Cobb-Douglas or constant-elasticity-of-substitution functions. The limited variety of functional forms arises from the need to ensure that the functions describing the optimisation process are convex. By using convex functions, it increases the likelihood of finding a unique solution to the model as non-convex functional forms may result in multiple solution or no solution at all.

The non-linear nature of CGE models combined with their scale result in the need for complex solution algorithms. Although in some cases models have been transformed into linear forms through logarithms, such as in the ORANI model (Dixon et al., 1982) for example, the majority are solved using numerical algorithms such as the Newton-Raphson method. Given that the model is built using equations to specify the many economic systems, over-determination is a particular problem (Loveridge, 2004). This issue arises from having more equations than there

are unknowns, the result being a model with no solution. Over-determination can be resolved by imposing assumptions about which variables in the model should be exogenous. These assumptions are known as model closures. For example, three frequently used CGE model closure methods are as follows (Loveridge, 2004):

- assume capital and labour are fixed and so prices adjust until supplies are fully utilised;
- assume factor supplies are not fully utilised;
- assume that factor supplies are fixed and consumption adjusts to match investment requirements.

Although making these model closure assumptions increases the likelihood of solving the model, the CGE technique is highly non-linear making it susceptible the problems of non-existence of a solution and multiple solutions for the same set of data (Loveridge, 2004; Rattso, 1982).

The primary benefit of the CGE approach is that both the supply side and the demand side is explicitly determined with full price response (West, 1995). How well neoclassical general equilibrium theory applies, particularly at the regional level, depends largely on the strength of the small country assumption[9]. Although the CGE technique is theoretically satisfying in that it conforms with micro-economic theory, empirically it may be a different matter. For example, there is a lack of consensus regarding model parameterisation and the necessity of making possibly contentious assumptions (Shoven and Whalley, 1992). The implementation of a CGE model demands the specification of a large number of parameters and coefficients, such as elasticities of production. In the majority of cases, these are based on previous studies or best guesses since very few model builders have the resources to engage in a primary survey to estimate these coefficients directly. This injects a large unknown element into the model that could have a significant impact on the estimates derived from the model. The magnitudes of these effects are difficult to judge, although one of the benefits of the CGE approach is that a

[9] The assumption that a country (or region) is too small to affect world prices, incomes and interest rates.

sensitivity analysis can be carried out that examines the sensitivity of the final model to variations in these parameters (Greenaway et al., 1993).

Since CGE models are based on the basic economic structure of markets, the models used to evaluate different policies need not be different (Koh et al., 1993). Any differences arise primarily in the dimensionality of the various elements of the models, which is usually driven by the policy issue in question (Shoven and Whalley, 1984). CGE models have been constructed to examine a variety of regional issues with many designed to examine regional tax policies: examples include Jones and Whalley (1989), Jones et al. (1985) and Mutti et al. (1989). Nevertheless, as both understanding of the technique and the relevant technology has developed, the use of the technique has become more common and is applied to an increasingly wide range of policies and issues. Although many examples are still focused on the impact of tax policies, such as the model by Cutler and Strelnikova (2004), other uses have included the analysis of environmental policies, such as in the study by Küster et al., (2007) and analysis of the regional housing market, for example the study by Mansur et al., (2002). In general, many regional or sub-regional CGEs tend to be issue-driven rather than universal policy analysis tools.

The CGE modelling approach was chosen to develop the model of the South West housing market because supply-side constraints are explicitly modelled within the CGE framework, the model can provide disaggregated impact analysis and the technique has a sound economic basis. The approach can also incorporate dynamic properties and given the durable nature of housing, this is an important property.

The discussion has so far focused on national and regional scale modelling. This study, however, is examining the impact of exogenous supply shocks at the sub-regional level. Although many of the issues encountered at the sub-regional level are common to regional and national models, there are some issues that apply only to smaller geographic areas. Thus, the chapter continues with a discussion of sub-regional modelling.

5.6 Sub-regional Economic Modelling

Apart from the geographic differences between regional and sub-regional modelling, there is also a distinction in the overall structure and aims of the models. Regional models have primarily been used for general impact analysis and have incorporated detailed industrial sectors, whereas sub-regional models have tended to focus on issues linked to households such as commuting and shopping patterns (Madsen and Jensen-Butler, 2004). However, in the last decade there has been increasing focus on economic interactions of sub-regions, particularly central business districts, other urban areas and rural areas (Renkow and Hoover, 2000). There is also increasing interest in externalities and spillover effects (Acs et al., 1994; Audretsch and Feldman, 1996; Glaeser et al., 1992; Henderson et al., 1995; Parr et al., 2002).

5.6.1 Sub-Regional Flows

One of the reasons for the relatively low number of regional models is the fact that regional economies are more open than national economies, implying close links with other regional economies. This situation is even more pronounced at the sub-regional level and is embodied in the small country assumption, stating that the smaller a region is relative to the rest of the world, the more open will be the economy (West, 1995). Firms and labour are more mobile at the sub-regional level and as a consequence, sub-regions are more integrated than regions (Hoover and Giarratani, 1999).

Location decisions of firms are mainly influenced by the minimisation of costs, thus firms will generally choose to locate in areas where, for instance, the wage level is relatively low. Firms will also choose to locate in areas where they are able to take advantage of external economies of scale that occur in regions with a high concentration of similar firms, since this implies that the input infrastructure and markets will already be in place (Hoover and Giarratani, 1999). Given these relationships, the industrial mix in sub-regional areas is likely to be unique and unlike that at either the regional or national level. Thus, capturing the key linkages is important to generate realistic estimates of the impact of economic shocks. Given the level of openness at the sub-regional level, flows of goods and services and other resources such as labour between

contiguous areas are likely to be significant. Capturing the nature of these flows is therefore important when estimating overall impacts since a change in one sub-region will significantly affect other sub-regions.

Existing sub-regional models tend to be of the urban land use type that are econometric in nature and lack links to the wider sub-regional and regional economies. For this reason these models are most frequently used to examine specific issues such as commuting i.e. travel between place of residence and the place of production or place of demand (Casado-Díaz, 2000; Gitlesen and Thorsen, 2000; Renkow and Hoover, 2000; Wang, 2001). The primary reason for the dominance of these models is the paucity of suitable data required to capture the nature of the sub-regional inter-linkages, which are necessary in the specification of general impact models.

The input-output approach is better suited for use as a general impact analysis tool. The implementation of this technique at the sub-regional level differs very little from implementation at the regional level. However, IO analysis operates on the implicit assumption that the place of residence and place of production (employment) are the same (Madsen and Jensen-Butler, 2004). Whilst this is very unlikely to cause problems at either national or regional level in the UK, this could have serious consequences for the results of any analysis at the sub-regional level. For example, two firms in the same input-output sector have identical production functions in a technical sense, yet one firm may take advantage of its location by purchasing inputs from adjacent areas to a greater degree than the other firm (Hewings, 1970). It could be argued, however, that within a small geographical area, the number of firms in a sector will be small. Thus, the purchasing patterns of any two firms in the same sector are likely to be similar. Nevertheless, significant estimation errors could arise if a lack of suitable data necessitated a high level of aggregation. In this case, one would be dealing with firms with vastly different technical production functions in addition to different spatial input requirements and sales patterns.

Another important problem at the sub-region level occurs when the magnitude of the entries in the inter industry part of the matrix are negligible with value added by local labour and sales to local consumers being the only entries of any importance. If this pattern is found in a majority of sectors and in a large number of sub-regions then one may question the practicality of IO analysis at this level. However, if such a pattern is a feature of some rather than the majority of sub-regions, it may be convenient to 'close' the sub-regional matrices with respect to local consumption and local value-added when attempts are made to measure the impacts of exogenous changes.

The studies by Rickman (1992) and Gillespie et al. (2001) show how input-output models overestimate economy wide impacts of business assistance programmes in the absence of pre-existing excess factor supply. Because of their fixed price and implicit perfect elastic supply assumptions, IO models are incapable of estimating the potential supply induced displacement of other economic activity, which leads to overestimates of net benefits, particularly for job creation, of regional business assistance programs. As Gillespie et al. (2001) note, this is of particular significance in short to medium run time frames.

5.6.2 Scale

Apart from the ways in which urban land-use models and input-output models are able to incorporate sub-regional flows, there is also a difference between the detail incorporated in each type of model. The IO approach is based upon monetary values and focuses on the operation of the commodity market. Therefore, the detail is contained solely in the definition of the commodity markets. By contrast, urban land use models are based on the operation of factor markets or property markets (Johnes and Hyclak, 1999). Consequently, these types of models rarely include any detail in terms of commodities but the household sector has a relatively fine level of disaggregation.

There are also differences in the way the models treat commodity supply and demand. In terms of the land use models, supply and demand in the commodity markets are assumed to be exogenous. In regional input-output models, intra-regional (usually urban) commodity

transactions are usually omitted, chiefly because of the difficulty in acquiring suitable data (Madsen and Jensen-Butler, 2004).

The variety of sub-regional economic models available to the researcher is largely the same as that available at the regional level with some minor differences. For example, at a sub-regional level spatial considerations are often more important since many sub-regional studies deal with issues such as commuting. However, the choice of sub-regional model is largely subject to the same considerations as regional models: namely data restrictions and the purpose of the model.

5.7 Software

The implementation of a computable general equilibrium model requires the use of suitable software to generate a model solution. This section discusses the potential software choices for the execution of the South West housing model.

Computable general equilibrium models were initially constructed and solved using high level programming languages such as FORTRAN (Greenaway et al., 1993). Model builders were required to programme solution algorithms or in some cases, libraries of subroutines were available such as the FORTRAN NAG (Numerical Algorithms Group) library. Thus, the model builder required a high level of programming expertise and it was often the case that the resulting programmes were model-specific, making improvements or generalisations very difficult if not impossible.

Developments in technology have resulted in a greater choice of software available to the CGE model builder. There are general mathematical programming solutions available that incorporate a wide variety of statistical and mathematical routines. However, there are also programmes specifically developed for the solution of large systems of non-linear equations and the solution of general equilibrium models in particular.

The advantages of using software designed specifically for the construction and solution of CGEs are clear, the most significant being the ease with which the models can be built. However, these packages tend to be more restrictive in terms of the variety of functional forms available to the model builder. The more general mathematical programming languages have much more flexibility but require considerably more in the way of programming expertise.

5.7.1 General Mathematical and Statistical Software

There is a variety of mathematical and statistical software available and the most frequently used packages are:

- GAUSS
- Mathematica

- GAMS (General Algebraic Modelling System)

GAUSS is a mathematical and statistical programming language that operates on data in the form of matrices. Many CGE models are structured around data in the form of transactions tables and specifying a model in GAUSS is relatively straightforward. GAUSS is also able to read data from a variety of sources and since the GAUSS programming statements actually resemble their algebraic form, checking the structure of the model is a straightforward process. However, GAUSS does not contain any pre-written algorithms for the solution of CGE models but there are additional application modules that can be utilised.

Mathematica is an extremely sophisticated piece of software that can solve a wide range of mathematical and statistical problems. It can manipulate and solve systems of algebraic equations in addition to providing algorithms for the solution of numerical problems, making it useful for both theoretical and empirical work. Although the algebraic element would be of little use to CGE models, Mathematica does contain pre-programmed algorithms designed to solve large systems of non-linear equations.

In terms of CGE modelling, GAMS (Rutherford, 1998b) is probably the most widely used of the general mathematical and statistical packages. Although GAMS was not specifically designed for this purpose, it was developed for the solution of linear and non-linear programming problems. This is particularly useful for the CGE modeller as large systems of non-linear equations, such as those constituting a CGE model, can be treated as a special form of non-linear programming problem. The GAMS package allows the option of using various general-purpose solvers or application specific solvers. Furthermore, there is a relatively extensive library of applications available including some CGEs. Since GAMS is purely a non-linear programming package, it does lack some of the flexibility of the other general mathematical packages. However, many of the functional aspects of both Mathematica and GAUSS are largely surplus to requirements and therefore GAMS does not suffer excessively in comparison.

5.7.2 Computable General Equilibrium Software

Although computable general equilibrium modelling is a highly specialised area, several software package have been designed specifically for this purpose and these are (Harrigan, 1993):

- HERCULES (High level Economic Representation for Creation and Use of Large Economy wide Systems)
- MPS/GE (Mathematical Programming Software/ General Equilibrium)
- ASAP (A Social Accounting Package)
- MAQM (Maquette)
- GEMPACK (General Equilibrium Modelling PACKage)

The HERCULES software enables the model builder to construct a CGE model based on data stored in a SAM using functional forms that are already 'hard-wired' into the system. When using more generalised mathematical programming software, the construction of a CGE requires the model builder to first define the functional forms being used, find the first order optimality conditions and then code these conditions as part of the model. This is a time consuming and error-prone process and the benefits of avoiding it are considerable. However, this software has a limited number of functional forms that are fully defined within the software. This is not necessarily a problem, as the existence of a solution to a CGE cannot be proven analytically and therefore using standard functional forms is one of the easiest ways to ensure that the model will have a unique solution. In order to solve the model, the HERCULES software calibrates the model parameters automatically using data from the SAM. However, exogenous parameters such as elasticities need to be provided by the user prior to the calibration of the model.

HERCULES uses the GAMS software to provide a solution algorithm, however it is designed to operate on a previous version of GAMS and has been superseded by MPS/GE which runs with the current GAMS software. The MPS/GE software is based on a technique for solving CGE models developed by Scarf and Hansen (1973) and has its own programming language,

allowing for a relatively simple representation of complex models. As with HERCULES, certain functional forms are 'hard-wired' into the system making model construction relatively rapid and bypassing the need for the derivation of first order conditions. Although the range of functional forms is limited, MPS/GE allows for greater flexibility by allowing the model builder to nest functions, thereby creating different levels in the production activity with distinct elasticities for each level. The calibration of the model is automatic however, unlike the software packages centred on a SAM, MPS/GE has no inbuilt requirement that the benchmark data represent an equilibrium before the solution algorithm proceeds. This means that the construction of the benchmark data set has to be undertaken with some care.

ASAP is similar to both HERCULES and also MAQM, as it operates on data in matrix formats. It has similar features to GAUSS but it does contain an algorithm for the solution of systems of non-linear equations. However, unlike HERCULES and MPS/GE there are no functional forms pre-programmed within the system and neither does it automatically calibrate the model. Therefore, ASAP is a much more cumbersome tool for solving large and complex CGEs.

MAQM is modelling tool designed specifically for constructing models belonging to the Maquette class (Bourguignon et al., 1989). This software is menu driven, requiring the user to do little in the way of programming. Many of the structural aspects of the model, such as functional forms, are pre-programmed. The software will even check the benchmark data set and adjust it as necessary to ensure the data represents an equilibrium situation. Despite its high-level user-friendly approach, this software is only useful for a very limited class of models.

The GEMPACK software is particularly suited to large scale models, an example being the ORANI model of the Australian economy (Dixon et al., 1982). Different model closure rules can be specified and overall, the system is extremely flexible, particularly given the size of models that can be accommodated. This flexibility comes at a price since coding the model requires considerable programming expertise.

The software package chosen to develop the model in this study is the MPS/GE software. The regional/sub-regional nature of the model and the fact that it is focused on the operation of the

housing market, means that the scope and dimension of the model is relatively small. Thus, software that can deal with very large models was not necessary. The nature of the model is empirical rather than analytical and in order to increase the likelihood of the existence of a solution to the model, only the standard functional forms (Leontief, CES etc.) are considered. Consequently, high levels of flexibility in terms of specification of functional form are not required and so the general mathematical packages were ruled out. The MPS/GE software offered all that was required in terms of ease of use for solving CGEs, whilst allowing a suitable degree of flexibility in terms of model specification.

5.8 Conclusion

This chapter presented the various techniques used to develop both regional and sub-regional economic models. From the relatively simple Keynesian multiplier approach to the complex CGE technique, each type of model has its uses. For instance, if overall impacts are of paramount importance and industry or distributional impacts are not of primary concern, the Keynesian multiplier is the easiest of the techniques to implement. However, if the consequences of an exogenous shock to demand need to be understood across finely detailed industry sectors, an input-output model would meet the requirements.

The aim of this study was the development of a model to analyse the economic impact of increasing the supply of housing in South West. Thus, the techniques that were unable to model changes to supply were immediately ruled out. As such, the final choice was made between econometric IO models and CGE models. The CGE technique was selected primarily because a clear economic framework is integral to the approach, thus avoiding the need to choose an economic structure for the model, as is necessary when constructing econometric IO models. Computable general equilibrium models also have an advantage over other forms of economic modelling because they avoid the need for excessive aggregation but also account for the interaction of the different macro and micro interrelationships (Iqbal and Siddiqui, 2001).

The nature of modelling software has changed considerably over the years and packages such as MPS/GE, are making the process of developing empirical CGE models much easier than ever before. Nevertheless, the problem with such software is that the structural nature of these languages conceals much of the detail of the functional forms and thus the underlying mathematical framework of the model. One of the primary criticisms of the CGE approach is that it creates 'black box' models that are structurally complex thus inhibiting the ability to trace the impact of a shock through the structure of the model. Such criticism typically rests on the presumption that CGE models contain a large number of variables and parameters and are structurally complex and allowing questionable assumptions to be hidden that ultimately end up driving the results. Thus, the danger with using software such as MPS/GE is that it is difficult

for the model builder to assess where problems might occur. Nevertheless, with careful construction based on clearly stated assumptions, many of these issues can be resolved.

6 A Social Accounting Matrix for the South West

The Social Accounting Matrix (SAM), a technique related to national income accounting, has been used by economists for over two decades as a tool for providing both a prescriptive and descriptive analysis of regional economies (Isard et al., 1998; Sen, 1996). A SAM "is simply defined as a single entry accounting system whereby each macroeconomic account is represented by a column for outgoings and a row for incomings" (Round, 1991). National economic accounts describe the circular flow of income in the economy and social accounting matrices are an extension of these that quantify the relationships between economic and social variables. This allows economists to record and examine the transfers and transactions between all economic agents, be they enterprises, households, workers or government during an accounting period (usually 1 year) (Pyatt and Jeffery, 1985).

Early SAMs were constructed almost exclusively at the national level because of the dependency of the method on large quantities of data. Nonetheless, increasing numbers of applications of this methodology to policy analysis together with greater availability of regional level data encouraged the development of sub-national SAMs (Fannin, 2000). Techniques that combine national level accounts together with secondary regional data, known as hybrid techniques (Isard et al., 1998), have made the construction of sub-national SAMs much more viable by reducing the need for primary regional data and therefore reducing costs.

The SAM is a vital component in the implementation of the CGE technique in real-world applications as it supplies a benchmark data set used in the calculation of model parameters. The quality and timeliness of the data are of the utmost relevance in the assessment of the quality and credibility of the model. The cost of collecting primary data is very often prohibitive and it is usually necessary to rely on the publication of official data. Solutions to this problem do exist in the form of updating techniques that allow the researcher to estimate the details of an updated SAM based upon aggregate totals from published sources. It is these techniques that are used in this study to produce the SAM required for the bi-regional CGE model of the South West.

This chapter continues with a description of the framework of a general SAM and presents the methods available for data reconciliation. The final section of the chapter describes the development of SAMs for both the northern and southern areas of the South West Region.

6.1 The Construction of Social Accounting Matrices

6.1.1 Framework

A SAM is characterised by a square matrix with rows and columns representing incomes and expenditures of all sectors of the economy including producers, households and government (Sen, 1996). A representative framework for a SAM is shown in Figure 6-1. It matches expenditures made by each individual sector to the income for that sector and, following the conventions of double-entry bookkeeping, the total income and expenditures must balance. That is, every row sum and corresponding column sum must be equal, hence

$$\sum_j T_{ij} = \sum_k T_{ki}$$

Where, for example, T_{ij} is the cell entry for column j row i and is therefore is the payment from account j to account i (Robinson et al., 2001). Hence the sum of row i must equal the sum of column i.

FIGURE 6-1 STRUCTURE OF A SOCIAL ACCOUNTING MATRIX

	Activities	Commodity	Factors	Households	Investment	Govt	World	Totals
Activities		output						
Commodity	intermediate inputs			consumption	investment	consumption	exports	
Factors	value added						foreign value added	
Households			distribution of value added			transfer payments	foreign transfer and savings	
Investment				savings				
World		imports						
Govt	use and sales taxes			income and property taxes		inter-government transfer payments		
Totals								

Source: Schwarm and Cutler (2003)

The convention when reading a SAM is that each cell represents a payment from the column account to the row account. The "activities" column represents the production sectors and reading down shows firstly intermediate demand i.e. the commodities required by the industry

for production of output. This is followed by expenditures on factors of production and finally tax payments and other costs of doing business.

Combined, these represent total expenditures required to produce domestic output. The SAM framework requires total expenditures equal total output in each sector. Thus, the sum of each "activities" column must be equal to the sum of the corresponding "activities" row. This row represents domestic output for each production activity.

The household column catalogues the allocation of household income to consumption, savings and tax. The "commodities" row shows the sales of each commodity to intermediate inputs, household consumption, government consumption and exports, whilst the household row represents the sources of income (land, labour and capital) and government transfers including social security. All other rows and columns can be interpreted in a similar fashion.

The SAM framework can be used for the analysis of specific policy areas (Isard et al., 1998). For example, in the case of this study, the focus is the housing market and therefore the SAM can be constructed with production disaggregated to detail the construction of housing provided suitable data is available. Disaggregation of factors of production and household sectors is a fundamental issue in the construction of any SAM. One of the basic principles when selecting factor and household classifications is that the classifications should be chosen to maximise within-group homogeneity relative to between group heterogeneity (Pyatt and Thorbecke, 1976). Levels of income are rarely chosen to identify different factor groups because households in particular can be mobile between income groups (Round, 2003). However, suitable classifications include gender, skill levels or education levels for labour, type of use for land and mobility levels for capital.

Another key concern when choosing classifications for the sectors is to ensure as much flexibility as possible (Round, 2003). In the past, once the classifications had been decided upon it was an irrevocable decision due to the large investments of both time and finances that SAM construction required. However, as computing power and relevant software has become more readily available, emphasis is now being placed on keeping as much detail as possible to

maximise the flexibility of the SAM. Recent developments in this area have tended towards the micro-simulation approach; modelling in detail the behaviour at the household and firm level (Robilliard et al., 2001; Robilliard and Robinson, 2003). This reinforces the need for sufficiently detailed SAMs to avoid compromising their later use.

6.1.2 Compilation and Data Reconciliation Issues

Social accounting matrices are data intensive and suitable data is unlikely to come from one individual source. This is particularly true when the region of study is small and thus the availability of data is often limited. It is sometimes necessary to carry out a primary study, a decision largely dependent upon the quantity and quality of secondary data available for use and also the resources available for model construction. It is important that the researcher make use of all information available to ensure that the resulting SAM be as accurate as possible given that all data generally result from a survey with all the associated weaknesses therein.

In terms of this study, the resources required for a primary survey were not available. However, a set of regional economic accounts are available for the South West, the construction of which was partially based on a primary survey conducted by the South West Economy Centre at the University of Plymouth Business School (South West Economy Centre, 2003). The production of a bi-regional SAM for the South West required the use of these accounts together with other secondary sources of regional data.

There are several issues to be considered when using data collected from a wide variety of sources. For example, the data may be from different time periods or based upon varying geographic definitions (Isard et al., 1998). Synthesising data from separate sources often means that expenditures and incomes do not match and require adjustments to the data in order to make the SAM balance. The issue is then what method to choose to balance the matrix.

Matrix balancing problems can generally be classified as one of two types (Schneider and Zenios, 1990):

Type 1 –

If X is an m x n non-negative matrix and there exists two positive vectors, u and v, of order m and n respectively, then the problem amounts to finding an m x n matrix, X*, which is by some definition 'close to' X, such that

$$\sum_j x_{ij}^* = u_i$$
$$\sum_i x_{ij}^* = v_j$$

Where x_{ij}^* is an element of X* and $x_{ij}^* > 0$ iff $x_{ij} > 0 \ \forall i, j$

Type 2 –

If X is an m x n non-negative matrix, then find an m x n matrix X* which is 'close to' X, such that

$$\sum_j x_{ij}^* = \sum_j x_{ji}^* \qquad \forall i$$

and $x_{ij}^* > 0$ iff $x_{ij} > 0 \ \forall i, j$

These two types define distinct classes of matrix balancing problem (Round, 2003). The first type is more common when dealing with input-output tables where row and column totals are known. The second type is more commonly encountered with SAMs where row and column totals may not be known but the accounting structure of the SAM requires a row sum and its corresponding column sum must balance.

Regardless of the type of problem, the most fundamental issue is to define a measure of 'closeness'. Once this has been done, the problem can be resolved as a constrained minimisation exercise, although the constraints need not necessarily be limited to those defined in the types above. For example, we may wish to set limits on certain elements of the matrix depending upon the information that we have.

It should be noted that although the matrix balancing problem has been described in mathematical terms, relying on the judgement of the researcher to balance the SAM is a valid

approach. However, this method is highly dependent upon the researcher's knowledge of the region, the industry sector and the data quality and is perhaps best used in conjunction with the other mathematical techniques.

Since there are no standard methodologies associated with the "judgement" approach, this discussion will focus on the mathematical algorithms for balancing a matrix. These algorithms can be classified into two broad categories (Fannin, 2000):

- bi-proportional scaling - uses an iterative mathematical approach;
- information theoretic methods - constrained optimization framework, involving the minimisation of a penalty function measuring the deviation of the new SAM from an initial SAM subject to a set of conditions (Canning and Wang, 2004).

Bi-proportional Scaling methods

Bi-proportional scaling methods are probably the most widely used procedure for constrained matrix balancing problems. Of these, the RAS technique is the most common. Although its origins are not clear, it appears to have been independently developed in several different fields such as economics, probability and transportation (Schneider and Zenios, 1990). However, the use of this particular technique in an economic context was first introduced by Stone (1961) and Stone and Brown (1962) where it was used in the development of input-output tables for the UK (McDougall, 1999).

The RAS technique benefits greatly from the simplicity of its application (Toh, 1998). It requires the use of iterative methods to find diagonal matrices $\hat{R}$ and $\hat{S}$ to solve the equation $A^* = \hat{R}\overline{A}\hat{S}$ where $\overline{A}$ and A^* are the existing and new SAMs respectively. For a full description of this approach in matrix notation see Fofanna et al. (2002).

Günlük-Senesen and Bates (1994) show that the RAS method is equivalent to a 'type 1' matrix balancing problem and is therefore more appropriate for balancing input-output tables. Moreover, despite the relative ease of use, this technique has some noteworthy drawbacks. Firstly the RAS approach has no obvious economic foundations although some effort has been

made in order to explain it in economic terms (Fofana et al., 2002; Toh, 1998). The technique also requires that all new row and column totals need to be known in advance in order for there to be a unique solution and there is some difficulty involved in incorporating information on the errors inherent in the known data (Lahr, 2004; Thissen and Loefgren, 1998).

There have been numerous approaches to overcoming these issues, with most taking an information theoretic approach. These techniques, discussed in the following section, are suitable for dealing with 'type 2' matrix balancing problems and are therefore most useful for dealing with SAMs. For a discussion of alternatives to the RAS method for type 1 problems, see Round (2003).

Information Theoretic Methods

The information theoretic or cross-entropy (CE) methods are based on information theory, developed in the middle of the last century by Shannon (1948) and first used in economics by Theil (1967). This approach incorporates errors in variables, constraints on the data and any prior knowledge about the SAM in order to estimate the new SAM. The technique gains on the RAS method through the use of all available information and these gains can be significant (Robinson et al., 2001).

The CE method involves minimising the Kullback-Leibler cross-entropy measure that quantifies the distance between the new and prior data (Kullback and Leibler, 1951). This technique can either be applied to balance a set of data from multiple sources or to update a previous SAM where new row and column totals are known with a degree of certainty. If we look at the latter example, the technique requires that if we start with prior SAM information t_{ij}^{0} and assuming that column sums X are known together with any constants, then the problem can be written as follows:

$$\min_{\{t^1\}} H = \sum_i \sum_j t_{ij}^1 \ln \frac{t_{ij}^1}{t_{ij}^0} = \sum_i \sum_j t_{ij}^1 \ln t_{ij}^1 - \sum_i \sum_j t_{ij}^1 \ln t_{ij}^0$$

Subject to:

$$\sum_j t_{ij}^1 X_j = X_i$$

$$\sum_j t_{ij}^1 = 1_i$$

Where t_{ij}^1 is a new value of cell ij and $0 \leq t_{ij}^1 \leq 1$ (Fofana et al., 2002). The CE technique was first developed for use with information in the form of probabilities hence the requirement for the cell values to be between 0 and 1. However, it is a relatively simple task to modify the technique to deal with SAM transactions: for a formulation see Fofana et al. (2002)

The RAS and CE techniques have been shown to be similar under certain circumstances, specifically when column and row sums are known (Gunluk-Senesen and Bates, 1994). The advantage of the CE approach, however, is that it is a more generalised form of the RAS technique that allows for cell values within the SAM to be fixed in addition to fixed row and column sums (Fofana et al, 2005).

Experimental Evidence

Several researchers have carried out experiments comparing the success of each of the approaches discussed here. Robinson et al. (2001) used both CE and RAS techniques on type 1 problems and found that the CE approach was superior, whereas Günlük-Senesen and Bates (1994) carried out similar experiments but observed more mixed outcomes. However, there are inherent difficulties when conducting experiments of this type as measuring the 'closeness' of the adjusted matrix to the original is related to the choice of minimand. Thus there is inherent bias in any experiment of this type making it difficult to draw objective conclusions (Round, 2003).

Whilst the evidence suggests little difference between the RAS and CE techniques in terms of performance, the CE approach offers a greater level of flexibility required for balancing SAMs and hence this approach is used to balance the SW SAM. However, it should be borne in mind that these techniques should not be a substitute for using carefully assembled data in the first instance (Round, 2003).

Implementation

Both the RAS and CE methods are defined in algebraic terms and thus it is possible to implement either technique using software that has a suitable minimisation algorithm. Spreadsheet-based software, such as Microsoft Excel, has been utilised in the past: a particular example being the SAM built by Schwarm and Cutler (2003) for use with a CGE of cities in Colorado State. Although this is not an example of the true CE method, it did utilise the idea of numeric 'closeness'. The problem with using generic spreadsheet software is the implementation of either technique requires some modification of the technique itself or additional coding within the software. Whilst this is possible, and certainly, spreadsheet-based software is ideal for collating the data, it is not specifically designed for the solution of this type of algebraic problem.

Many software packages exist that incorporate specific algorithms for numerical optimisation. However, there is one software package that has regularly been used to balance SAMs and that is the General Algebraic Modelling System (GAMS). Some examples of studies utilising the GAMS software include Fofana et al. (2002), Robinson et al. (2001) and McDonald and Thierfelder (2004) with other examples being available at www.gams.org. The fact that GAMS is also used to develop computable general equilibrium models is a key benefit of using this package as both the SAM and CGE can be constructed in the same programming language. The GAMS software is an integrated development environment with a group of interrelated solvers designed specifically to solve linear, non-linear and mixed integer optimisation problems (GAMS, 2007), thus making it a very useful package for formulating and solving matrix balancing problems.

The GAMS code used to balance the SAM for the South West, is available online from the Poverty and Economic Research Network (www.pep-net.org). It was developed by Sherman Robinson and Moataz El-Said (2000) and is shown in Appendix 3. A detailed description of the algebra and programme code can also be found in Fofana et al. (2002). The programme uses the CE technique to balance matrices compiled of data from different sources or to update an existing SAM given new row and/or column totals. The SAM is first converted into

proportions, because the CE method operates on data in the form of probabilities. Since the CE process relies on calculating logs of cell values, negative entries must be removed. This is achieved by adding the absolute value of the cell to the value in the transpose of the cell and setting the original cell to zero. The programme creates a new matrix listing the location of the negative values so that they can be recovered once the SAM has been balanced. Zero values are dealt with by adding a small amount to zero value cells. The CE optimisation problem is defined by three equations: an optimisation criterion, a constraint requiring that row and column sums be equal and a constraint requiring that proportions sum to one. The programme also allows the user to fix cell values that are known with certainty.

The next stage in the development of the South West SAM required the construction of an unbalanced matrix. The details of the construction of this matrix now follow.

6.2 The South West Social Accounting Matrix

The South West SAM was constructed in conjunction with the CGE model. Consequently, the evolution of the SAM was driven primarily by the needs of the model. Nonetheless, the SAM could be used to investigate the distribution of the effects resulting from changing the supply of housing in the region. However, as noted in Chapter 5, these estimates would not account for 'dynamic' issues such as the effects of price changes. This study therefore makes use of the SAM in conjunction with the computable general equilibrium model. It would be useful in the future to perhaps develop a more detailed matrix that could be used as a model in its own right. A further discussion of this possibility is considered in the final chapter.

The data set required for this study needed to identify the structure of the two sub-regions, North and South. This was achieved using a top down approach where the first step involved the development of a SAM for the South West region. The regional SAM was then split into the two sub-regions. This approach retained the greatest degree of consistency, since much of the relevant data is available only at the regional level. Thus, it made sense to create a regional SAM that could be divided into the two sub-regions using all available sub-regional data.

This chapter continues with a description of the framework of the South West SAM and the derivation of the elements of the matrix.

6.2.1 Structure

The structure of the regional SAM is shown in Figure 6-2.

FIGURE 6-2 STRUCTURE OF THE INITIAL SW SAM

	Activities	Commodity	Factors	Households	Investment	Govt	World	Totals
Activities		Output (block 1)						
Commodity	Intermediate inputs (block 2)			Consumption (block 10)	Investment (block 12)	Consumption (block 9)	Exports (block 5)	
Factors	Value added (block 3)							
Households			Distribution of value added (block 6)			Transfer payments (block 8)		
Investment				Savings (block 11)				
World		Imports (block 4)						
Govt			Value added tax (block 7)					
Totals								

The layout of this table differs slightly from the example framework given in the early part of this chapter in two ways. Firstly, 'foreign value added' and 'foreign transfer and savings' have been omitted and secondly, all taxes are included in the 'value added tax' cell. The latter is due to an idiosyncrasy of the GAMS/MPSGE software requiring that taxes are paid on the use of factors and taxes are therefore incorporated into the 'factors' column. The omission of foreign value added etc. was a direct result of the assumption that South West factors are not employed outside the region and no factors used within the region are sourced from outside the region. Furthermore, savings and investments were assumed to be entirely domestic: i.e. the region received no investment from outside the region and total investment was equal to total savings, which were also domestic.

The net result of these assumptions is an underestimation of the magnitude of the intra-regional linkages and those between the region and the rest of the UK/world as factors, investment and savings are likely to be more fluid at the regional and sub-regional level. Factor prices are affected since no resources can be sourced from outside the region and no factors receive non-domestic returns, and all investment requirements would have to be met from regional saving,

thereby affecting the savings rate. In the final version of the SAM, neither foreign savings and investments nor domestic savings and investments were included since the model was static.

Government is incorporated into the SAM as a single sector. Given the geographic focus of the model, it would be more realistic to include a two-tier government and hence to include a local government sector and a national government sector. Some suitable data does exist for government at the regional level. However, sub-regional data are patchy making the incorporation of regional government problematic. Although the housing market is linked to the government sector via social housing and housing taxes, this study focuses primarily on the private housing market, and it was for this reason that social housing was not incorporated in the final model.

6.2.2 Data

The basis of the South West SAM is the set of Regional Accounts developed by the South West Economy Centre (South West Economy Centre, 2003). These accounts, in the form of a social accounting matrix, have been constructed to be consistent with standard national accounting systems, in particular the European System of Accounts. Thus, in addition to providing much of the data required for the CGE model, the data is consistent with that produced by the ONS such as the Census. This circumvents many of the problems of inconsistency associated with bringing together data from a variety of sources. However, the SAM could not based solely on the Regional Accounts for two reasons: firstly the CGE model is based upon sub-regions of the South West and therefore sub-regional data is required and secondly the data contained in the Regional Accounts are not sufficiently detailed in some sectors for the requirements of the CGE. Therefore, decisions had to be made with regard to other suitable sources of data.

Since sub-regional data is required and in particular sub-regional household data, the 2001 Census data was the obvious choice. Although the South West Regional Accounts are available for all years from 1999 to 2003, the accounts for 2001 were used to ensure consistency with the 2001 Census. The time period chosen for all further sources of data was 2001 or time periods within this year. The majority of data is sourced from the ONS since the industrial,

occupational and socio-economic definitions used in the accounts are consistent with those used by the ONS. A summary of the data used is shown in Table 6-1.

TABLE 6-1 DATA SOURCES

Description	Time period	Geography	Source
GVA intermediate purchases imports & exports firm spending including taxes household income occupational earnings household spending occupations by industry	2001	SW	SW Regional Accounts
GVA Employment	2001	UAs and CCs	SW Regional Accounts
Households by occupation of the HRP[1] Households by tenure and occupation of HRP Quality[2] of housing by type of accommodation[3]	2001	SW & UAs and CCs	2001 Census
Average household expenditure by component of expenditure and socio-economic group of HRP	2001/02	UK	ONS Family Spending Survey 2001/02
Constructors output by type of work[4]	2001	SW	DTI Construction Statistics Annual Report 2006
Average house price by type[5] of house Number of sales by type of house	2001	SW	HM Land Registry
Housebuilding – permanent dwellings started and completed by tenure	2001	SW & UAs and CCS	Department of Communities and Local Government
Earnings by industry	2001	GB	New Earnings Survey

1 Household representative person

2 Indicated by whether or not the dwelling has central heating

3 Type of house (detached, terraced etc) or apartment (converted house, purpose built building etc)

4 New housing (public and private), other new work (infrastructure, public, private industrial, private commercial) and maintenance and repair

5 Detached, semi-detached, terraced, apartment

6.2.3 Variables

The choice of variables to include in the SAM is dependent upon two factors: the requirements of the CGE and availability of suitable data. Thus, the level of aggregation results partly from the data and from the need to provide a suitable degree of detail.

Housing was included in the SAM via two construction sectors, the construction of new houses and the construction of new apartments, and the housing service sector that captures the consumption of existing housing. Since the primary focus of the model is to estimate the impact of an increase in the supply of new housing, it is important to be able to distinguish between new housing and existing housing. A detailed description of each of the housing sectors follows in section 6.3.1.

A list of the variables is given in Table 6-2.

TABLE 6-2 SAM VARIABLES

Description	Breakdown	SAM Label	Notes
Activities and commodities	Non-service sector	A1	SIC92 A,B,C,D,E and a proportion of F (excludes construction of new dwellings)
	Service sector	A2	SIC92 G to Q
	Construction of new houses	A3	SIC92 proportion of F
	Construction of new apartments	A4	
	Housing service	A5	
Factors	Capital	F1	
	Professional labour	F2	SOC2000 1,2 and 3
	Intermediate occupations and skilled labour	F3	SOC2000 4,5 and 6
	Unskilled/ manual labour	F4	SOC2000 7, 8 and 9
	Good quality houses	F5	Factors employed in the housing service sector
	Poor quality houses	F6	
	Good quality apartments	F7	
	Poor quality apartments	F8	
Households	Professional	H1	
	Intermediate	H2	
	Routine manual	H3	
	Unemployed/unclassified	H4	
Investments		I	
Exports/imports		W	Exports/imports to/from the rest of the world including the rest of the UK
Government		G	

The GAMS program used to balance the SAM requires that the unbalanced matrix be in square format i.e. all SAM elements should be non-negative and row and corresponding column sums must be equal. However, the MPS/GE formulation of the CGE model requires a rectangular SAM (Rutherford, 1998a). This format requires that rows and columns must sum to zero, implying a mix of positive and negative entries in the table, where a negative entry represents expenditure and a positive entry represents receipts. Hence, total expenditures equal total receipts. Once the SAM is built, it then needs to be changed from the square format to the rectangular format.

The remainder of the chapter describes how the regional SAM is constructed and gives details of the data included in the matrix. The process by which the regional level SAM is divided into

two sub-regional matrices is also described together with the method of combining these two SAMs to produce the final matrix used in the CGE model. The chapter concludes with a description of the process followed when converting the matrix from a square to a rectangular format.

6.2.4 Primary assumptions

This section summarises key assumptions that were made in order to facilitate the construction of the SAM. Some of these follow from the SAM framework shown in Figure 6-2 and the remainder are simplicity assumptions or are driven by the availability of data.

Further data driven assumptions were required when manipulating the data to incorporate into the SAM and these are explained at the appropriate points in the next section.

The main assumptions are:

- Production:
    - All sectors with the exception of the housing service sector use the non-service and service commodities as intermediate inputs;
    - No sectors used output from the new housing construction sectors or the housing service sector as intermediate inputs;
    - All sectors with the exception of the housing service sector use capital and all types of labour as factors of production but used none of the housing factors;
    - The housing services sector uses only housing factors in the production of output. This results from the fact that output in the housing service sector is effectively a measure of imputed rent and this will be explained in the next section;
    - Only output from the non-service sector and the service sector is used for investment;
    - None of the output from any of the housing sectors is traded and thus these sectors neither import nor export;

- No foreign factors (i.e. those originating outside the region) are used in production.

- Factors, Households and Government:
  - Government revenue is raised by taxing capital and labour inputs only. Housing factors are not taxed.
  - Government revenue is used to fund purchases of final demand and is distributed to households in the form of transfer payments.
  - Households receive income from returns on the ownership of capital, labour and housing factors in addition to transfer payments.
  - Each household owns only one type of labour since household groups are classified according to occupation.
  - Households use income to fund consumption of final demand and household saving.
  - Households do not receive any income from factor usage outside the region.
- Savings and investment are entirely domestic and thus total savings must equal total investment. Furthermore, total imports must equal total exports.

The next section describes the construction of the SAM in detail and explains how each of the SAM was derived.

6.3 Construction of the South West SAM

6.3.1 Output (block 1)

Housing service sector

Models of the housing market frequently assume that housing stock and housing services are interchangeable, with the standard assumption that one homogenous unit of housing stock provides one unit of housing service (Smith et al., 1988). This assumption allows the abstraction from the tenure choice decision with housing modelled as a single market rather than as a rental and an asset market, thus simplifying the analysis whilst capturing many of the characteristics of the market. Using housing service units also incorporates the nature of housing as a durable product. Since houses are durable, once built homes continue to provide housing service units until they are demolished. When households move from one property to another, they are therefore changing the quantity of housing service that they are consuming.

The standard approach to quantifying housing services is known as imputed rent and the next section discusses how an estimate of imputed rent was achieved in this study.

Imputed Rent

Economic advantage arises from home ownership in two ways: as an income advantage in the sense that rent does not have to be paid and as a return on private investment (Frick and Grabka, 2003). The valuation of these mechanisms is known as imputed rent and this measure therefore captures the expenditure by households on housing but also captures the return on housing received by those same households. In essence, imputed rent assumes that households are renting to themselves.

A variety of methods have been used to estimate the monetary value of imputed rent. There are, however, two main approaches, the market value approach and the opportunity cost approach. The market-value approach treats an owner-occupied household as if it is renting the property to itself (Saunders and Siminski, 2005). Thus, it includes the rental return on the dwelling as part of the income of the owner. It is possible to estimate this form of imputed rent in a variety of

ways such as using the actual rental prices of properties with similar characteristics as the owner occupied properties. However, estimations of imputed rent for national accounts frequently use housing expenditures such as mortgage interest repayments, repairs, and maintenance costs, insurance and utilities (i.e. the costs associated with owning housing) as a proxy measure for rent (Frick and Grabka, 2003).

The opportunity cost approach calculates the cash income foregone by homeowners investing in housing equity rather than financial assets by estimating the financial benefit of converting the equity in one's home into an annuity (Saunders and Siminski, 2005). Hence, the opportunity cost approach assumes that the value of housing services is equivalent to the return on a similarly valued financial investment.

The opportunity cost approach is difficult to implement in practice because it requires a reasonably accurate approximation of the current value of properties (Saunders and Siminski, 2005). This data is not readily available since most housing market data is based on housing sales and purchases. Thus, the market value approach is used as housing expenditure data is more freely available.

The existing South West Regional Accounts (South West Economy Centre, 2003) do not include an explicit measure of imputed rent and therefore it is necessary to estimate values for South West households. The opportunity cost approach was ruled out because of the problems associated with sourcing suitable data. By contrast, data for household expenditure on housing and associated costs is available from the Family Expenditure Survey from the ONS. Thus, average net housing expenditure per household is used as the measure of imputed rent. The definition of this measure is shown in Table 6-3.

TABLE 6-3 DEFINITION OF NET HOUSING EXPENDITURE

Housing (Net)	Gross rent, mortgage interest payments, water charges, council tax,	
	less housing benefit, rebates and allowances received	
	Net rent, mortgage interest payments, water charges, council tax, etc	Mortgage interest payments
		Net rent
		Council tax, domestic rates
		Water and sewerage charges
		Structural insurance
		Other regular housing payments
	Repairs, maintenance and decorations	Central heating repairs
		House maintenance etc (contracted out)
		Paint, wallpaper, plaster, wood
		Doors, electrical & other fittings
		Tools, e.g. paint brushes, spanners
		Other materials, hire of equipment

Source: Family Expenditure Survey 2001-02

The measure of imputed rent is treated slightly differently in this study in that all households purchase final demand from the housing service sector regardless of housing factor endowments. Therefore, the level of purchases of housing service by some households may be higher than the level of income they receive from owning housing factors. In effect, they are renting from other households. Thus, the model captures the rental market, albeit in a very broad sense.

Some existing housing market models incorporate a measure of housing quality. Thus, the movement of houses between quality levels can be modelled and the choices consumers make between different qualities of housing can be captured. The quality of housing is a particular issue in the South West as identified in *The Regional Housing Strategy* (South West Housing Body, 2005) which estimated that 30 percent of the region's housing stock falls into this category. Thus, incorporating a measure of housing quality in the South West model could be of use in assessing how housing quality is valued by consumers. Further discussion of the incorporation of quality into the housing consumption choice in given in Chapter 7, section 7.3 where the issue of hedonic pricing is discussed.

To incorporate housing quality into the model it is first necessary to choose a specific measure of quality. Data from the 2001 Census includes details of certain characteristics of housing occupied by resident households in the South West. Much of this information relates to the

number of bedrooms and bathrooms in a property, which gives an indication of size but not of quality. However, Census data also distinguishes between properties that have central heating and those that do not, so this characteristic is used as the measure of quality of housing. Thus, good quality housing is that with central heating and poor quality housing is that without central heating. The number of households distinguished by quality of housing and size of property (house or apartment) is shown in Table 6-4.

According to data from the Family Expenditure Survey 2000-01 (Office for National Statistics, 2001), the average yearly spend on housing per household in the South West was £3,324. Data for household expenditure on housing by social class or by type of housing for the South West region is not available and so an estimate for household spend by housing type is necessary. The estimation of the total spend on housing in the South West is calculated by using Census data for household numbers and multiplying these by average household spend (see Table 6-4).

TABLE 6-4 TOTAL EXPENDITURE ON HOUSING SERVICES

	Number of households	Expenditure* (£)
Good[1] quality houses	1,585,774	5,270,529,211
Poor quality houses	154,068	512,065,335
Good[1] quality apartments	278,845	926,778,165
Poor quality apartments	44,744	148,712,590
Total	2,063,431	6,858,085,301

1 Good quality housing has central heating and poor quality housing does not have central heating.
Source: ONS - Census 2001

Given the nature of imputed rent, output from the housing service sector is equivalent to expenditure on housing. Consequently, total expenditure on housing services must be equal to the output of the housing service sector. Thus, total output of the housing service sector in the South West in 2001 is estimated to be £6,858 million.

Construction of New Housing

Output from the construction sector is available directly from the Regional Accounts. To disaggregate construction into new housing, data from the Department for Business Enterprise and Regulatory Reform (formerly the Department for Trade and Industry) are used to estimate the percentage of total output accounted for by the construction of new housing (Table 6-5).

TABLE 6-5 CONSTRUCTORS OUTPUT IN THE SOUTH WEST (£ MILLION)

	2001
New housing (public and private)	868
All new work	3042
All maintenance and repair	2834
All work	5877
% of output from new housing	14.8

Source: BERR (DTI) Construction Statistics

Thus, output from the construction of new housing is calculated using the proportion derived from the BERR data and the value of output for the construction sector from the Regional Accounts (see Table 6-6)

TABLE 6-6 OUTPUT OF CONSTRUCTION (£ MILLION)

	Gross output	%
Construction	11,444	100
New housing	1,690	14.8
Construction minus new housing	9,754	85.2

Source: SW Regional Accounts

Housing is distinguished by both quality and size (whether house or apartment). In order to determine output from the construction of new houses and the construction of new apartments, housing sales data from the Land Registry is used as the housing categories used are disaggregated by size. Specifically, regional data detailing average house prices and number of sales by size of dwelling are used to calculate the percentage of total sales accounted for by houses and by apartments (Table 6-7). It is then assumed that output from the construction of houses and apartments can be split according to the relative proportions of sales (see Table 6-8).

TABLE 6-7 VALUE OF HOUSE SALES IN THE SOUTH WEST, 2001

	£ million	%
Houses	3,158	90.1
Apartments	349	9.9
All	3,507	100

Source: Land Registry

TABLE 6-8 OUTPUT OF NEW HOUSING CONSTRUCTION (£ MILLION)

	Gross output	%
New housing	1,690	100
New houses	1,522	90.1
New apartments	1,68	9.9

Source: SW Regional Accounts

Output of Other Industries

Output of all other industries is derived directly from the Regional Accounts. These are aggregated to non-service industries: primary, secondary, manufacturing, energy and water and construction (minus construction of new housing) and services (Table 6-9).

TABLE 6-9 OUTPUT OF OTHER INDUSTRIES (£ MILLION)

	Gross output
Non-service industries	47,897
Services	83,598

Source: SW Regional Accounts

The output block (Block 1) for the South West SAM is given in Table 6-10.

TABLE 6-10 SAM BLOCK 1 - GROSS OUTPUT (£ MILLION)

		Non-service industries (excluding construction from new housing)	Services	New houses	New apartments	Housing service
		C1	C2	C3	C4	C5
Non-service industries (excluding construction from new housing)	A1	47,897	0	0	0	0
Services	A2	0	83,598	0	0	0
New houses	A3	0	0	1,522	0	0
New apartments	A4	0	0	0	168	0
Housing service	A5	0	0	0	0	6,858

6.3.2 Intermediate Inputs (Block 2)

It is assumed that no industry uses new houses as an intermediate input and therefore the only intermediate inputs are services and non-service commodities. The production of housing services uses only factors of production and thus does not use intermediate inputs.

The SAM framework implies that the sum of each row in the activities block (total output by sector) must equal the sum of each corresponding column in the activity block (total inputs by sector). Thus, intermediate inputs to the construction sector are allocated to the construction of new housing and the construction of new apartments using proportions derived from the BERR and Land Registry data (see Table 6-11).

TABLE 6-11 INTERMEDIATE INPUTS IN CONSTRUCTION

	Total construction	Construction of new housing		New houses		New apartments	
	£ million	£ million	% of total construction purchases[1]	£ million	% of new housing purchases[2]	£ million	% of new housing purchases[2]
Non-service industries	5,006	739.4	14.8	666	90.1	74	9.9
Services	1,488	219.8	14.8	198	90.1	22	9.9

1 See Table 7-6

2 See Table 7-8

Source: SW Regional Accounts

Intermediate inputs for all other sectors are sourced directly from the Regional Accounts (see Table 6-12).

TABLE 6-12 SAM BLOCK 2 - INTERMEDIATE PURCHASES BY SECTOR (£ MILLION)

			Purchases by:				
			Non-service industries (excluding construction from new housing)	Services	New houses	New apartments	Housing Service
			A1	A2	A3	A4	A5
Purchases from:	Non-service industries	C1	20,421	8,398	666	74	0
	Services	C2	9,063	23,935	198	22	0
	New houses	C3	0	0	0	0	0
	New apartments	C4	0	0	0	0	0
	Housing Service	C5	0	0	0	0	0

6.3.3 Factor inputs (Block 3)

All industries, with the exception of the housing service commodity, used the primary factors (capital and both types of labour). The housing service sector uses only existing dwellings (good and poor quality houses, good and poor quality apartments) due the nature of imputed rent. The derivation of labour and capital inputs is presented first followed by a description of the allocation of housing factors.

Labour Inputs

The SAM framework requires that purchases of factors be gross of tax and disaggregated by sector and by factor. However, gross value added by sector and by factor are not directly available from the Regional Accounts. However, data showing income and tax for labour by occupation is available (Table 6-13) as is data showing earnings (net of tax) by occupation and by sector (Table 6-16).

It is assumed that the sum of income plus tax is equal to gross value added.

TABLE 6-13 TAX AND EARNINGS BY OCCUPATION (£ MILLION)

	Tax	Income	Total
Professional/managerial	12,113	31,574	43,687
Intermediate	4,430	11,452	15,882
Routine manual	1,998	5,028	7,026

Source: Regional Accounts

Value added is distributed across sectors using proportions derived from data showing earnings by occupation by sector (Table 6-14). Before calculating these proportions, however, it is first necessary to allocate earnings to the construction of new housing. This is achieved using the proportions from the BERR and Land Registry data for the same reason as stated in Section 6.3.2 (see Table 6-15).

TABLE 6-14 EARNINGS BY OCCUPATION (£ MILLION)

	Non-service industries (excluding construction)	Services	Construction
Professional/managerial	5,083	18,285	1,012
Intermediate	3,070	10,037	2,000
Routine manual	2,601	4,907	306

Source: Regional Accounts

TABLE 6-15 LABOUR EARNINGS IN THE NEW HOUSING CONSTRUCTION SECTOR (£ MILLION)

	Construction of new housing		New houses	New apartments
Professional/managerial	150		135	15
Intermediate	295		266	29
Routine manual	45		41	4

Source: Regional Accounts

The estimated earnings (net of tax) from each sector by occupation are shown in Table 6-16.

TABLE 6-16 LABOUR EARNINGS BY SECTOR (£ MILLION)

	Non-service industries (excluding construction from new housing)	Services	New houses	New apartments
Professional/managerial	5,946	18,285	135	15
Intermediate	4,775	10,037	266	29
Routine manual	2,862	4,907	41	4

Source: Regional Accounts

Using this data, the distribution of earnings by sector is calculated (Table 6-17).

TABLE 6-17 PERCENTAGE OF LABOUR EARNINGS BY SECTOR AND BY OCCUPATION (%)

	Non-service industries (excluding construction from new housing)	Services	New houses	New apartments	Total
Professional/managerial	24	75	0.6	0.1	100
Intermediate	32	66	1.8	0.2	100
Routine manual	37	63	0.5	0.1	100

Source: Regional Accounts

Total purchases of labour (earnings plus taxes) by occupation (Table 6-13) are allocated to sectors according to the proportions shown in Table 6-17 to arrive at labour inputs by sector (Table 6-18)

TABLE 6-18 LABOUR INPUTS (£ MILLION)

		Non-service industries (excluding construction from new housing)	Services	New houses	New apartments	Housing service	Total
		A1	A2	A3	A4	A5	
Professional/managerial	F2	10,654	32,764	242	27	0	43,687
Intermediate	F3	5,020	10,552	280	30	0	15,882
Routine manual	F4	2,573	4,412	37	4	0	7,026

Although capital expenditures by sector are available from the Regional Accounts, these figures are not used as they do not indicate the geographic source of capital and since it is assumed that no factors are sourced outside the domestic region, these data are not appropriate. Furthermore, an estimate of tax paid on capital usage is not available from the Regional Accounts. The derivation of capital inputs is therefore explained in following section.

Deriving Capital Inputs

For the South West SAM, it is assumed that households receive income from earnings, from the ownership of capital and from social benefits (transfer payments). Total capital income is then equal to the difference between total household income and the sum of income from earnings plus social benefits. From Regional Accounts data it follows that total income from the ownership of capital is £19,275 million (Table 6-19).

Tax paid on capital ownership as assumed to be the difference between total household tax and total tax paid by labour owning households, which amounts to £2,513 million. This value is added to household capital income to give a total value of capital inputs. Hence, capital input is estimated as £21,788. This total is allocated to sectors using the distribution of output between sectors. The housing service sector is excluded since this uses only housing factors (Table 6-21).

TABLE 6-19 HOUSEHOLD INCOME AND TAX BY SOURCE

	£ million
Household income	73,212
Income from earnings and social benefits	53,937
Income from capital	19,275
Tax paid by all households	21,054
Tax paid by labour owning households	18,541
Tax paid by capital owning households	2,513

Source: Regional Accounts

TABLE 6-20 CAPITAL INPUTS (£ MILLION)

		Non-service industries (excluding construction from new housing)	Services	New houses	New apartments
		A1	A2	A3	A4
Proportion of total output		0.360	0.628	0.011	0.001
Capital inputs	F1	7,836	13,676	249	27

Source: Regional Accounts

Housing Factor Inputs

Total output from the housing service sector (i.e. imputed rent) is distributed amongst housing factors according to proportions of house types derived from Census data. The derivation now follows.

Data is available from the 2001 Census that details the number of households by type and by quality (housing with and without central heating). The average household expenditure on housing per year from the Family Expenditure Survey (Office for National Statistics, 2001) is used together with the number of households of each type to produce an overall expenditure on each type of housing (originally shown in Table 6-4). This is then assumed to be the value of factor inputs into the housing service sector (Table 6-21). The sum of these inputs is equal to the output of the housing service sector since the production of output in this sector uses only housing factors and no other inputs.

TABLE 6-21 TOTAL EXPENDITURE ON HOUSING FACTORS

	Households	Expenditure (£ million)
Good quality houses	1,585,774	5,271
Poor quality houses	278,845	927
Good quality apartments	154,068	512
Poor quality apartments	44,744	149
Total	2,063,431	6,858

Source: ONS - Census 2001 and Family Expenditure Survey

6.3.4 Imports and Exports (Blocks 4 and 5)

Firstly, it is assumed that only the two non-housing sectors trade output. Data is available from the Regional Accounts detailing transactions between the region and the rest of the UK and the rest of the world. Transactions with the rest of the UK and the rest of the world are amalgamated to produce a single export sector and a single import sector (Table 6-22 and Table 6-23).

TABLE 6-22 EXPORTS (£ MILLION)

		Exports
		W
Non-service industries (excluding construction from new housing)	C1	26,781
Services	C2	16,725

Source: Regional Accounts

TABLE 6-23 IMPORTS (£ MILLION)

		Imports
		W
Non-service industries (excluding construction from new housing)	C1	34,145
Services	C2	22,479

Source: Regional Accounts

6.3.5 Distribution of Value Added (Block 6)

All households received income from owning capital, labour and the housing factors. The Regional Accounts do not include a specific measure of income from capital. It is therefore assumed to be the difference between total household income and the sum of income from labour and the income from social benefits (Table 6-24).

TABLE 6-24 HOUSEHOLD INCOME FROM CAPITAL (£ MILLION)

		Capital
		F1
Professional	H1	5,777
Intermediate	H2	2,016
Routine manual	H3	748
Unemployed	H4	10,734

Source: Regional Accounts

Labour income for each household group is derived directly from the Regional Accounts. The accounts data indicate that unemployed households receive some income from labour and so it is assumed that this is income from unskilled labour (Table 6-25).

TABLE 6-25 HOUSEHOLD INCOME FROM LABOUR (£ MILLION)

			Labour		
			Professional/ Managerial	Intermediate	Routine manual
			F2	F3	F4
Households	Professional	H1	31,574	0	0
	Intermediate	H2	0	11,452	0
	Routine manual	H3	0	0	5,028
	Unemployed	H4	0	0	500

Source: Regional Accounts

Income from Housing Factors

The nature of imputed rent means that household expenditure on housing is equivalent to income received from owning housing. Hence, total output from the housing service sector is equal to total household income received from housing factor returns.

Allocating output from the housing service sector to households is accomplished by assuming that income from each housing factor is distributed to households according to proportions of households by occupation. This data is not directly available from any source but is calculated

from Census data for the South West detailing the number of households by occupation and tenure and the number of households by tenure and house type. Thus, from this data it is possible to derive proportions of households by occupation for each house type (Table 6-26).

TABLE 6-26 PERCENTAGE OF HOUSE TYPES OWNED BY EACH TYPE OF HOUSEHOLD (%)

	Professional	Intermediate	Routine manual	Unemployed	total
Good houses	34.0	28.4	18.5	19.1	100
Poor houses	30.3	26.1	18.6	25.0	100
Good apartments	21.0	20.7	19.6	38.6	100
Poor apartments	22.7	21.3	18.7	37.4	100

Source: Census 2001

These proportions are then applied to the total expenditure by house type (Table 6-21) to give the final expenditure on housing and therefore the household income from each type of housing (Table 6-27).

TABLE 6-27 HOUSEHOLD INCOME FROM HOUSING (£ MILLION)

		Good houses	Poor houses	Good apartments	Poor apartments
		F4	F5	F6	F7
Professional	H1	1,790	195	155	34
Intermediate	H2	1,497	192	134	32
Routine manual	H3	974	182	95	28
Unemployed	H4	1,009	358	128	56

6.3.6 Taxes, Government transfers and expenditures (Blocks 7, 8 and 9)

Transfers to households and factor taxes are derived directly from the Regional Accounts. Tax is not defined by factor but rather by household (Table 6-28). Since there is no factor directly linked to unemployed households (although unemployed households do receive some income from unskilled labour) it is necessary to allocate tax paid by these households to a specific factor. Since unemployed households also include unclassified households and receive very little income from labour, it must be assumed that tax is paid on some other factor owned by this group. This implies that unemployed households pay tax on capital since they receive little income from labour and tax is not paid on housing factors (Table 6-29).

TABLE 6-28 TAX BY HOUSEHOLDS (£ MILLION)

	£ million
Professional	12,113
Intermediate	4,430
Routine manual	1,998
Unemployed	2,513
Total	21,054

Source: Regional Accounts

TABLE 6-29 TAX BY FACTOR (£ MILLION)

		Capital	Professional	Intermediate	Routine manual	Total
		F1	F2	F3	F4	
Government	G	2,513	12,113	4,430	1,998	21,054

Transfer payments to households are sourced directly from the Regional Accounts (Table 6-30).

TABLE 6-30 GOVERNMENT TRANSFERS (£ MILLION)

		Gov't
		G
Professional	H1	733
Intermediate	H2	1,471
Routine manual	H3	1,249
Unemployed	H4	1,931
Total		5,384

Source: Regional Accounts

Government expenditure on final demand is calculated as the difference between transfers and tax. All government spending is allocated to services since the Regional Accounts only detailed government spend on services. Therefore, total government spend on services is £17,363 million (Table 6-31).

TABLE 6-31 GOVERNMENT EXPENDITURE ON FINAL DEMAND (£ MILLION)

		Government
		G
Non-service	C1	0
Service	C2	17,363

6.3.7 Household Spending (Block 10)

Total spend by households on all goods and services, apart from housing services, are sourced directly from Regional Accounts. Spending on construction is adjusted using the proportions from the DTI/BERR and Land Registry data to derive spending on the construction of new houses and the construction of new apartments (

Table 6-32).

TABLE 6-32 HOUSEHOLD EXPENDITURE ON GOODS AND SERVICES (£ MILLION)

		Professional	Intermediate	Routine manual	Unemployed
		H1	H2	H3	H4
Non-service industries (excluding construction from new housing)	C1	6,030	2,778	1,393	3,148
Services	C2	19,041	7,549	3,580	7,480
Construction of new houses	C3	27.3	11.3	5.1	17.2
Construction of new apartments	C4	3.0	1.2	0.6	1.9

Source: Regional Accounts, Land Registry and DTI/BERR

Data showing average expenditure per week on housing by socio economic groups from the Family Expenditure Survey (Office for National Statistics 2001) are used to estimate household spending on the housing service commodity. There figures are used to give average expenditure per year (Table 6-33). This is multiplied by the number of households of each type and the percentage of expenditure on housing accounted for by each group is then calculated. It is then assumed that output from the housing service sector can be allocated according to these proportions (Table 6-34).

TABLE 6-33 HOUSING EXPENDITURE BY SOCIO ECONOMIC GROUP

	Professional	Intermediate	Routine manual	Unemployed	total
Average expenditure per household per year	2,339	1,873	1,923	3,014	
Number of households	646,336	553,276	385,244	478,575	
Total household expenditure per year (£ million)	1,512	1,036	741	1,443	4,732
Percentage of total expenditure by household	32.0	21.9	15.7	30.5	
Total output of housing service allocated to households	2,191	1,502	1,074	2,091	6,858

TABLE 6-34 SPENDING ON HOUSING SERVICE BY HOUSEHOLDS (£ MILLION)

		Professional	Intermediate	Routine manual	Unemployed	total
		H1	H2	H3	H4	
Housing service	C5	2,191	1,502	1,074	2,091	6,858

6.3.8 Savings and Investments (Blocks 11 and 12)

Investment is derived directly from the Regional Accounts. It is assumed that there is no investment from new housing or the housing service sectors and therefore all investment is allocated between the non-service and service sectors (Table 6-35).

TABLE 6-35 INVESTMENT (£ MILLION)

		Investment
		I
Non-service industries (excluding construction from new housing)	C1	11,665
Services	C2	1,509
Total		13,174

Source: Regional Accounts

Since total household savings must balance with total investments, the value of total investments is distributed across household groups. It is assumed that household saving is linked to income levels and so investment is distributed across households according to the proportion of total household income received by each household group.

TABLE 6-36 SAVINGS BY HOUSEHOLD TYPE (£ MILLION)

		Professional	Intermediate	Routine manual	Unemployed	
		H1	H2	H3	H4	total
Total income		34,481	14,778	7,556	3,982	60,797
% of total		56.7	24.3	12.4	6.5	
Saving	I	7,472	3,202	1,637	863	13,174

Source: Regional Accounts

This ends the description of the construction of the South West SAM. The unbalanced and subsequent balanced SAM are given on the following pages as is the key for the SAM.

TABLE 6-37 KEY FOR THE SAM

		Description
Activities	A1	Non-service industries (excluding construction from new housing)
	A2	Services
	A3	Construction of new houses
	A4	Construction of new apartments
	A5	Housing service
Commodities	C1	Non-service industries (excluding construction from new housing)
	C2	Services
	C3	Construction of new houses
	C4	Construction of new apartments
	C5	Housing service
Factors	F1	Capital
	F2	Professional
	F3	Intermediate
	F4	Routine manual
	F5	Good houses
	F6	Good apartments
	F7	Poor houses
	F8	Poor apartments
Households	H1	Professional
	H2	Intermediate
	H3	Routine manual
	H4	Unemployed
Investments	I	
Exports/imports	W	Exports/imports to/from the rest of the world including the rest of the UK
Government	G	

	A1	A2	A3	A4	A5	C1	C2	C3	C4	C5	F1	F2	F3	F4	F5	F6	F7	F8	H1	H2	H3	H4	I	W	G	Total
A1	0	0	0	0	0	47897	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47897
A2	0	0	0	0	0	0	83598	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	83598
A3	0	0	0	0	0	0	0	1522	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1522
A4	0	0	0	0	0	0	0	0	168	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	168
A5	0	0	0	0	0	0	0	0	0	6858	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6858
C1	20421	8398	666	74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6030	2778	1393	3148	11665	26781	0	81354
C2	9063	23935	198	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19041	7549	3580	7480	1509	16725	17363	106465
C3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	11	5	17	0	0	0	61
C4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	2	0	0	0	7
C5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2191	1502	1074	2091	0	0	0	6858
F1	7836	13676	249	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21788
F2	10654	32764	242	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43687
F3	5020	10552	280	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15882
F4	2573	4412	37	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7026
F5	0	0	0	0	5271	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5271
F6	0	0	0	0	927	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	927
F7	0	0	0	0	512	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	512
F8	0	0	0	0	149	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	149
H1	0	0	0	0	0	0	0	0	0	0	5777	31574	0	0	1,790	195	155	34	0	0	0	0	0	0	733	40258
H2	0	0	0	0	0	0	0	0	0	0	2016	0	11452	0	1,497	192	134	32	0	0	0	0	0	0	1471	16794
H3	0	0	0	0	0	0	0	0	0	0	748	0	0	5028	974	182	95	28	0	0	0	0	0	0	1249	8304
H4	0	0	0	0	0	0	0	0	0	0	10734	0	0	500	1,009	358	128	56	0	0	0	0	0	0	1931	14716
I	0	0	0	0	0	0	0	0	0	0									7472	3202	1637	863	0	0	0	13174
W	0	0	0	0	0	34145	22479	0	0	0									0	0	0	0	0	0	0	56624
G	0	0	0	0	0	0	0	0	0	0	2513	12113	4430	1998	0	0	0	0	0	0	0	0	0	0	0	21054
Total	55567	93737	1672	184	6859	82042	106077	1522	168	6858	21788	43687	15882	7526	5270	927	512	150	34764	15044	7690	13601	13174	43506	22747	

	A1	A2	A3	A4	A5	C1	C2	C3	C4	C5	F1	F2	F3	F4	F5	F6	F7	F8	H1	H2	H3	H4	I	W	G	Total
A1	0	0	0	0	0	42351	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42351
A2	0	0	0	0	0	0	83329	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	83329
A3	0	0	0	0	0	0	0	1427	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1427
A4	0	0	0	0	0	0	0	0	157	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	157
A5	0	0	0	0	0	0	0	0	0	6861	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6861
C1	9153	3790	483	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12424	3567	1999	2943	11658	34203	0	80273
C2	7680	17570	152	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15648	9511	4276	7509	1516	22009	15732	101619
C3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	590	297	105	435	0	0	0	1427
C4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61	21	20	55	0	0	0	157
C5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2010	1482	1112	2257	0	0	0	6861
F1	5282	15960	182	21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21445
F2	11631	31570	262	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43490
F3	5562	9995	305	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15900
F4	3043	4444	43	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7532
F5	0	0	0	0	5270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5270
F6	0	0	0	0	932	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	932
F7	0	0	0	0	509	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	509
F8	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150
H1	0	0	0	0	0	0	0	0	0	0	6216	30691	0	0	1765	200	157	36	0	0	0	0	0	0	845	39910
H2	0	0	0	0	0	0	0	0	0	0	2084	0	11375	0	1571	193	130	35	0	0	0	0	0	0	1698	17086
H3	0	0	0	0	0	0	0	0	0	0	691	0	0	5010	952	180	95	23	0	0	0	0	0	0	1429	8380
H4	0	0	0	0	0	0	0	0	0	0	9909	0	0	503	982	359	127	56	0	0	0	0	0	0	2184	14120
I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9177	2208	868	921	0	0	0	13174
W	0	0	0	0	0	37922	18290	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56212
G	0	0	0	0	0	0	0	0	0	0	2545	12799	4525	2019	0	0	0	0	0	0	0	0	0	0	0	21888
Total	42351	83329	1427	157	6861	80273	101619	1427	157	6861	21445	43490	15900	7532	5270	932	509	150	39910	17086	8380	14120	13174	56212	21888	

6.4 South West Sub-Regional SAMs

This section summarises the primary assumptions that were made in order to facilitate the construction of the sub-regional SAMs and describes the process of sub-dividing the components of the regional SAM to capture the sub-regional structure.

6.4.1 Primary assumptions

- Commodities, factors and households are all differentiated by sub-region.
- No domestic factors are employed outside the sub-region and similarly no sector employs foreign (originating outside the sub-region) factors.
- Savings and investments are entirely domestic. Thus, total savings equals total investments. Furthermore, total imports equal total exports.
- Sub-regions export and import non-service and services to each other. These flows are assumed to be equal to the difference between total sector output in the sub-region and the sum of sales of outputs to all other agents in the sub-region (intermediate inputs, household, government).

6.4.2 Output and intermediate inputs

The first step involves choosing proportions in which to allocate South West output to the productive sectors in each sub-region. For the non-service and service sectors, data showing the proportion output by sub-region from the Regional Accounts is used (Table 6-38). Data from the Department for Communities and Local Government detailing housing starts by sub-region is used to allocate output from the housing construction sectors (Table 6-39). In terms of the housing service sector, figures drawn from the 2001 Census data giving the relative sub-regional proportions of households are used (Table 6-40).

TABLE 6-38 PERCENTAGE OF OUTPUT BY REGION, 2001

	Non-service industries (excluding construction from new housing)	Services
North	64.3	66.7
South	35.7	33.3
South West	100	100

Source: Regional Accounts

TABLE 6-39 NUMBER OF HOUSING STARTS BY REGION, 2001

	Number	%
North	8,599	55.1
South	6,999	44.9
South West	15,598	100

Source: Department of Communities and Local Government

TABLE 6-40 PERCENTAGE OF HOUSEHOLDS BY REGION (%)

	%
North	57.6
South	42.4
South West	100

Source: ONS Census 2001

Table 6-41 shows the output and intermediate input blocks of the South West SAM.

TABLE 6-41 PRODUCTION ELEMENTS OF THE SOUTH WEST SAM

	A1	A2	A3	A4	A5	C1	C2	C3	C4	C5	....	Total
A1						42,351						R_{A1}
A2							83,329					R_{A2}
A3								1,427				R_{A3}
A4									157			R_{A4}
A5										6,861		R_{A5}
C1	9,153	3,790	483	53	0							
C2	7,680	17,570	152	16	0							
C3												
C4												
C5												
⋮												⋮
Total	C_{A1}	C_{A2}	C_{A3}	C_{A4}	C_{A5}						....	

The social accounting identity requires that a row sum and its corresponding column sum must be equal i.e. the sum of the first row must equal the sum of the first column and so on. This governs the way transactions are allocated to each of the two sub-regions. Using the non-service sector (A1 and C1) as an example, in order to calculate the output for the North, the value in cell (A1,C1) is multiplied by 0.643 since 64.3 percent of total South West output in this

industry is attributable to the North sub-region. Since $R_{A1} = C_{A1}$, to calculate the intermediate purchases made by the non-service industries sector in the North from itself, cell (C1,A1) is also multiplied by 0.643. Similarly, calculating the output from service industries (A2 and C2) in the North, cell (A2,C2) is multiplied by 0.667, as 66.7 percent of total South West output from this sector originates from the North sub-region. Since $R_{A2} = C_{A2}$, then intermediate purchases by Service industries (A2) from non-service industries in the North (C1) is calculated by multiplying cell (C1,A2) by 0.667.

The percentages used to allocate output and intermediate inputs to the North sub-region are shown in Table 6-42.

TABLE 6-42 PROPORTIONS OF SOUTH WEST OUTPUTS AND INTERMEDIATE INPUTS ALLOCATED TO THE NORTH

	A1	A2	A3	A4	A5	C1	C2	C3	C4	C5	....	Tota
A1						0.643						R_{A1}
A2							0.667					R_{A2}
A3								0.551				R_{A3}
A4									0.551			R_{A4}
A5										0.576		R_{A5}
C1	0.643	0.667	0.551	0.551	0.576							
C2	0.643	0.667	0.551	0.551	0.576							
C3												
C4												
C5												
⋮												⋮
Total	C_{A1}	C_{A2}	C_{A3}	C_{A4}	C_{A5}						....	

The output and intermediate inputs for the North are given in Table 6-43 and those for the South are given in Table 6-44

TABLE 6-43 OUTPUTS AND INTERMEDIATE INPUTS FOR NORTH SUB-REGION

	A1	A2	A3	A4	A5	C1	C2	C3	C4	C5
A1						27,232				
A2							55,580			
A3								786		
A4									87	
A5										3,952
C1	5,885	2,528	266	29	0					
C2	4,938	11,719	84	9	0					
C3										
C4										
C5										

TABLE 6-44 OUTPUTS AND INTERMEDIATE INPUTS FOR SOUTH SUB-REGION

	A1	A2	A3	A4	A5	C1	C2	C3	C4	C5
A1						15,119				
A2							27,749			
A3								641		
A4									70	
A5										2,909
C1	3,268	1,262	217	24	0					
C2	2,742	5,851	68	7	0					
C3										
C4										
C5										

6.4.3 Factor Inputs

The allocation of factor inputs to the sub-regions is implemented according to the same reasoning as that used for intermediate inputs. Looking at Table 6-45, for the SAM to balance, $R_{A1} = C_{A1}$, $R_{A2} = C_{A2}$ and so on. Given, for example, that 57.6 percent of output from the South West housing service sector originates in the North sub-region (cell (A5,C5)) then 57.6 percent of each of the total factor inputs to the sector in the South West are used in the North sub-region (cell (F5,A5) to cell (F8,A5)). Similarly, 66.7 percent of South West Services output comes from the North (cell (A2,C2)), and so 66.7 percent of regional factor inputs are used in the North (cell (F1,A2) to cell (F4,A2)).

Table 6-43 details the proportions used to allocate output and factor inputs to the North sub-region.

TABLE 6-45 PROPORTIONS USED TO ALLOCATE OUTPUT AND FACTOR INPUTS TO NORTH SUB-REGION

	A1	A2	A3	A4	A5	C1	C2	C3	C4	C5	....	Total
A1						0.643						R_{A1}
A2							0.667					R_{A2}
A3								0.551				R_{A3}
A4									0.551			R_{A4}
A5										0.576		R_{A5}
⋮												⋮
F1	0.643	0.667	0.551	0.551								R_{F1}
F2	0.643	0.667	0.551	0.551								R_{F2}
F3	0.643	0.667	0.551	0.551								R_{F3}
F4	0.643	0.667	0.551	0.551								R_{F4}
F5					0.576							R_{F5}
F6					0.576							R_{F6}
F7					0.576							R_{F7}
F8					0.576							R_{F8}
⋮												⋮
Total	C_{A1}	C_{A2}	C_{A3}	C_{A4}	C_{A5}	C_{C1}	C_{C2}	C_{C3}	C_{C4}	C_{C5}	....	

The factor inputs for the North are given in Table 6-46 and those for the South are given in Table 6-47.

TABLE 6-46 FACTOR INPUTS USED IN THE NORTH SUB-REGION

	A1	A2	A3	A4	A5	....	Total
⋮							⋮
F1	3,396	10,645	100	12	0		14,153
F2	7,479	21,057	144	15	0		28,695
F3	3,576	6,667	168	21	0		10,432
F4	1,957	2,964	24	1	0		4,946
F5	0	0	0	0	3,036		3,036
F6	0	0	0	0	537		537
F7	0	0	0	0	293		293
F8	0	0	0	0	86		86
⋮							⋮
Total	C_{A1}	C_{A2}	C_{A3}	C_{A4}	C_{A5}	....	

TABLE 6-47 FACTOR INPUTS USED IN THE SOUTH SUB-REGION

	A1	A2	A3	A4	A5	....	Total
⋮							⋮
F1	1,886	5,315	82	9	0		7,292
F2	4,152	10,513	118	12	0		14,795
F3	1,986	3,328	137	17	0		5,468
F4	1,086	1,480	19	1	0		2,586
F5	0	0	0	0	2,234		2,234
F6	0	0	0	0	395		395
F7	0	0	0	0	216		216
F8	0	0	0	0	64		64
⋮							⋮
Total	C_{A1}	C_{A2}	C_{A3}	C_{A4}	C_{A5}	....	

6.4.4 Exports to and imports from the Rest of the World

For those sectors engaged in trade, levels of exports and imports to/from the rest of the UK and rest of the world are allocated according to the distribution of output (Table 6-48). Since 64.3 percent of output in the non-service industry in the South West (cell (A1,C1)) is allocated to the North sub-region, it seems reasonable to assume that 64.3 percent of imports used by the non-service industries in the South West are used in the North sub-region (cell (W,C1)). Similarly, since 66.7 percent of output from the South West service sector comes from the North (cell (A2,C2)), then 66.7 percent of imports to South West Service industries are imported to the North (cell (W,C2)).

According to the SAM identity, $R_W = C_W$ and hence it is assumed that 64.3 percent of exports from South West non-service industries comes from the North (cell (C1,W)) and 66.7 percent of exports from South West service industries comes from the North (cell (C2,W)). The proportions used to allocate exports and imports are shown in Table 6-48.

TABLE 6-48 PROPORTIONS OF SOUTH WEST OUTPUT, IMPORTS AND EXPORTS ALLOCATED TO NORTH SUB-REGION

	....	C1	C2	C3	C4	C5	....	W	....	Total
A1		0.643								R_{A1}
A2			0.667							R_{A2}
A3				0.551						R_{A3}
A4					0.551					R_{A4}
A5						0.576				R_{A5}
C1								0.643		R_{C1}
C2								0.667		R_{C2}
C3										R_{C3}
C4										R_{C4}
C5										R_{C5}
⋮										⋮
W		0.643	0.667							R_W
⋮										⋮
Total	....	C_{C1}	C_{C2}	C_{C3}	C_{C4}	C_{C5}	....	C_W	....	

The resulting levels of exports to and imports from the Rest of the World for the two sub-regions are given in Table 6-49 and Table 6-50.

TABLE 6-49 ROW EXPORTS AND IMPORTS FOR THE NORTH SUB-REGION

	....	C1	C2	C3	C4	C5	....	W
⋮								⋮
C1								21,993
C2								14,680
C3								
C4								
C5								
⋮								⋮
W	....	24,384	12,199				....	

TABLE 6-50 ROW EXPORTS AND IMPORTS FOR THE SOUTH SUB-REGION

	....	C1	C2	C3	C4	C5	....	W
⋮								⋮
C1								12,210
C2								7,329
C3								
C4								
C5								
⋮								⋮
W		13,538	6,019				...	

The calculation of the levels of exports and imports between the two sub-regions is left until all other values have been derived since these figures are assumed to be the difference between total output and the sum of commodity sales to all other agents (productive sectors, households, investment, exports to RoW and government).

6.4.5 Distribution of Value Added

Since it is assumed that domestic firms do not use factors from outside the region and domestic factors are not employed outside the region, total factor inputs (returns) are equal to total factor endowments plus taxes.

Factor returns are allocated to households and to government in the form of factor taxes. Thus, it is possible to calculate the factor tax rate for the entire region by dividing tax paid by factor (cell (G,F1) to cell (G,F8)) by total factor endowments (cell (Total,F1) to cell (Total,F8)). So, for example, the capital tax rate in the South West is 11.9 percent, given by 9909/21445 = 0.119. The relevant tax rate is then multiplied by the total factor returns in each sub-region to give the tax paid on the usage of each factor.

It is assumed that total factor returns in each sub-region are distributed across households in the same proportions that factor returns are distributed across regional households. The distribution of regional factor returns is shown in Table 6-51 and the resulting proportions are shown in Table 6-52..

TABLE 6-51 DISTRIBUTION OF FACTOR TAXES AND ENDOWMENTS IN THE SOUTH WEST

	F1	F2	F3	F4	F5	F6	F7	F8
⋮								⋮
H1	6,216	30,691			1,765	200	157	36
H2	2,084		11,375		1,571	193	130	35
H3	691			5,010	952	180	95	23
H4	9,909			503	982	359	127	56
⋮								⋮
G	2,545	12,799	4,525	2,019				
Total	21,445	43,490	15,900	7,532	5,270	932	509	150

TABLE 6-52 FACTOR TAX RATES AND PROPORTION OF FACTOR ENDOWMENTS, SOUTH WEST (%)

	F1	F2	F3	F4	F5	F6	F7	F8
⋮								⋮
H1	28.99	70.57			33.49	21.46	30.84	24.00
H2	9.72		71.54		29.81	20.71	25.54	23.33
H3	3.22			66.52	18.06	19.31	18.66	15.33
H4	46.21			6.68	18.63	38.52	24.95	37.33
⋮								⋮
G	11.87	29.43	28.46	26.81				
Total	100	100	100	100	100	100	100	100

Thus, for example, 11.87% of returns to capital (F1) are paid in taxes (cell (G,F1)), and 3.22% of returns to capital are paid to routine manual households (cell H3,F1).

Recall from Table 6-46 and Table 6-47 that the total factor returns to factor F1 (capital) for example, is equal to R_{F1} since this total will be the sum of the row F1. The total factor returns for each sub-region are given in Table 6-53.

TABLE 6-53 TOTAL FACTOR RETURNS

	North	South
F1	14,153	7,292
F2	28,695	14,795
F3	10,432	5,468
F4	4,946	2,586
F5	3,036	2,234
F6	537	395
F7	293	216
F8	86	64

To calculate the factor taxes and factor endowments, the percentages in Table 6-52 are applied to the factor returns given in Table 6-53. So, for example, the quantity of tax paid in the North by Intermediate labour is given by 10,432 x 29.43/100 = 2,969. Total household income (totals R_{H1} to R_{H4}) cannot be calculated at this point because households also receive income in the form of transfer payments.

TABLE 6-54 DISTRIBUTION OF VALUE ADDED AND FACTOR TAXES, NORTH

	....	F1	F2	F3	F4	F5	F6	F7	F8	....	Total
⋮											⋮
H1		4,103	20,250			1,017	115	90	21		R_{H1}
H2		1,375		7,463		905	111	75	20		R_{H2}
H3		456			3,290	548	104	55	13		R_{H3}
H4		6,540			330	566	207	73	32		R_{H4}
⋮											⋮
G		1,680	8,445	2,969	1,326						R_G
Total	....	14,153	28,695	10,432	4,946	3,036	537	293	86	....	

TABLE 6-55 DISTRIBUTION OF VALUE ADDED AND FACTOR TAXES, SOUTH

	....	F1	F2	F3	F4	F5	F6	F7	F8	....	Total
⋮											⋮
H1		2,113	10,441			748	85	67	15		R_{H1}
H2		709		3,912		666	82	55	15		R_{H2}
H3		235			1,720	404	76	40	10		R_{H3}
H4		3,369			173	416	152	54	24		R_{H4}
⋮											⋮
G		865	4,354	1,556	693						R_G
Total	....	7,292	14,795	5,468	2,586	2,234	395	216	64	....	

6.4.6 Government transfers and spending

Government receives revenue from taxes and the total (R_G from Table 6-54 and Table 6-55) is redistributed as transfer payments to households and funds consumption of goods and services. The South West transfer payments to each household type (Table 6-56) are allocated to the sub-regions according to proportions of each household type by sub-region derived from Census 2001 data (Table 6-57).

TABLE 6-56 TRANSFER PAYMENTS BY HOUSEHOLD, SOUTH WEST

	£million
H1	845
H2	1,698
H3	1,429
H4	2,184
Total	6,156

TABLE 6-57 PROPORTIONS OF HOUSEHOLDS BY TYPE AND BY REGION (%)

	North	South	South West
H1	63.6	36.4	100
H2	55.9	44.1	100
H3	55.5	44.5	100
H4	52.7	47.3	100

Source: ONS Census 2001

Thus, for example, professional households (H1) in the North receive 845 x 0.636 = £537 million in transfer payments. Table 6-58 and Table 6-59 show the transfer payments for each household type and total household income (this figure includes value added).

TABLE 6-58 TRANSFER PAYMENTS TO HOUSEHOLD AND TOTAL HOUSEHOLD INCOME, NORTH

	....	G	Total[1]
⋮			⋮
H1		537	26,133
H2		949	10,899
H3		793	5,259
H4		1,151	8,899
⋮			⋮
G			14,419
Total	....	64	

1 Total household income including value added.

TABLE 6-59 TRANSFER PAYMENTS TO HOUSEHOLD AND TOTAL HOUSEHOLD INCOME, SOUTH

	....	G	Total[1]
⋮			⋮
H1		308	13,777
H2		749	6,187
H3		636	3,121
H4		1,033	5,221
⋮			⋮
G			7,469
Total	....	64	

1 Total household income including value added.

Once transfer payments have been allocated it is possible to calculate government spend on goods and services because this is equal to the difference between total government revenues and total transfer payments to households. This is shown in Table 6-60.

TABLE 6-60 GOVERNMENT REVENUE AND EXPENDITURE

	North	South
Government revenue	14,419	7,469
Transfer payments	3,431	2,275
Expenditure on goods and services	10,998	4,744

Government only consumes output from the service sector and is shown in Table 6-61 and Table 6-62.

TABLE 6-61 GOVERNMENT EXPENDITURE ON GOODS AND SERVICES, NORTH

	....	G	....	Total
⋮				⋮
C1		0		R_{C1}
C2		10,998		R_{C2}
C3		0		R_{C3}
C4		0		R_{C4}
C5		0		R_{C5}

TABLE 6-62 GOVERNMENT EXPENDITURE ON GOODS AND SERVICES, SOUTH

	....	G	....	Total
⋮				⋮
C1		0		R_{C1}
C2		4,744		R_{C2}
C3		0		R_{C3}
C4		0		R_{C4}
C5		0		R_{C5}

6.4.7 Household Consumption and Savings

Households are assumed to save a proportion of their income with the remainder used for the consumption of final demand. South West household consumption and savings for each household type are allocated to each sub-region using proportions of households by type for the sub-regions derived from Census 2001 data (Table 6-63).

TABLE 6-63 PROPORTION OF HOUSEHOLDS BY REGION OF RESIDENCE

	North	South
Professional	63.6	36.4
Intermediate	55.9	44.1
Routine manual	55.5	44.5
Unemployed	52.7	47.3

Source: ONS Census 2001

The data for the South West is given in Table 6-64. Household consumption is given in rows C1 to C5 and savings are in row I.

TABLE 6-64 SOUTH WEST HOUSEHOLD CONSUMPTION AND SAVING

	....	H1	H2	H3	H4
⋮					
C1		12,424	3,567	1,999	2,943
C2		15,648	9,511	4,276	7,509
C3		590	297	105	435
C4		61	21	20	55
C5		2,010	1,482	1,112	2,257
⋮					
H1					
H2					
H3					
H4					
I		9,177	2,208	868	921
⋮					
Total		39,910	17,086	8,380	14,120

Thus, for example, the amount household group H1 (managerial and professional households) spends in the North on commodity C1 (non-service goods) is calculated by finding 63.6% of 12,424 and so H1 spends £7,902 million on commodity C1. The remainder of the consumption values are calculated in the same way, as are the savings patterns.

The full spending and savings patterns for the North are given in Table 6-65 and for the South are given in Table 6-66.

TABLE 6-65 HOUSEHOLD CONSUMPTION AND SAVING, NORTH

	....	H1	H2	H3	H4
⋮					
C1		7,902	1,994	1,109	1,551
C2		9,952	5,317	2,373	3,957
C3		375	166	58	229
C4		39	12	11	29
C5		1,278	828	617	1,189
⋮					
H1					
H2					
H3					
H4					
I		5,837	1,234	482	485
⋮					
Total		25,383	9,551	4,651	7,441

TABLE 6-66 HOUSEHOLD CONSUMPTION AND SAVING, SOUTH

	....	H1	H2	H3	H4
⋮					
C1		4,522	1,573	890	1,392
C2		5,696	4,194	1,903	3,552
C3		215	131	47	206
C4		22	9	9	26
C5		732	654	495	1,068
⋮					
H1					
H2					
H3					
H4					
I		3,340	974	386	436
⋮					
Total		14,527	7,535	3,729	6,679

6.4.8 Investment

Since savings and investment are assumed to be entirely domestic, then total investment is equal to total household savings. Thus, total investment in the North is equal to total household saving in the North and total investment in the South is equal to total household saving in the South. Since figures for total sub-regional savings have already been derived, these values need to be allocated to sectors as investment. This is achieved using the assumption that the patterns of sub-regional investment by sector are the same as those in the region as a whole. In the

South West, 88.5% (11,658/13,174) of total investment results from the non-service sector with the remainder from the service sector (see Table 6-67). Investment in the North is shown in Table 6-68 and for the South is shown in Table 6-69.

TABLE 6-67 SOUTH WEST INVESTMENT BY SECTOR

	I	%
C1	11,658	88.5
C2	1,516	11.5
C3	0	0
C4	0	0
C5	0	0
Total	13,174	

TABLE 6-68 INVESTMENT BY SECTOR, NORTH

	....	I	....	Total
⋮				
C1		7,113		-
C2		925		-
C3		0		-
C4		0		-
C5		0		-
⋮				
I				8,038[1]
⋮				
Total		8,038		

1 Total household savings

TABLE 6-69 INVESTMENT BY SECTOR, SOUTH

	....	I	....	Total
⋮				
C1		4,545		-
C2		591		-
C3		0		-
C4		0		-
C5		0		-
⋮				
I				5,136[1]
⋮				
Total		5,136		

1 Total household savings

6.4.9 Exports and Imports between the Sub-Regions

The final values calculated are the imports and exports between the two sub-regions. It is assumed that these values are equal to the difference between total output and the sum of sales of commodities to all agents in the SAM (intermediate inputs, households, investment, exports to RoW and government).

Sales of commodities to all agents in the North are shown in Table 6-70. Exports to the South (column S) are therefore equal to the difference between the values in the 'Total' column and the sum of all other values. For example, SC1 is equal to

$$51{,}616 - (5{,}885 + 2{,}528 + 266 + 29 + 7{,}902 + 1{,}994 + 1{,}109 + 1{,}551 + 7{,}113 + 21{,}993 + 0) =$$

$$1{,}245 = S_{C1}$$

TABLE 6-70 SALES OF COMMODITIES, NORTH

	A1	A2	A3	A4	A5	...	H1	H2	H3	H4	I	S	W	G	Total
⋮															
C1	5,885	2,528	266	29	0		7,902	1,994	1,109	1,551	7,113	S_{C1}	21,993	0	51,616
C2	4,938	11,719	84	9	0		9,952	5,317	2,373	3,957	925	S_{C2}	14,680	10,988	67,780
C3	0	0	0	0	0		375	166	58	229	0	0	0	0	786
C4	0	0	0	0	0		39	12	11	29	0	0	0	0	87
C5	0	0	0	0	0		1,278	828	617	1,189	0	0	0	0	3,952

The values for exports from the North to the South are shown in Table 6-71 and the values for exports from the South to the North in Table 6-72.

TABLE 6-71 EXPORTS FROM THE NORTH TO THE SOUTH

	S
C1	1,245
C2	2,837
C3	0
C4	0
C5	0

TABLE 6-72 EXPORTS FROM THE SOUTH TO THE NORTH

	N
C1	-1,245
C2	-2,837
C3	0
C4	0
C5	0

Notice that the values of exports from the South to the North are negative. This is counterintuitive since it would suggest that the region is both a net importer and a net exporter. When the model was balanced, however, the process removed the negative signs although this also could have been addressed by amalgamating the sub-regional export and import sectors with the rest of world sectors thus giving values for total exports and total imports.

It is assumed that exports equal imports and hence imports in each sector are the negative of those shown in Table 6-71 and Table 6-72.

This ends the description of the process of disaggregating the South West SAM into the two sub-regional SAMS. Figure 6-3 shows a summary of the steps taken to split the South West SAM by sub-region.

FIGURE 6-3 SUMMARY OF THE STEPS USED TO ALLOCATE SOUTH WEST TRANSACTIONS TO THE SUB-REGIONS

Allocation of output and intermediate inputs

- Regional accounts used to calculate the proportions of SW output in non-housing sectors by sub-regions
- Housing starts data from Dept of Communities and local Government used to allocate SW output from the housing construction sectors to sub-regions
- Proportions of households by type and by sub-region from Census 2001 used to allocate sub-regional output from the housing service sector

Factor inputs

- Allocated to sub-regional sectors according to the proportion of SW sector output by sub-region

Exports and Imports to/from RoW

- Allocated to sub-regional production sectors according to the proportions of output by sub-region

Distribution of value added

- Factor tax rate in SW applied to sub-regional factor returns to calculate sub-regional factor taxes
- Difference between factor inputs and factor taxes gives factor endowments by sub-region
- Total factor endowments are allocated to households assuming that regional and sub-regional distributions are the same

Government transfers and spending

- SW transfer payments allocation to sub-regions according to the proportions of households by type and by sub-region derived from Census 2001 data (also used to allocate sub-regional output of the housing service sector).
- Sub-regional spending is equal to difference between total sub-regional government revenue (sum of factor taxes) and total sub-regional transfer payments. All government spending allocated to Service sector.

Household Income, Consumption and Saving

- Both SW consumption and saving were allocated to sub-regions according to the proportions of household by type and by sub-region

Investment

- Total sub-regional investment is equal to sub-regional savings. It was assumed that the patterns of investment in the sub-regions as in the South West region.

Exports and Imports Between Sub-Regions

- Export to other sub-region is equal to the difference between total sub-regional output and the sum of sales of commodities to all agents in the SAM (productive sectors, households, investment, exports to RoW and government).
- Imports from other region

6.4.10 Balancing the South West SAMs

Once constructed, the unbalanced sub-regional SAMs are then balanced using the GAMS programme listed in Appendix 3. Due to software licence limitations restricting the number of variables that can be solved for simultaneously, the tables could not be balanced in their entirety meaning that various versions of each of the table had to be balanced where elements of the table are aggregated in order to reduce the number of variables being used in the cross entropy calculations. By running different versions of the aggregate tables through the software, it was possible to generate new tables with very small discrepancies between the row and column sums. The final balancing of the SAMs was carried out by judgement and only very small adjustments to the values were required.

The final SAMs for the North and the South are presented on the following pages.

	A1	A2	A3	A4	A5	C1	C2	C3	C4	C5	F1	F2	F3	F4	F5	F6	F7	F8	H1	H2	H3	H4	I	S	W	G	Total
A1	0	0	0	0	0	27241	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27241
A2	0	0	0	0	0	0	55509	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55509
A3	0	0	0	0	0	0	0	787	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	787
A4	0	0	0	0	0	0	0	0	87	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	87
A5	0	0	0	0	0	0	0	0	0	4001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4001
C1	5903	2490	273	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8087	2313	1325	2011	7468	0	21813	0	51713
C2	5030	11700	82	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10082	6253	2818	4988	976	62	14677	10912	67589
C3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	340	167	50	230	0	0	0	0	787
C4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	11	10	35	0	0	0	0	87
C5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1210	857	602	1332	0	0	0	0	4001
F1	3392	10640	102	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14145
F2	7381	21050	142	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28590
F3	3582	6665	165	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10430
F4	1953	2964	23	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4942
F5	0	0	0	0	3140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3140
F6	0	0	0	0	602	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	602
F7	0	0	0	0	189	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	189
F8	0	0	0	0	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70
H1	0	0	0	0	0	0	0	0	0	0	4106	20421	0	0	1035	130	57	16	0	0	0	0	0	0	0	515	26280
H2	0	0	0	0	0	0	0	0	0	0	1374	0	7425	0	961	123	50	15	0	0	0	0	0	0	0	908	10856
H3	0	0	0	0	0	0	0	0	0	0	451	0	0	3280	562	120	35	13	0	0	0	0	0	0	0	759	5220
H4	0	0	0	0	0	0	0	0	0	0	6529	0	0	323	582	229	47	26	0	0	0	0	0	0	0	1104	8840
I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6530	1255	415	244	0	0	0	0	8444
S	0	0	0	0	0	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62
W	0	0	0	0	0	24410	12080	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36490
G	0	0	0	0	0	0	0	0	0	0	1685	8169	3005	1339	0	0	0	0	0	0	0	0	0	0	0	0	14198
Total	27241	55509	787	87	4001	51713	67589	787	87	4001	14145	28590	10430	4942	3140	602	189	70	26280	10856	5220	8840	8444	62	36490	14198	

	A1	A2	A3	A4	A5	C1	C2	C3	C4	C5	F1	F2	F3	F4	F5	F6	F7	F8	H1	H2	H3	H4	I	S	W	G	Total
A1	0	0	0	0	0	15110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15110
A2	0	0	0	0	0	0	27820	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27820
A3	0	0	0	0	0	0	0	640	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	640
A4	0	0	0	0	0	0	0	0	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70
A5	0	0	0	0	0	0	0	0	0	2860	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2860
C1	3250	1300	210	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4337	1254	674	932	4190	40	12390	0	28600
C2	2650	5870	70	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5566	3258	1458	2521	540	20	7270	4820	34050
C3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	250	130	55	205	0	0	0	0	640
C4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	10	10	20	0	0	0	0	70
C5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	800	625	510	925	0	0	0	0	2860
F1	1890	5320	80	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7300
F2	4250	10520	120	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14900
F3	1980	3330	140	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5470
F4	1090	1480	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2590
F5	0	0	0	0	2130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2130
F6	0	0	0	0	330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	330
F7	0	0	0	0	320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	320
F8	0	0	0	0	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80
H1	0	0	0	0	0	0	0	0	0	0	2110	10270	0	0	730	70	100	20	0	0	0	0	0	0	0	330	13630
H2	0	0	0	0	0	0	0	0	0	0	710	0	3950	0	610	70	80	20	0	0	0	0	0	0	0	790	6230
H3	0	0	0	0	0	0	0	0	0	0	240	0	0	1730	390	60	60	10	0	0	0	0	0	0	0	670	3160
H4	0	0	0	0	0	0	0	0	0	0	3380	0	0	180	400	130	80	30	0	0	0	0	0	0	0	1080	5280
I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2647	953	453	677	0	0	0	0	4730
S	0	0	0	0	0	40	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60
W	0	0	0	0	0	13450	6210	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19660
G	0	0	0	0	0	0	0	0	0	0	860	4630	1520	680	0	0	0	0	0	0	0	0	0	0	0	0	7690
Total	15110	27820	640	70	2860	28600	34050	640	70	2860	7300	14900	5470	2590	2130	330	320	80	13630	6230	3160	5280	4730	60	19660	7690	

6.5 Incorporating the Benchmark Data Into the CGE

This section describes the final stages in the development of the benchmark data set that was used in the CGE model. However, before the final version of the SAM could be constructed, both sub-regional SAMs were converted from square to rectangular format since the model cannot use a benchmark data set in square form. Recall that a rectangular format is such that receipts are recorded as positive elements in the SAM and expenditures are negative elements and column sums and row sums must equal zero. The structure of the two rectangular sub-regional SAMs is shown in Figure 6-4.

FIGURE 6-4 STRUCTURE OF RECTANGULAR SUB-REGIONAL SAM

	Activities	Households	Investment	Gov't	Imports	Exports	Totals
Production	Outputs and intermediate inputs	Consump-tion	Investment	Gov't Consump-tion	Imports	Exports	
Factors	value added	distribution of value added					
Foreign exchange					Price of foreign exchange	Price of foreign exchange	
Investment		Savings	Investment				
Tax	Value added tax			Gov't revenue			
Transfer payments		Transfer payments		Transfer payments			
Totals							

Some values appear twice in order to balance the matrix. For example, household saving is allocated to the investment row account. However, output is sold to investment and thus there needs to be a column account. In order for this to balance, the investment row account makes a payment to the investment column account that exactly equals savings.

The conversion of the SAM from square to rectangular format entails several steps. The first step involves changing all expenditures to negative values, whilst receipts remain positive. The second step requires some transposition and rearrangement of values to fit with the new structure, although no values needed to be changed. The next step involves incorporating the output block into the intermediate inputs block to create a single domestic production block. In

order to incorporate outputs with the intermediate inputs a sector sells to itself, the two figures are added since output is positive and intermediate inputs are negative, thus giving the net output from the sector. So, for example, output from the non-service sector (C1) in the North is £27,241 million and intermediate inputs from the sector to itself are £5,903. So net output is 27,241 - 5,903 = £21,338 million.

Once both matrices were converted to rectangular format and after some experimentation with the model, the most efficient structure for the benchmark data set was found to be a combined North and South SAM with the data for both regions represented in a single matrix. This means that commodities, factors and households are identified by region. So, for example, the housing service commodity in the North (NC5) and the housing service commodity in the South are treated as separate goods. The combined production block of the interim matrix is shown in Table 6-73.

TABLE 6-73 COMBINED PRODUCTION BLOCK FOR NORTH AND SOUTH

	NC1	NC2	NC3	NC4	NC5	SC1	SC2	SC3	SC4	SC5
NC1	21,338	-2,490	-273	-30	0	0	0	0	0	0
NC2	-5,030	43,809	-82	-9	0	0	0	0	0	0
NC3	0	0	787	0	0	0	0	0	0	0
NC4	0	0	0	87	0	0	0	0	0	0
NC5	0	0	0	0	4,001	0	0	0	0	0
SC1	0	0	0	0	0	11,860	-1,300	-210	-23	0
SC2	0	0	0	0	0	-2,650	21,950	-70	-7	0
SC3	0	0	0	0	0	0	0	640	0	0
SC4	0	0	0	0	0	0	0	0	70	0
SC5	0	0	0	0	0	0	0	0	0	2,860

The values on the leading diagonal of the matrix show net output, whilst all other values are intermediate inputs and follow directly from the fully balanced sub-regional SAMs. Thus, for example, the construction of new houses in the North (NC3) purchases £82 million from the Service sector in the North (NC2).

In the final benchmark data set some of the sectors are combined, for example both non-housing sectors are combined. Thus, NC1 and NC2 are amalgamated resulting in the final non-housing sector NM and SC1 and SC2 are also combined in the sector SM. The construction of new

houses and the construction of new apartments are combined to result in a single construction of new housing sector for each sub-region, namely NHS and SHS.

In order to calculate output and intermediate inputs for the combined variables, the column accounts for each of the sectors are added together and then the row accounts are added together. Using the production block and in particular the construction of new houses and new apartments in the North as an example, output in the new sector is equal to 87 + 787 = £874 million. Similarly, the inputs of the sectors are combined since NM and NNS are also grouped into a single sector thus inputs to the construction of new housing are equal to

-273 + -30 + -82 + -9 = -394

The combined sectors are shown in Table 6-74.

TABLE 6-74 COMBINED SECTORS

	NM	NNH	NHS	SM	SNH	SHS
NM	57627	-394	0	0	0	0
NNH	0	874	0	0	0	0
NHS	0	0	4001	0	0	0
SM	0	0	0	29860	-310	0
SNH	0	0	0	0	710	0
SHS	0	0	0	0	0	2860

The two export sectors, i.e. exports to the rest of the world and the exports to the other region, are combined for each sub-region, as are the two import sectors (see Table 6-75).

TABLE 6-75 COMBINES IMPORTS AND EXPORTS

	Exports	Imports
NM	-36,552	36,552
NNH	0	0
NHS	0	0
SM	-19,720	19,720
SNH	0	0
SHS	0	0

Due to the way in which the MPGS/GE software reads the benchmark data set, households could only receive income from one factor of production and from transfer payments. Thus, it

is necessary to allocate value added for each factor to a single household group. For instance, one household group only receives income from capital, one receives income from professional/managerial labour and so on. Thus, one household was created for each factor and total value added is then allocated to the appropriate household group. Some factors, and thus households, are also combined in order to simplify the model. Professional and intermediate labour are combined to produced a skilled labour factor. Similarly, good quality houses and good quality apartments are combined to create a good quality housing factor and the same process was followed to create a poor quality housing factor. Table 6-76 shows the distribution of value added, where NK is capital in the North, NLS is skilled labour in the North, NLU is unskilled labour in the North, NGH is good quality housing in the North, NPH is poor quality housing in the North, SK is capital in the south and so on.

TABLE 6-76 HOUSEHOLD INCOME FROM FACTOR RETURNS

		Households:									
		NK	NLS	NLU	NGH	NPH	SK	SLS	SLU	SGH	SPH
Factors:	NK	12,461									
	NLS		27,845								
	NLU			3,603							
	NGH				3,742						
	NPH					259					
	SK						6,440				
	SLS							14,220			
	SLU								1,910		
	SGH									2,460	
	SPH										400

This is a stylised way in which to represent households and does not characterise the real structure of the economy. Consequently, figures for changes in household income that result from the model cannot be considered to correspond to real households and this is further complicated by the existence of transfer payments, which also contribute to the changes in income.

With new household groups, household spending on final demand has to be reallocated. This is achieved using the proportion of total sub-regional household income by household type to

allocate sub-regional spending. So, for example, using the values shown in Table 6-76, total household income in the North is given by

$$12{,}461 + 27{,}845 + 3{,}603, +3{,}742 + 259 = 47{,}910$$

Thus, capital-owning households receive 26 percent (12,461/47,910) of total household income in the North. Hence, it is assumed that capital-owning households purchase 26 percent of final demand in each sector. Similarly, skilled labour households in the North purchase 58 percent (27,845/47,910) of final demand in each sector.

After experimentation with the data set and the model, it is assumed that government revenue is entirely distributed as transfer payments. Thus, government did not consume any final demand. Furthermore, since the model is static, savings and investments are removed from the SAM. Therefore, since imports and exports must balance, domestic output from the construction of new housing (NNH, SNH) and from the housing service sector (NHS, SHS) is sold only to households. A proportion of domestic output from the non-housing sector (NM, SM) is sold as intermediate inputs to the new housing sector with the remainder being sold to households. Moreover, household income (from factor returns and transfer payments) is spent entirely on consumption. The household consumption patterns are shown in Table 6-77.

TABLE 6-77 HOUSEHOLD SPENDING PATTERNS

	NK	NLS	NLU	NGH	NPH	SK	SLS	SLU	SGH	SPH
NM	-14,886	-33,263	-4,304	-4,470	-309					
NNH	-227	-508	-66	-68	-5					
NHS	-1,041	-2,325	-301	-312	-22					
SM						-7,483	-16,524	-2,219	-2,859	-465
SNH						-180	-397	-53	-69	-11
SHS						-724	-1,599	-215	-277	-45

Since household consumption balances with sector output, this results a mismatch between household income and household consumption (equal to the previous value of government expenditure on final demand). Since all government revenue is now available for transfer payments, government revenue is allocated to households in order to balance total household

income with total household spending. The full derivation of these values is shown in Table 6-78.

TABLE 6-78 HOUSEHOLD CONSUMPTION AND TRANSFER PAYMENTS

	Household consumption:										
	NK	NLS	NLU	NGH	NPH	SK	SLS	SLU	SGH	SPH	Total
NM	14,886	33,263	4,304	4,470	309						
NNH	227	508	66	68	5						
NHS	1,041	2,325	301	312	22						
SM						7,483	16,524	2,219	2,859	465	
SNH						180	397	53	69	11	
SHS						724	1,599	215	277	45	
Total household consumption	16,154	36,097	4,671	4,851	336	8,387	18,520	2,488	3,204	521	
Total income from factors	12,461	27,845	3603	3742	259	6,440	14,220	1,910	2,460	400	
Difference between income and consumption	3,693	8,252	1,068	1,109	77	1,947	4,300	578	744	121	21,888
% difference	16.9	37.7	4.9	5.1	0.4	8.9	19.6	2.6	3.4	0.6	100
Allocation of transfer payments	3,693	8,252	1,068	1,109	77	1,947	4,300	578	744	121	21,888

The complete list of final variables is given in Table 6-79.

TABLE 6-79 FINAL MODEL VARIABLES

Description	Description	Notes	Variable Names	
			North	South
Activities and commodities	Non-housing sectors	All sectors with the exception of the construction of new housing	NM	SM
	Construction of new houses		NH	SH
	Housing service		NHS	SHS
Factors/households	Capital		NK	SK
	Skilled labour	Professional and intermediate labour	NLS	SLS
	Unskilled/ manual labour	Routine manual labour	NLU	SLU
	Good quality housing	Good quality houses and good quality apartments	NGH	SGH
	Poor quality housing	Poor quality houses and poor quality apartments	NPH	SPH
Exports/Imports	Exports	All exports and imports were amalgamated	EROW	
	Imports		IROW	
Government			GOVT	

The final stage in the process of incorporating the benchmark data set involves rescaling the data such that values are expressed in £ billion (US definition). The software used to generate the model is, in practice, sensitive to large differences in magnitude of the benchmark data values and therefore when the data was rescaled, some of the very lowest values are set to zero. This required some additional manipulation of the data set, which was done on an ad hoc basis. The final data used in the model is on the following page.

The processes that were followed to achieve the final SAM resulted in a benchmark data set that is rather stylised in structure. The relative magnitudes of the different entries in the SAM will impact the final results of the model since some elements were necessarily set to zero in order to balance the final data set.

The final benchmark data set used in the model is shown overleaf.

	NM	NNH	NHS	SM	SNH	SHS	NHK	NHLS	NHLU	NGHO	NPHO	SHK	SHLS	SHLU	SGHO	SPHO	EROW	IROW	Govt	
NM	58	-1	0	0	0	0	-11	-37	-5	-3	-1	0	0	0	0	0	-36	36	0	0.0
NNH	0	4	0	0	0	0	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0	0.0
NHS	0	0	5	0	0	0	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0	0.0
SM	0	0	0	30	-1	0	0	0	0	0	0	-6	-18	-3	-1	-1	-19	19	0	0.0
SNH	0	0	0	0	5	0	0	0	0	0	0	-1	-2	-1	-1	0	0	0	0	0.0
SHS	0	0	0	0	0	5	0	0	0	0	0	-1	-1	-1	-1	-1	0	0	0	0.0
NK	-12	-1	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0.0
NLS	-28	-1	0	0	0	0	0	29	0	0	0	0	0	0	0	0	0	0	0	0.0
NLU	-4	-1	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0.0
NGH	0	0	-4	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0.0
NPH	0	0	-1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.0
SK	0	0	0	-6	-1	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0.0
SLS	0	0	0	-14	-1	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0.0
SLU	0	0	0	-2	-1	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0.0
SGH	0	0	0	0	0	-3	0	0	0	0	0	0	0	0	3	0	0	0	0	0.0
SPH	0	0	0	0	0	-2	0	0	0	0	0	0	0	0	0	2	0	0	0	0.0
PFX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	-55	0	0.0
TK	-2	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.0
TLS	-11	0	0	-6	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0.0
TLU	-1	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.0
TRN	0	0	0	0	0	0	0	10	2	1	1	1	6	2	0	0	0	0	-23	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

6.7 Conclusion

The most common approach to arranging benchmark data for CGE models is to develop a SAM for the geographic area of interest. For this study, it was necessary to construct two sub-regional SAMS: one for the North of the region (comprising Bath and North East Somerset, Bristol, S Glos, N Somerset, Dorset, Poole, Bournemouth, Swindon, Wiltshire and Gloucestershire) and one for the South of the region (comprising Cornwall, Devon, Plymouth, Torbay and Somerset).

The process of building the complete South West SAM and the two sub-regional SAMs was carried out using a variety of published data sources including the 2001 Census. However, the majority of the data are derived from the South West Regional Accounts published by the South West Economy Centre (2003). Once the data was collated in a suitable format, a GAMS program was used to balance each of the SAMs. Due to software license constraints restricting the number of variables involved in the calculations, it was necessary to balance a series of aggregated SAMs in order to reduce the number of variables in the CE calculations. Therefore, the final process of matrix balancing was carried out by judgement.

Once a regional SAM had been constructed, this was subsequently disaggregated by sub-region using data primarily from the Regional Accounts and from the 2001 Census. The resulting SAMs, once balanced, were combined and aggregated to produce the final benchmark data set that was used in the CGE model.

In conclusion, the benchmark data set was generated from a consistent set of Regional Accounts and other published data and is therefore based on detailed regional data. However, certain compromises needed to made in order to incorporate the data into the model. This has resulted in a rather stylized benchmark data set, which does have implications for its usage. For instance, since households can receive income from only one factor of production, this would limit the use of the model for welfare studies where detailed impacts on households would be required. However, future development of the SAM is discussed in final chapter.

7 A Bi-regional CGE Model for the South West Housing Market

The discussion in Chapter 5 illustrates the reasons for choosing the CGE approach to develop the South West model. To reiterate, many of the techniques used for other regional impact studies, such as IO analysis, cannot be used to analyse supply shocks, which is the aim of this study. Furthermore, many of these techniques are essentially static in nature and thus, for example, assume fixed prices. By contrast, the CGE approach allows variables such as prices to be determined endogenously and therefore avoids many of these problems. Consequently, the CGE technique was deemed to be the most effective choice for the South West model. The next stage in the process requires the determination of the detailed structure of the CGE model.

In a regional CGE model, firms and household are optimizing agents, with firms maximizing profit and households maximizing utility. Since production and consumption are sensitive to price changes, goods prices and factor prices adjust to equilibrate supply with demand in goods markets and factor markets respectively. Hence, it was necessary to decide on an appropriate formulation for the optimisation choices of both firms and households, in addition to choosing the nature of the agents that were to be incorporated in the model.

Regional economies are more open than national economies and this implies, for example, a greater degree of labour and capital mobility at the regional level. Hence, it was also necessary to make decisions regarding the way in which issues that are of particular concern at the regional level, such as factor migration, would be incorporated. There were various difficulties encountered during the development of the model, primarily arising from software and other resource issues, that limited certain aspects of the model. Although these are mentioned briefly in this chapter together with any implications they might have had for the research, they are discussed more fully in the final chapter of thesis in terms of what can be done to further the development of the model.

This chapter continues with a review of the approaches that have been used to develop regional CGE models and in particular, those that have been used in the development of models

examining the behaviour of the housing market. The chapter continues with an examination of the choices made with regard to each element of the South West model and presents the reasons for these choices. The chapter concludes with a presentation of the final form of the South West model and a summary of its key characteristics.

7.1 An Overview of Regional CGE Modelling

This section provides an overview of the individual elements that comprise a full CGE model and includes a discussion of the primary ways in which they are modelled.

7.1.1 Production and Product Markets

Unlike regional input-output models that are based on Leontief technology, the nature of production in regional CGE models is specified according to a neoclassical framework. Consequently, CGE models do not represent factor demands as linear functions of output but rather factor demands depend on both output and relative prices. The accepted approach to modelling the production of outputs is to define the mathematical relationship between the factors of production, intermediate inputs and the corresponding level of output. With CGE models it is very difficult, if not impossible, to prove the existence of an equilibrium (i.e. a solution to the set of modelling equations). Consequently, the variety of functional forms used is generally limited to a group of functions with well-known properties that satisfy the criteria for the existence of an equilibrium solution. These equations are usually in one of three forms:

- Cobb-Douglas: $Y = AL^{\alpha}K^{\beta}$, where Y is output, L is labour, K is capital and A, α and β are determined by the production technology;
- constant-elasticity-of-substitution: $Y = \left(\alpha K^{\rho} + \beta L^{\rho}\right)^{\frac{1}{\rho}}$ where Y is output, K is capital, L is labour and α, β and ρ are determined by the production technology;
- flexible functional forms: for example the translog function, a generalisation of the Cobb-Douglas function that allows for Allen partial elasticities[10] to be used. This implies that multiple factors can be incorporated (Berndt and Christensen, 1973).

The choice of function depends upon a trade-off between simplicity and flexibility. Cobb-Douglas (CD) and constant-elasticity-of-substitution (CES) functions are the easiest to

[10] The Allen partial elasticity of substitution is defined as the percentage change in the ratio of the quantity of two factors to the percentage change in their price ratio allowing all other factors to adjust to their optimal level (Hitt and Snir, 1999).

incorporate. However, both types of function place severe restrictions on the elasticities of substitution: in the case of CD functions, income and own-price elasticities are restricted to unity, whereas CES functions allow different but fixed elasticities. The wide variety of flexible functional forms available to use place little or no restriction on the values of elasticities. However, the price of this flexibility is an increased numbers of parameters, a problem if suitable data is not available. Moreover, these functions only possess the necessary functional properties in certain domains

An alternative, and less data intensive, way to increase the flexibility of functional forms is to use hierarchical (or nested) functions. Instead of using a single production function, layers of functions are used, allowing for differing elasticities between pairs of factors. For instance, capital and labour can be combined in the first level of production to create a composite value added good. In the final level, the composite is combined with intermediate inputs to produce final output. The advantages of using production functions in this way are twofold: firstly, the increased numbers of elasticities allows for a more detailed production structure, whilst retaining much of the simplicity of standard functional forms, and secondly, intermediate goods can be treated differently from value added factors. This produces the greatest benefits when examining the mechanics of particular sectors within an economy. Nested production functions are also useful when incorporating imports into production, which is of particular importance to regional models where there are two sources of imports, namely other regions within the country and the rest of the world. In most examples, the Armington assumption is assumed to hold and CES functions are used to combine domestic products and imported goods to produce a final demand good (Partridge and Rickman, 1998).

For the sake of expediency, it is assumed that production technologies exhibit constant returns to scale since increasing returns result in non-convex production sets (Scarf, 1981a, b). Provided there are no indivisibilities this does not usually cause a problem, although if indivisibilities exist, many different approaches can be taken such as the dual approach that uses cost functions rather than production functions to describe production in the model. Even if the

original technology is non-convex (as is the case with increasing returns to scale) the technology recovered from the cost function will be convex (Kuosmanen, 2003).

Product markets are usually assumed to be perfectly competitive, thereby providing the link between producer costs and commodity prices. An important issue when dealing with product markets is the dimensionality of the model. Typically, this depends upon the intended purpose of the model and the availability of suitable data. In general-purpose impact models, the level of aggregation tends to vary. For example, the ORANI model of the Australian economy (Dixon et al., 1982) uses 114 industries and commodities, whereas the model of the UK economy developed by Piggott and Whalley (1985) used 33 industries and commodities and the US model developed by Ballard et al. (1985) incorporated 19 industries and 16 commodities. In general, issue-specific models tend to use a greater degree of aggregation. For example, in a model investigating the demand and supply of energy in China developed by Shibusawa et al. (1999), 9 industries and commodities were used.

To conclude, the structure of the production block is driven partly by the purpose of the model and partly by technical considerations. The majority of models rely on a few standard functional forms. However, the production process can be layered (i.e. functions are nested) to allow a greater degree of flexibility in the specification of production than would otherwise be available from using the standard production functions alone.

7.1.2 Household Demand

Household demand is driven by household income and household consumption decisions are represented by a utility maximisation problem. Analogous to production, household demand is most commonly modelled using functions of the CD or CES type leading to a well-defined utility maximisation problem. Both CD and CES functions constrain the income elasticities of demand to unity, so in some circumstances, the linear expenditure system (LES) is used. This is a modification of CD and CES functions that incorporates a minimum level of demand for each good thereby removing the unitary elasticity of demand (Dorosh and Sahn, 2000). Essentially, the arguments of the utility function in a LES specification represent the amount by which the

quantities consumed exceed the subsistence requirement of each commodity. The cost of the increased flexibility of this approach is an increased number of parameters to calibrate, specifically the subsistence or minimal level of each commodity must be determined.

Savings and investments are also determined by household decision-making. In closed-economy (usually national) models, investment tends to be linked to household saving and based on constant expenditure shares (Abler et al., 1998). The problem being that the household propensity to save will change with the economic climate. A more detailed approach is taken by Shibusawa, Miyata and Chen (1999) who link investment to household saving in addition to government saving, capital depreciation and the savings of the foreign sector that receives income from imported goods and expends income on exported goods.

Since household decision-making is a matter of utility production, modelling the household sector is treated in much the same way as the standard industrial production sector. In short, household decision-making is modelled by using standard production functions that can then be nested to increase the degree of detail whilst retaining tractability.

7.1.3 Factor Markets

The most common approach is to assume that factor markets are perfectly competitive, where both firms and households are treated as price takers (Vargas et al., 2001), although the factors included and the degree of factor mobility vary considerably according to the nature of the study and the availability of data (Partridge and Rickman, 1998). Some form of labour and capital are usually used, although land is another common choice particularly for those studies focusing on environmental issues, for examples see the studies by Jorgenson and Wilcoxen (1993) and Mutti et al. (1989). Like commodities, factors are disaggregated to provide structural detail, such as dividing labour into skilled and unskilled components. As with many other model variables, the degree of disaggregation in factor markets is determined by available data and the purpose of the model. Moreover, household groups are usually chosen in order to minimise within-group heterogeneity, as first suggested by Pyatt and Thorbecke (1985).

The level of factor mobility is primarily motivated by the time frame of the model (Partridge and Rickman, 1998). In general, the longer the time period and/or more open the economy, the greater the level of factor mobility, thus allowing for differences in factor returns between regions in the short run (Harrigan et al., 1996; Jorgenson and Wilcoxen, 1993; McGregor et al., 1996).

Less easily dealt with are variations in patterns of factor ownership between the national and regional level. One way in which this has been addressed is to incorporate a relationship between regional factor ownership and region of factor use (Jones et al., 1986; Koh et al., 1993). An alternative approach is to adjust income by place of employment to income by place of residence to produce net factor ownership, particularly capital ownership (Rickman 1992, and Waters, Holland and Webber 1997). The advantage being that this estimates the leakage of income from the region.

7.1.4 Savings and Investment

Since many regional models are static in nature, savings and investment are often omitted since households have no incentive to save (Partridge and Rickman, 1998). In models where savings have been included, they are often endogenously linked to investment in a classical fashion as, for instance, in the model by Li and Rose (1995). Alternatively, savings are assumed to flow into national savings, with exogenous investment treated in a Keyensian fashion (Kraybill et al., 1992). A study by Kilkenny (1993) includes savings from households in the region, savings from firms, government savings and savings from outside the region.

7.1.5 Government

Government generates income through the taxation mechanism, distributes this income in the form of transfer payments and expenditure on goods and services and is usually treated exogenously in regional models (Partridge and Rickman, 1998). In those cases where the government sector is endogenous, it is treated in the same way as households; generating

income and making expenditure decisions. For examples, see the studies by Jones et al. (1986), Mutti et al. (1989) and Morgan et al. (1996).

Since regions tend to operate with a local and national government sector, many studies have combined the two, which are then treated exogenously as in the studies by Koh et al. (1993) and Hoffman et al. (1996). Even in the case where national and regional government are treated separately, regional governments are often assumed exogenous, for an example see the study by Kraybill et al. (1992).

Government income generation is straightforward to incorporate. For instance, a sales tax set at level τ would be incorporated by setting the consumer price q, to be equal to $p(1+\tau)$ where p is the producer price. However, the government expenditure decision is treated in much the same way as household expenditure: a utility function is maximised leading to a consumption decision and using standard functional forms.

7.1.6 Static vs. Dynamic Models

In static CGE models agents optimise over a single time-period, ranging in length from a single year to a whole lifetime. These models are used to analyse changes in the nature of an economy as it moves from one state of exogenous conditions to another. This type of comparative static analysis is useful for situations where flows such as savings are not of primary concern, since static models omit the time path of a response. Dynamic behaviour is incorporated into CGE models in an attempt to include a time dimension. Due to the dominance of taxation research, dynamic models generally aim to capture changes in household behaviour (Pereira and Shoven, 1992): the magnitude of the expected future after-tax capital return influences the consumption/savings decision requiring an inter-temporal utility function (Partridge and Rickman, 1998).

Dynamics can capture changes in product markets including shifts in the number and composition of commodities and agents. Where commodities are concerned, the numbers of varieties are fixed and therefore shifts in allocation determine the change in composition.

Alternatively, modelling changes in the characteristics of commodities is achieved via a continuous exogenous or endogenous process. For example, entry and exit of firms can be modelled by assuming that firms can be inactive, thus entry and exit is treated as the transition from inactive to active and vice versa while the total number of producers remains constant.

Consumers can be represented in a similar fashion, with flows between finite numbers of social classes, such as occupational groups. For consumers who live for a time-period shorter than the horizon of the model, the overlapping generations approach is often used, where lifetimes are defined by specific time-periods. For example, a lifetime could be divided into three periods: childhood, adulthood and retirement, each period having its own characteristics. This approach can capture important intergenerational issues and is therefore of particular use when a policy influences generations in different ways or there is an impact on the aggregate savings rate, level of capital accumulation or economic growth (Farmer and Wendner, 2004).

An alternative to the overlapping generations approach is the recursive technique. This assumes that the behaviour of agents within a model depends only on current and past states of the economy. The time path is modelled by solving a sequence of equilibria according to inter-temporal equations representing, for example, the updating of capital stock. Hence, in each period an equilibrium solution is calculated given existing supplies of capital and labour. When the supplies of capital and labour are updated, a new equilibrium solution is calculated.

The final approach to dynamic modelling assumes that agents' expectations depend, not only on the past and the present, but also on the future state of the economy. It then becomes necessary to solve for all periods simultaneously, leading to full multi-period dynamic CGE models. Uncertainty about future states can be incorporated by using stochastic equations.

The main concern when creating dynamic models is the large number of parameters that need to be estimated, further complicating model solution and thus frequently impacting the level of sector and factor detail that can be incorporated within the model. Although both the overlapping generations approach and the expectations approach incorporate a greater degree of realism, they also require a larger number of parameters in comparison to the recursive

approach. Thus the decision of whether to create a dynamic model and then which approach should be used, must be balanced against the need for detail within the model.

7.1.7 Model Closure

The issue of model closure was first identified by Sen (1963) who noted the problem of over-determination in a theoretical macro-model given by the following equations (Thissen, 1998) and explained below:

$$X_s = f_p(L,K) \qquad (1)$$

$$w = \frac{\partial X_s}{\partial L} \qquad (2)$$

$$X_s = \pi + wL \qquad (3)$$

$$S = s_p\pi + s_w wL \qquad (4)$$

$$I = I^* \qquad (5)$$

$$S = I \qquad (6)$$

Good, X_s, is produced via a neo-classical production function, f_p, with factors, K and L. These factors receive returns according to their marginal productivities and so labour, L, receives the wage rate, w, and capital, K, receives total capital income, π. Total savings are determined by the savings ratios, s_w and s_p. Investment, I, is equal to some exogenous value, I^* and total savings are equal to total investment. Of these variables, five are endogenous: X_s, I, S, w and π. Consequently, this model is over-determined i.e. there are more equations than unknown variables. In order to find a solution to the model, it is necessary to either remove one of the equations, allow an exogenous variable to be determined endogenously or set an exogenous level for one of the endogenous variables. The choice between these three options defines the issue of model closure. Although there are many variations, there are four main macro-closures used and these are the neoclassical closure, the Johansen closure the Keynesian closure and the

Kaldorian closure and the neoclassical is the most frequently used of these (Dewatripont and Michel, 1987; Thissen, 1998)

Both the neoclassical and the Johansen closures involve removing one of the equations from the model. In the case of the neoclassical closure, investment is assumed to be endogenous (equation 5 is removed) and the model adjusts until investment is equal to savings i.e. whatever is saved is then invested (Swan, 1960). The mechanism that achieves equilibrium is often assumed to be an interest rate, although this is rarely modelled explicitly (Thissen, 1998). By contrast, the Johansen closure removes the link between savings rates and total savings and thus equation 4 is removed. Savings are assumed to adjust to the exogenous investment level either by changes to private consumption (Dewatripont and Michel, 1987) or by the incorporation of endogenous government spending (Thissen, 1998). With both the neoclassical and Johansen closures, the production side gives total output since resources are fully utilised. Both product markets and labour markets clear, and wages adjust to give full employment. In the neoclassical case, investments will adjust to the given savings decisions. Yet in the Johansen closure, investment is exogenous and so consumption must change endogenously to maintain full employment.

With the Keynesian closure, the wage rate is fixed, thus equation 2 is removed and labour supply is therefore endogenous (Dewatripont and Michel, 1987) and so this closure incorporates the possibility of unemployment. Finally, the Kaldorian closure assumes that the wage rate is less than or equal to the marginal product of labour, thus equation 2 is removed and the wage rate adjusts to ensure full employment. Hence, the Kaldorian closure is consistent with a redistribution of income.

These four closure methods are usually employed in closed economy models. Yet they do not have the same relevance for regional models since they relate to variables over which an open economy will have little or no influence. For example, the high level of capital mobility at the regional level renders the neoclassical closure irrelevant. In a study by Adams and Parmenter (1995), the rate of return for capital was exogenous, thereby implying that the supply of capital

is perfectly elastic and domestic capital formation is not constrained by domestic saving. Therefore, regional closures tend to be more idiosyncratic and a number are discussed here.

Balance of payment closure refers to the conditions for clearing markets for foreign exchange, rather than the previous closures discussed that give conditions for closing aggregate goods markets. In the most simple case, the demand for foreign exchange equals the demand for imports, whilst supply equals the value of exports plus net borrowing (Kraev, 2003). The balancing mechanisms are either quantity clearing (net borrowing adjusts), rationing (foreign exchange is allocated between sources of demand) or price clearing (real exchange rate adjusts).

Since macro-economic closures have much less relevance at the regional level, econometric closures have also been introduced to allow more flexibility. Regional labour markets are more mobile and consequently there have been efforts to introduce migration into regional models. One such approach was first developed by Harris and Todaro (1970), where the net migration rate is negatively related to the log of the ratio of domestic regional unemployment to national unemployment and positively related to the log of the ratio of the domestic regional wage to the national wage. This approach has been incorporated into regional CGE models such as AMOSENVI (Hanley et al., 2006) that are also dynamic in nature. Wage bargaining has been included in models with imperfectly competitive labour markets. For instance, in a model of Merseyside developed by Minford et al. (1994), wages are subject to a regional bargained real wage function in which the regional real consumption wage is directly related to workers bargaining power, and hence inversely related to the regional unemployment rate.

Model closure ensures that the CGE model is solvable or computable simply by guaranteeing that the number of equations and endogenous variables match. Moreover, it establishes causality based on the theoretical preference of the model builder, and thus there is no right or wrong standard that can be applied (Mitra-Kahn, 2008). The choice of closure rules is therefore governed less by the needs of the model and more by the particular viewpoint of the model builder. This discussion is limited by the fact that mention of closure rules in the modelling literature is minimal as mentioned in the recent survey of CGE modelling by Mitra-Kahn

(2008), where the author states that closure rules "..are rarely, *if ever*, discussed or justified in model papers."

7.1.8 Model Parameterisation

The way in which model parameters are determined is subject to considerable debate. Specifically, the way in which models are calibrated using benchmark data for a single year is problematic because:

- data for a single year may not be enough to specify all parameters leading to a reliance on external data sources (Hansen and Heckman, 1996);
- the benchmark data may not represent the economy in equilibrium (Greenaway et al., 1993)

There are ways in which one can try to overcome these problems such as using econometric estimation of parameters or partitioning the model into blocks of relationships and thus reducing the number of parameters to be estimated. However, these approaches have many inherent difficulties, particularly at the regional level: time series data may not be available and endogeneities are often ignored (Partridge and Rickman, 1998). Therefore, the majority of regional models are calibrated to a benchmark data set and the potential problems are borne in mind when interpreting the results from the model.

The issues discussed in this section are those with particular relevance to regional CGE models in general. The next section focuses on the issues directly relevant to housing market CGE models.

7.2 CGE Models of the housing market

The realm of housing research is multi-disciplinary and has been influenced by work in many different (Doling, 2001). Economic modelling techniques have already made a significant contribution to the development of understanding of land use, planning, residential and commercial property, housing finance and communities (O'Sullivan et al., 2003). Nevertheless, there is some concern regarding the use of such techniques because of the increasingly sophisticated modelling approaches used and the applicability to the practical issues faced by policy makers (Harris and Cundell, 1995). The benefits of abstracting the processes involved in the operation of the housing market are generally not denied, however the nature of these abstractions is a contentious issue (Marsh and Gibb, 1999). These simplifying assumptions can be classified into three broad categories (Wallace, 2004):

- Negligibility assumptions – the assumption that an individual factor or group of factors has no significant influence on the events under consideration;
- Domain assumptions – the conditions under which the theory applies;
- Heuristic assumptions – although they are known to be false, they are made in order to facilitate theoretical investigation.

The choice of simplifying assumption is governed by the chosen modelling technique and by the purpose of the model itself. It is therefore important to understand the implications of any assumptions made as these can significantly affect the outcome of the analysis.

Various aspects of the housing market have been subject to the application of statistical and economic modelling techniques. There are a number of studies examining house prices and the effect of house prices on the economy, for instance the papers by Cook and Thomas (2003) and Drake (1995), whilst others focus on the house-building industry, such as the research by Ball (2003) and Tiwari (2004). Kim and Ju (2003) and Kenny (1999) investigate the effects of housing supply on the macroeonomy and both Arnott (1980) and Gibb (2000) explore the operation of the housing market. Other issues examined include residential mobility (Hardman and Ioannides, 1999), property taxes (Julia-Wise et al., 2002) and urban housing supply (Kim

and Ju, 2003). The remainder of this section discusses existing CGE models that focus in some way on the impact and behaviour of the housing market.

7.2.1 Structure

In general, the structure of a CGE model depends largely upon its purpose. Theoretical models tend to have the simplest structure and complex specifications are introduced only in order to facilitate the investigation of the theory in question. Empirical models tend to include more detail. The most detailed models are those built for general policy analysis whereas issue-specific empirical models will usually have very detailed specifications in those areas that have the greatest influence on the topic in question and a more generic specification for those elements that have little influence on the outcome.

In general, housing market models tend to include detailed specifications of the house-building sector, household consumption and in some cases, the market for credit where issues relating to the use of housing as an asset are being examined.

7.2.2 Scope and Dimensionality

Most housing market models tend to focus on a particular aspect of the housing market. The study by Luk (1993), for example, examines residential location choices and the impact this has on the formation of urban areas. The model incorporates three non-housing commodities, twenty-four different types of houses, three factors and five different types of household. Houses are distinguished by location, dwelling type, lot size and floor space. This model is relatively rich in terms of the number of dimensions included. A similar study by Kim and Ju (2003) models the housing market in Seoul, Korea with a specific focus on the impact of urban housing. The level of aggregation is similar to the previous example, with eight industry sectors, five factors of production, five household groups and two tiers of government. These studies are similar in three ways. Firstly, the models are used to examine spatial aspects of household location decisions and thus some of the detail in the models results from distinguishing housing and households by geographic location. Secondly, these are both

empirical/applied models in that they have been developed to investigate 'real' economic phenomenon rather than to examine 'theoretical' issues or to further understanding of the modelling technique itself. Thirdly, these models are static and are therefore solved for only one period. Static models are usually much easier to solve than dynamic models primarily because agents are only optimising over a single time-period. Static models generally have far fewer parameters and only require one solution to be found unlike recursive models, for example, that require a series of solutions. Consequently, it is easier to incorporate a greater degree of heterogeneity in the specification of static models.

Very few CGE models that incorporate housing focus on assessing macro economic impacts. However, one such example is a study by Aoki et al. (2004) investigating the impact of imperfections in credit markets. This is based on the hypothesis that house prices influence consumption, specifically when housing is used as collateral to reduce agency costs associated with borrowing. Although the model focuses on macro effects, the overall scope of the model is relatively narrow and thus the dimensionality of the model is small, for instance production is limited to two commodities, durables and non-durables and two household types, homeowners and consumers. The model is also dynamic in order to capture changes in the UK credit market. The additional complexity resulting from the dynamic elements limits the level of sectoral heterogeneity. A similar pattern is noticed in the model constructed by Ebrahim and Mathur (2004), examining the link between interest rates and house prices. This two-period dynamic model has two agents, a homeowner and a lender, with two types of assets, a house and a mortgage. Both models incorporate a lesser degree of heterogeneity in terms of household and commodity definitions in comparison to those developed to examine residential location decisions.

The degree of heterogeneity, and hence the dimensionality, of the model is closely linked the scope of the model. Those that focus on spatial issues, such as residential location decisions, tend to incorporate detailed housing blocks since, regardless of what other physical characteristics of housing are included, there must be some geographical index in order to capture the spatial aspects of the issue.

7.2.3 Housing Market

One of the most interesting studies in terms of modelling housing markets was the study by Luk (1993). This was primarily theoretical although an empirical example was used for illustrative purposes. One of the more revolutionary ideas developed in this static CGE model was the use of hedonic pricing to model housing consumption, which until that point had not been used in CGE analysis. Another innovative aspect of the model was the treatment of housing, households and land as indivisible entities. This is not a common approach as indivisibility leads to discontinuous consumption sets. Luk avoids non-convexity by introducing a logit function that distributes households over available close-substitute choices thereby approximating a continuous consumption set.

A more complex specification of the housing market can be found in a study by Aoki et al. (2002). This model is used to investigate links between house prices, consumption and monetary policy. The model focuses on the methods by which household consumption is financed and follows the financial accelerator model of Bernanke et al. (1998). An interesting aspect of the approach taken here is the way in which the household sector is modelled. Each household is a composite of two behavioural types: homeowners and consumers. Homeowners borrow funds to purchase houses and then rent houses to consumers. This captures consumer borrowing and lending whilst avoiding much of the complexity inherent in modelling the utility optimisation of heterogeneous consumers under liquidity constraints. The study concludes that positive shocks to economic activity cause a rise in housing demand, leading to increased prices and therefore increases in homeowners' net worth. Although in this model, the direction of causality of the shock (from economic activity to the housing market) is opposite to that planned for the model developed in this study, it is interesting to note the dual household representation since the use of imputed rent in the South West SAM captures similar characteristics. The model by Ebrahim and Mathur (2002) took a similar approach and incorporated two agents, a homeowner and a lender and two commodities, a home and a 'risk-free' mortgage. This type of formulation is particularly useful when explicitly modelling the use of housing as an asset.

In some cases, the housing market has not been modelled explicitly, but instead a proxy measure has been used. For instance, in the study of Seoul in Korea by Kim and Ju (2003), the use of land for residential purposes is a proxy measure for the supply of housing. This approach precludes the incorporation of a secondary market for existing dwellings. Similarly, the model constructed by Julia-Wise at al. (2002) to examine property tax policies in Idaho, avoids modelling property markets explicitly. Instead, impacts are modelled by changing tax levels and the formulation follows the analysis of Waters et al. (1997).

The model by Tarlow (2004) was developed to investigate the impact of fixed transactions costs in the operation of the housing market. Although this has been the subject of other research, it is unique in terms of CGE modelling, the main reason being that fixed transactions costs introduce non-convexities into the consumption set as it represents a binary choice for households. The author incorporates a dynamic element into the model and in particular, an overlapping generations (OLG) approach, in order to overcome potential problems with non-convexity. It is assumed that consumers are born, live and act in the economy and then die, with this lifecycle divided into two or more stages. The advantage being that consumers are characterised by income and other characteristics such as age (i.e. the stage they have reached in their lifecycle). In this model, consumers are permitted to randomise over the decision of whether to pay transactions costs, resulting in sufficient heterogeneity to overcome the problem of binary choices in the consumption set (i.e. it replicates a continuum of choices) but the model remains tractable.

The final model discussed in this section also employs an OLG approach to modelling the dynamic aspects of the housing market. This model, developed by Hardman and Ioannides (1999), investigates the impact housing markets and residential mobility have upon economies. However, this model is theoretical and thus has a relatively stylised structure. Consumers maximise their utility with respect to the consumption of goods (both housing and non-housing) together with the number of residential moves they make over their lifetime. Transactions costs are incorporated by including a cost parameter that is a function of the informational structure within the economy and reflects the ease with which vacant homes can be found.

Although dynamic modelling approaches would seem to be the most appropriate treatment for the housing market, there remain relatively few examples. This review finds that dynamic models of housing markets tend to be theoretical in nature and highly stylised in structure, due in part to the inherent difficulties involved in incorporating dynamic elements into larger empirical studies. Adding a dynamic element increases the number of parameters and equations thus resulting in a much more complex structure. As can be seen from the models discussed here, model structure is kept relatively simple in order to enable the incorporation dynamic elements. Consequently, the criticisms aimed at economic modelling as regards the loss in realism due to simplifying assumptions are particularly resonant for dynamic modelling.

The final part of this chapter discusses hedonic pricing. This approach to pricing housing characteristics is not commonly seen in CGE models but has been used successfully to represent consumer choices in other forms of housing model.

7.2.4 Hedonic Pricing

In an attempt to quantify housing submarkets, the hedonic pricing approach was developed to estimate the 'price' of submarket characteristics (Rosen, 1974). Hedonic pricing operates on the assumption that an implicit market exists for different housing characteristics. This has led to a large body of research, much of which uses hedonic pricing to identify submarkets. See the paper by Bartik (1987) for a review.

The earliest attempt to incorporate submarkets and hedonic pricing functions into a housing market model is by Muth (1969) and this has been the basis for many further models. The Muth model collapses all housing characteristics into a single index, 'housing services', and then represents the housing market by two linked markets: a market for housing services and a market for housing stock. The stock generates a flow of housing services and the price of a unit of stock equals the present value of net revenue from this flow. This model can be extended to include structure type, spatial fixity and tenure choice by assuming a linked set of submarkets. The research was furthered by Sweeney (1974) who incorporated a 'quality' measure such that

housing submarkets were differentiated by quality, thus allowing the deterioration of dwellings to be modelled and maintenance costs to be included.

Of the more recent models of this type, one of the most comprehensive has been the Chicago Prototype Housing Market Model (CPHMM) by Anas and Arnott (1993). The CPHMM is a sub-regional (urban) model and was constructed specifically for the Chicago housing market. Within the framework of the CPHMM, houses can be constructed, demolished and can be moved up the quality scale by maintenance and by conversion whilst without maintenance, housing deteriorates in quality. In terms of hedonic pricing, consumers can choose from 50 different housing unit types, classified by size, quality and type. Many of the more recent models were based on the CPHMM, for example the study examining the issue of homelessness by Mansur et al. (2002).

Hedonic pricing is used to estimate the degree to which different housing characteristics influence house prices. Poor quality housing was identified in *The Regional Housing Strategy* (South West Housing Body, 2005) as a concern in the South West housing market, where an estimated 30 percent of the region's housing stock falls into this category. Thus, it is useful to have some method of incorporating quality into the South West CGE model and Section 6.3.1 on page 222 discusses how the measure of housing quality is determined for this model. The final part of this chapter describes the framework of the South West model, including the incorporation of housing quality levels into the household consumption block.

7.3 The Development and Structure of the South West Model

The objective of this research is the development of a model of the South West housing market because no such model currently exists. The model evolved during the development process and so this section describes the key decisions that were made during its construction and presents the overall structure of the final model.

7.3.1 Geography, Variables and Time Scale

The model for the South West is designed according to a bi-regional structure. The regional dichotomy is not modelled explicitly but is included via the benchmark dataset, where sectors, households and factors are disaggregated by sub-region. This process is discussed in detail in Chapter 6.

The model variables are broad in terms of the level of aggregation to retain a degree of tractability. For example, in the final benchmark data set, all non-housing commodities are aggregated into a single commodity. Some elements of the initial benchmark data set were aggregated during the development process in order to facilitate the solution of the CGE model. The primary factors used in this model are two types of labour (skilled and unskilled) and capital. There are two housing factors representing existing housing and these are disaggregated by quality (good and poor).

The final version of the model is a comparative static model. Thus, agents are optimising over a single time period.

7.3.2 Production

The first key decision was to use standard CD and CES functions because there was no sound reason for choosing otherwise. Furthermore, since the software chosen to solve the model was easily able to deal with nested functions, this allowed for more flexibility in the specification of the productive sectors.

The Treatment of Housing in the South West CGE

Supply in the housing market takes two forms, new construction and existing dwellings. The construction of new dwellings is treated in the same way as the production of other goods and thus uses a combination of factors (capital and labour) and intermediate inputs. Land has not been included in the final model because the sustainability study carried out by the Office of the Deputy Prime Minister (2005c), states that there is sufficient land for all housing development currently planned within the South West region, including levels of increased supply planned in the Regional Spatial Strategies. Thus, including a constraint on the supply of housing was not necessarily productive at this point, although this is something that could be incorporated in the future.

The model is static and thus the construction of new housing is treated in the same way as a non-durable good. Hence, output from the construction of new housing survives for only one time-period. This is clearly not realistic as houses should continue to provide services for multiple time-periods. The decision to consume new housing should be influenced by the consideration of the services that will be provided by the housing unit in future periods. Although this cannot currently be modelled, any future development of the model incorporating dynamic elements would provide the possibility of including these effects.

Existing dwellings are not produced but are bought and sold in the housing market. This secondary market for existing housing is represented in the South West model by the creation of a 'housing service' good, where the price is a measure of imputed rent. This follows the approach of Muth (1969), where existing dwellings are the sole factors of production. Using imputed rent as a good within the model also captures the rental market, albeit in a rather rudimentary fashion. Since the private rental sector and socially rented sector in the UK is relatively small and is not as significant as the owner-occupied sector (Hughes and McCormick, 1987; McCormick, 1997), the explicit inclusion of a rental market was left as an area for future development.

Treating housing as a perfectly divisible good (i.e. a 'housing service') is unappealing from a theoretical standpoint as it assumes that consumers can purchase any combination of housing characteristics in any quantity, which clearly cannot be so. However, models that assume divisibility have resulted in reasonably realistic outcomes, for example the spatial patterns of a particular city can be observed (Luk, 1993). This particular issue has more bearing on sub-regional models where the markets in question are smaller and the issue of sub-markets becomes much more significant. At the regional level, the assumption of divisibility is less problematic as, in aggregate, it is reasonable to assume that households can choose from what is effectively a continuum of characteristics. Since this model only considers spatial choices in terms of locating in the North sub-region or in the South, this geographic level is large enough to be able to assume a continuum of characteristics without much compromise from a theoretical point of view.

Structure of Production of goods and services

In the model, goods and services are produced using nested production functions. For goods and services other than the housing service, capital and labour combine at the first level to create a composite value added. This composite then combines with intermediate inputs to produce domestic output. Imports and domestically produced goods are assumed to be imperfect substitutes and an Armington specification is used to produce a composite final demand commodity. Perfect competition and constant returns to scale are assumed in all markets.

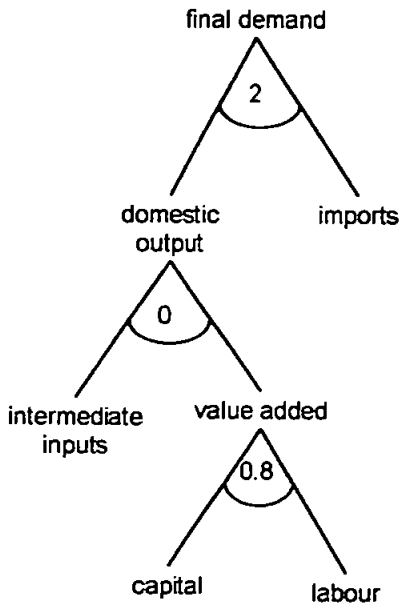
The housing service commodity is produced entirely from existing dwellings and so does not use any other value added or intermediate inputs. Existing dwellings are not used as value added by any other commodity. Neither the housing service sector nor the new housing construction sector exports or uses imports.

Non-housing sector output is sold to households, exports and intermediate demand. Output from the housing sector and the construction of new housing is only sold to households. Investment is not included as the model is static. Taxes are included, however, and the tax rates

for the use of value added are determined endogenously. The government is the tax collection agent and total tax revenue is distributed to households as transfer payments.

The elasticities chosen for the production functions follow those used in the CGE for Jersey, JEMENVI (Learmonth et al., 2001) and the environmental CGE model for Scotland, AMOSENVI (Ferguson et al., 2005) as these represented the closest approximations to the South West model that could be found in the current literature. Therefore, the intermediate transactions are assumed to be Leontief, whilst factors are combined using a CES function with an elasticity of 0.8. Imports and domestic goods for all non-housing commodities are combined with an elasticity of 2 to produce the final demand commodity. A summary diagram of the structure of production is shown in Figure 7-1.

FIGURE 7-1 PRODUCTION STRUCTURE OF THE SOUTH WEST CGE



Although the production of housing services does not involve intermediate inputs or imports, this commodity is produced using the same technology as represented in Figure 7-1. Good quality houses and poor quality houses are combined using an elasticity of 0.8 to produce final demand in the housing service sector.

Mathematically, the first level of production combines the factors of production according to a CES function with elasticity of 0.8 to give a composite value added good, VA. Therefore, the quantity of VA used in the production of commodity j is given by:

$$VA_j = \eta_j \left(\sum_{i=1}^{n} (\delta_{ij} F_{ij})^{\frac{(\sigma-1)}{\sigma}} \right)^{\frac{\sigma}{(\sigma-1)}}$$

where η_j is a scale parameter, δ_{ij} is a distribution parameter, F_{ij} is the amount of factor i used in the production of commodity j, σ is the elasticity of substitution and n is the total number of factors.

The next level of production combines the value added composite, VA, and intermediate inputs, V, according to a Leontief specification to produce domestic output, Q:

$$Q_j = \min\left\{ \frac{VA_j}{\alpha_j}, \frac{V_j}{\beta_j} \right\}$$

where α_j and β_j are the input-output coefficients of industry j for factor inputs and intermediate inputs, and VA_j and V_j are the factor inputs and intermediate inputs respectively.

The final level of production uses the Armington approach to combine domestic output, Q, and imports, QM, to produce total output, QT:

$$QT_j = \xi_j \left(\theta_j Q_j^{\frac{(\rho-1)}{\rho}} + (1-\theta_j) QM_j^{\frac{(\rho-1)}{\rho}} \right)^{\frac{\rho}{(\rho-1)}}$$

where ξ_j is a scale parameter, θ_j is a distribution parameter, Q_j is the quantity of the domestically produced commodity j and QM_j is the quantity of imports of commodity j used in the production of total output of commodity j and ρ is the elasticity of substitution.

7.3.3 Household Income

Households receive income from endowments of factors and transfer payments from government. However, use of the MPSGE software placed restrictions on the source of household income. Specifically each household could only receive income from one type of factor. Consequently, households are defined by the factors from which they receive income. Capital households, for example, only receive income from the rental of capital and no other households receive income from capital.

Housing services are measured in terms imputed rent as discussed in the previous chapter and hence "Persons who own the dwellings in which they live are treated as owning unincorporated enterprises that produce housing services that are consumed by the household to which the owner belongs." (United Nations Statistics Division, 1993). However, by allocating imputed rent only to those households that own housing factors, this implies that in essence, these households are renting housing services both to themselves and to households who receive income from other factors since all households purchase the housing service commodity.

Although this idiosyncratic allocation of factor incomes to households has consequences for the analysis of distributional effects of exogenous shocks, in aggregate it probably has only a limited detrimental effect.

7.3.4 Household Consumption

Household income is allocated entirely to the consumption of commodities because the model is static and so savings are ignored. This implies that households are myopic and are optimising over only one time-period. The problem with modelling a durable goods in this fashion is that the consumption of durables involves not only decisions regarding the quantity to consume but also the timing of consumption choices. New housing lasts only one period in this model and as such it cannot capture the inter-temporal nature of housing consumption decisions and may underestimate the consumption of housing goods.

Household demand in the South West is treated in a similar way to production in that the standard functional forms are used to represent the optimizing decision process. The household demand block comprises two layers. In the first layer, housing products are combined to produce an aggregate housing good and in the final layer, the housing aggregate is combined with output from the non-housing sector to produce final household consumption.

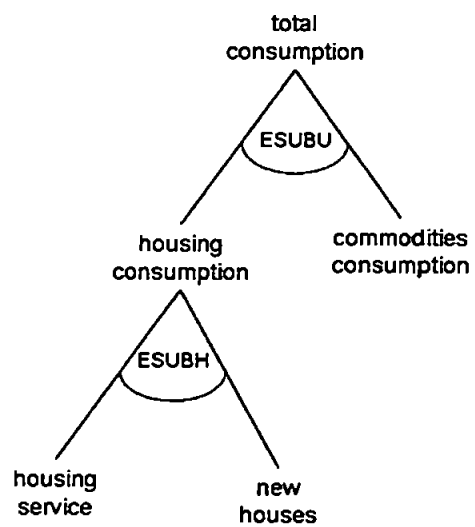
Both economic theory and empirical evidence indicate that consumption decisions involving housing are particularly complex because housing meets basic needs such as shelter, yet also acts as a means for storing household wealth. Consequently, nested functions are employed since this allows housing goods to be combined in a single housing composite modelling the choice households make between the consumption of existing housing and new housing. Specifically, utility derived from consuming commodities is modelled as a two stage nested function. At the first level, utility from the consumption of housing derived by combining housing services with new houses according to elasticity ESUBH. This housing composite is then combined with the remaining non-housing commodity with elasticity, ESUBU, to produce the price of utility. For a summary diagram of the structure of the utility function see Figure 7-2. The value of one was chosen for ESUBH thus the housing composite is modelled using a Cobb-Douglas function. This specification is used because it is assumed that consumers are reasonably indifferent between new houses and existing dwellings.

One of the objectives of this study is to investigate the behaviour of the housing market in the South West and to aid in this process, various different values of ESUBU (elasticity of substitution between housing consumption and non-housing consumption) are used. Empirical studies are divided with regard to the level of substitutability between the consumption of housing and the consumption of non-housing goods. The values range from 1.25 and higher (Davis and Martin, 2005; Piazzesi et al., 2007) to 0.5 or less (Flavin and Nakagawa, 2008; Hanushek and Quigley, 1980). The variety of empirical estimates of the substitutability between housing consumption and non-housing consumption are partly a result of the data used. Studies using macro level data estimate values larger than one whilst studies using household level data frequently estimate values much closer to zero. Aggregate macro level data will

likely mask any effects resulting from consumer life cycles for example, whereas household level data might be biased toward a certain type of household thus resulting in differing estimates. Thus many housing market models have used Cobb-Douglas specifications (elasticity of substitution of 1) for household preferences between housing and non-housing goods as a compromise between the various empirical estimates or to simplify numerical assumptions (Li and Yao, 2007).

Different values of ESUBU are used to investigate the impact of variations in consumer preferences and values vary between 0.1 and 1.6. Using 0.1 implies that households will consume housing and non-housing commodities in relatively fixed proportions and thus the relative price of housing has a limited effect on the consumption of housing. Increasing the value for this parameter increases the substitutability between the consumption of housing and non-housing commodities and so the relative prices will have a more marked affect on the patterns of household demand.

FIGURE 7-2 STRUCTURE OF UTILITY FUNCTION



At the initial level, the housing commodities are combined according to the elasticity ESUBH = 1 and this implies a Cobb Douglas function of the following form:

$$CH_j = \phi_j \prod_{i=1}^{h} HO_{ij}^{\gamma_i} \qquad s.t. \sum_i \gamma_i = 1$$

Where CH_j is the consumption of housing by household j, HO_{ij} is the quantity of housing commodity i consumed by household j, ϕ_j is a scale parameter, γ_i is a distribution parameter and h is the number of housing commodities.

Housing consumption, CH, then combines with consumption of the other non-housing commodity, CC, according to elasticity ESUBU to produce consumer utility:

$$U_j = \mu_j \left(\varphi_j CH_j^{\frac{(ESUBU-1)}{ESUBU}} + (1-\varphi_j) CC_j^{\frac{(ESUBU-1)}{ESUBU}} \right)^{\frac{ESUBU}{(ESUBU-1)}}$$

Where CH_j is the consumption of housing by household j, CC_{ij} is the quantity of non-housing commodities i consumed by household j, μ_j is a scale parameter, φ_j is a distribution parameter and U_j is overall level of consumer utility.

Since this is a regional model, the issue of migration is important. The final model is static and therefore migration cannot be determined endogenously. Thus, the level of net migration is determined exogenously as part of the counterfactual scenarios.

Although current research suggests that manual or unskilled labour households are much less mobile (McCormick, 1997), there will be natural changes in the numbers of unskilled labour households as new households are created, break up and some will migrate. The counterfactual scenarios therefore incorporate changes in the numbers of all labour owning households and all capital-owning households since housing factors cannot migrate. More details about the counterfactuals are given in section 7.3.8 on page 303.

7.3.5 Government

In the South West model, it is assumed that government receives income from taxes on factor inputs and distributes all of this income in the form of transfer payments. Although this does capture the impact taxes have on the use of factors, it does have implications for the use of the model to analyse shocks such as changes to the housing tax structure for example. However, this does not significantly impinge on the distribution of the impacts of interest here.

7.3.6 Dynamics

The durability of housing implies that households consume a flow of housing services and thus a dynamic model would be most appropriate. The theory presented in Chapter 2 suggests that the way in which consumers view housing depends upon the life cycle of the consumer (Silos, 2007). As such, the overlapping generations approach would be the most effective approach to incorporating a time dimension into the model. However, experimentation with an overlapping generations framework and a recursive framework both resulted in models with no solution. Thus, the final version of the model is a comparative static model. There is, however, further scope for incorporating dynamic elements into the model, a task that can be undertaken in future research.

The durability of housing, the transactions costs involved in changing levels of housing consumption and the nature of the services provided by housing all imply that consumers will optimise consumption of housing over a long time-period. However, the static model implies that consumers are optimising over a single time period which is clearly not realistic since consumers will be more likely to substitute consumption of other goods for the consumption of housing because the long term flow of services from housing is not considered. Thus, the importance of housing in the region may be underestimated.

7.3.7 Closure Rules

Investment and savings are not included in the final model and so a price clearing closure is adopted. Full factor employment is assumed with non-housing factors being mobile between sectors (with the exclusion of the housing service sector). The complete list of closure rules adopted for this model is given here.

Total demand for each commodity must equal total supply:

$$T_j = V_j + C_j + X_j$$

where T_j is the total supply of good j, V_j is the amount of good j supplied to domestic consumption (intermediate inputs), C_j is consumer demand for commodity j and X_j is the amount of j sold to exports.

Perfectly competitive product markets are assumed, hence the 'zero profits' condition holds for domestic output:

$$p_j Q_j = \sum_i p_{Vi} V_{ij} + \sum_k (1 + \tau_k) p_{Fk} F_{kj}$$

where p_j is the domestic price of good j, Q_j is the domestically produced quantity of good j and thus $p_j Q_j$ is the value of domestic output. Furthermore, p_{Vi} is the price of intermediate input i, V_{ij} is the amount of good i used as an intermediate input for good j, p_{Fk} is the price of factor k and τ_k is the tax rate for factor k.

The model includes an Armington composite and thus zero profits for total sector output are also assumed:

$$p_{Tj} T_j = p_j Q_j + p_{Mj} M_j$$

where p_{Tj} is the price of good j, p_{Mj} is the price of imports of good j and M_j is the quantity of imports of good j.

Factor demand is met by factor supply (i.e. full employment of all factors):

$$\sum_{i=1}^{n} F_{ki} = \sum_{j=1}^{m} E_{kj}$$

where E_{kj} are the endowments of factor k owned by household j, F_{ki} is the quantity of factor k demanded by industry i, m is the total number of households and n is the number of industries.

Households spend their entire income on consumption:

$$p_{Fk} E_{ki} + B_i = p_{Ui} U_i$$

where p_{Fk} is the price of factor k, B_i are the level of government transfers to household i and $p_{Ui}U_i$ is the total cost of utility for household i. Note that each household can only own one type of factor due to software restrictions.

Finally, we assume that the government distributes its entire income in the form of transfer payments. Therefore,

$$\sum_{k=1}^{m}\sum_{i=1}^{n}\tau_k p_{Fk}F_{ik} = \sum_{j=1}^{h}B_j$$

The full GAMS code for the model is listed in Appendix 1 on page 359.

7.3.8 Counterfactual Scenarios

The objective of this study is to contribute to a greater understanding of the operation of the South West housing market by developing a model of the regional housing market. Moreover, the model is used to examine the effects of demographic changes on the region's housing market and the impact of changes in housing supply as recommended in the *South West Regional Planning Guidance* (Government Office for the South West, 2001). This section describes the counterfactual scenarios incorporated in the model and, more specifically, how both demographic changes and the magnitude of changes in housing supply are derived.

The benchmark data set includes estimates for outputs, inputs and endowments in terms of values (price multiplied by quantity). Therefore, it is necessary to estimate the value of output from the new housing sector following the increase in supply. This is achieved by using data from the Survey of Mortgage Lenders (Council of Mortgage Lenders, 2001) detailing prices of new dwellings during 2001. The average price of a new dwelling is multiplied by the number of additional dwellings from the *Regional Planning Guidance* (Government Office for the South West, 2001) to provide an estimate for the value of output subsequent to the increase in supply.

The *Regional Planning Guidance* suggests that an additional 20,200 dwellings needs to be built annually during the period 1996 to 2016 in order to accommodate increases in population

arising from natural increase and net inward migration, and to address the issue of affordability. The sub-regional breakdown is given in Table 7-1. These figures are based upon supply and demand considerations such as population and household projections, net migration and forecasts for the performance of the regional economy. Much of this development is focused towards the Principal Urban Areas as outlined in Chapter 4.

TABLE 7-1 PROJECTED ADDITIONAL DWELLINGS PER ANNUM

County	Numbers	Estimated value of increased supply (£million) per annum
Avon	3,700	526
Cornwall	2,050	291
Devon	4,300	611
Dorset	2,650	376
Gloucs	2,400	341
Somerset	2,100	298
Wiltshire	3,000	426
South West	20,200	2,870
North	11,750	1,670
South	8,450	1,200

Source: Government Office for the South West (2001)

The benchmark data set within the model is expressed in terms of values in £ millions. Thus, the counterfactual scenarios examining the impact of changes in housing supply are created by adding 1.7 to the benchmark value of new housing sector output in the North and by adding 1.2 to the benchmark value of new housing sector output in the South.

The model is static and consequently, migration rates are determined exogenously and included in the model via a set of counterfactual scenarios. Changes to the numbers of households are integrated within the model as a percentage increase in the benchmark stock of non-housing factors of production.

Data for migration rates by occupational group are not available. Thus, an approximation was arrived at using percentages changes in employment by occupation available from the Labour Force Survey. The percentage changes in employee population for the North and for the South from 2001/02 to 2002/03 and from 2001/02 to 2005/06 for skilled labour (managers and senior officials, professionals, associate professional and technical, administrative and skilled trade)

and unskilled labour (all other occupation groups) are shown in Table 7-2. The percentage change in the endowments of each type of labour are then assumed to represent the migration rates for both types of labour included in the model. Furthermore, with a lack of any other evidence, it is assumed that capital shares the same migration rate as skilled labour.

TABLE 7-2: CHANGES IN FACTOR ENDOWMENTS

Region	Factor	2001/02 (000s)	2002/03 (000s)	2005/06 (000s)	% change 2001/02 to 2002/03	% change 2001/02 to 2005/06
North	Skilled labour	932	941	989.6	1.0	6.2
	Unskilled labour	505	501	472.3	-0.8	-6.5
South	Skilled labour	597	610	616.5	2.2	3.3
	Unskilled labour	355	355	380.4	0.0	7.2

Source: Labour Force Survey

The changes indicated in Table 7-2 are incorporated in the model by multiplying the benchmark factor endowments by the appropriate percentage. For example, the endowments of skilled labour and capital in the North are multiplied by 1.01 to represent changes over a single year and by 1.06 to represent changes over five years.

The full list of counterfactual scenarios used are listed in Table 7-3.

TABLE 7-3: SUMMARY OF COUNTERFACTUAL SCENARIOS

Scenario	Change in housing supply	Demographic changes	Time scale
1	Zero	All non-housing factors	1 year
2	Zero	All non-housing factors	5 years
3	RPG levels	All non-housing factors	1 year
4	RPG levels	All non-housing factors	5 years

7.3.9 Software and Solution Issues

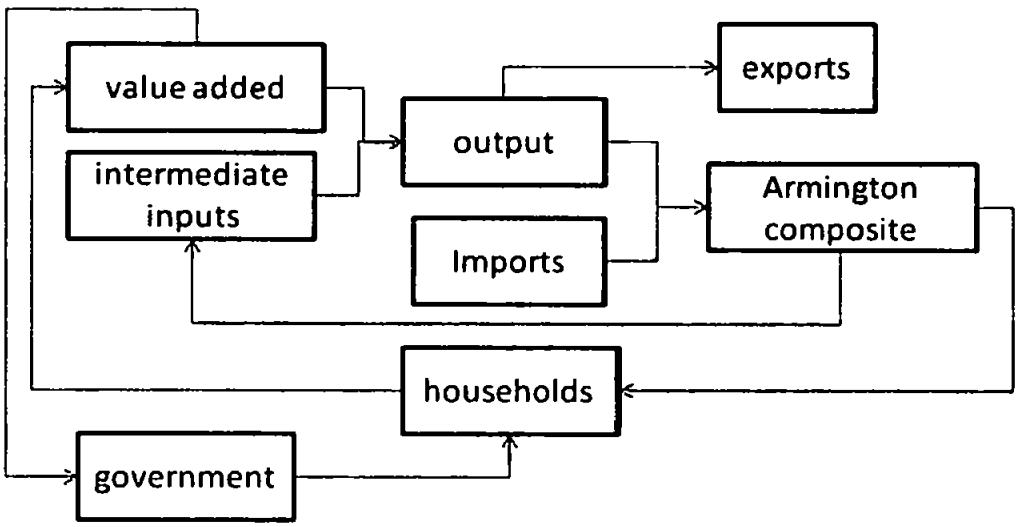
During development, there were difficulties with the solution and calibration of the model. The MPSGE software is particularly sensitive to differences in magnitude of the benchmark data. It is reported amongst users that successful solution of the model can be impeded by benchmark data sets where there are entries that differ significantly in terms of magnitude. As a result, there was some experimentation in terms of the level of aggregation of the underlying data set in order to find a solution to the model. This accounts for the changes made to the SAM

throughout the development process. This also precluded the inclusion of dynamics in the model at this stage. Although an overlapping generations model and a recursive model were developed with a similar overall structure to that of the final model, solutions could not be found for the benchmark data. A further discussion of these issues is included in the final chapter.

7.3.10 Model Summary

A diagrammatic summary of the final South West model is shown in Figure 7-3.

FIGURE 7-3 MODEL SUMMARY



To summarise, productive sectors use intermediate inputs and/or factors of production to produce domestic output. A proportion of domestic output is sold as exports and the remainder is combined with imports to produce an Armington composite. This composite is sold to households as final demand and to production as intermediate inputs. Taxes are paid on factor usage and the revenue government receives is redistributed to households as transfer payments. Households receive income from both factor ownership and transfer payments and use this income used to fund consumption of final demand. Counterfactual scenarios incorporate migration of factors, although in the current version of the model migration levels are not determined endogenously. The South West economy is open and hence the model includes a 'rest of the world' sector that incorporates all other areas outside the region. Moreover, this

sector also includes the other sub-region and thus the model includes transactions between the two sub-regions.

The final South West model captures the principal characteristics of the production of output and household behaviour within the economy. It is able to model the overall effects of supply shocks in any of the productive sectors, although the focus in this study has been on changes in the housing market. It allows the researcher to distinguish between the purchase of housing as a new good and the consumption of existing housing via the housing service sector where price is measured by imputed rent. The representation of the housing market also distinguishes between the quality of housing consumed. Housing factors are categorised according to whether they are of good quality (with central heating) or of poor quality (without central heating). Thus, the model also captures consumer choice between the different quality levels and this follows the hedonic pricing approach first introduced by Muth (1960).

Each household receives returns from only one type of factor, thus affecting the distribution of impacts resulting from shocks to the economy. This limits the potential application of the model, particularly for welfare studies. For instance, it would not be possible to examine the effects of changes in the level of housing supply on low-income households because households cannot be defined by any means other than the source of their income. This restriction results from the nature of the software used to code the model and the only resolution for this problem would be the use of alternative software packages such as a generic mathematical solver.

Housing is a durable good and as such, it provides services for multiple time-periods. However, the model is static and thus households are only optimising their consumption over one time-period. Therefore the future flow of services from housing is not incorporated into the decision making process. This could lead to the underestimation of the price of housing, although this is not certain since the omission of savings from the model means that there is no alternative store of wealth for households. This could be resolved by changing the model from a static to a dynamic specification.

7.4 Conclusion

The objective of this study is a contribution to knowledge of the housing market in the South West of England by the development of an economic model. Preliminary research indicated that a computable general equilibrium model would be the most appropriate framework given that this approach estimates the distribution of impacts via the detail incorporated in the benchmark data set (a social accounting matrix) in addition to modelling the impact of changing price levels since prices are determine endogenously. Moreover, computable general equilibrium models can be modified to incorporate dynamic elements, which could be of particular use for housing models.

The model captures the principal transactions in the economy and incorporates a more idiosyncratic treatment of housing that allows consumers to choose to allocate spending between new housing and existing housing (in the form of housing services). Since the latter is captured via a measure of imputed rent, this also incorporates the housing rental sector, albeit in a rather rudimentary fashion. Thus, the model can estimate the implications of changes to the housing sector although it is not limited to modelling supply side shocks. Specifically, the model is used to investigate the effects of demographic change, changing levels of housing supply and variations in household preferences on the regional housing market and regional economy. Demographic changes are incorporated by varying factor endowments according to percentage changes derived from Labour Force Survey data.

Changes in housing supply are incorporated into the model by adjusting the output of the new housing construction sector. The level of adjustments to output are estimated by assuming that the change in output is equivalent to the value of new dwellings sold. This figure is derived by taking values for average dwelling price by region, available from the *Survey of Mortgage Lenders* (Council of Mortgage Lenders, 2001), and multiplying this by suggested numbers of dwellings that need to be constructed according to the *Regional Planning Guidance* (Government Office for the South West, 2001).

The impact of household preferences is examined by changing the elasticity of substitution between housing consumption and non-housing consumption in the final level of utility production. Each of the counterfactual experiments is run using various different values for the elasticity, starting with a point at which households consume in relatively fixed proportions and then relaxing this assumption.

The final chapter in this thesis begins with the presentation and discussion of the results of the counterfactual scenarios. This includes an examination of the potential impact that changes in housing supply and demographic changes will have on the regional housing market and economy and an analysis of the effect of variations in consumer preference patterns. The chapter ends with an overview of the key conclusions from both the review of housing market research and the analysis of national and region housing markets, together with a reflective discussion upon that which has been learnt from the development of the model itself and an exploration of potential directions for future research.

8 RESULTS AND CONCLUSIONS

The objective of this study is an investigation of the behaviour of the housing market in the South West. To that end, the outcome of this research process is a computable general equilibrium model of the regional housing market incorporating both new housing and existing housing. It captures the principal characteristics of the regional economy and generates theoretically sound outcomes that will be described in this chapter.

This final chapter begins with a summary of the structure of the model, describing the key components and the overall operation of the model. Output from the counterfactual scenarios is presented together with a description of how the impacts are traced through the model. A sensitivity analysis is undertaken to examine how the model reacts to changes in the key parameters thus identifying how robust the model is to changes in assumptions. The chapter concludes with a discussion of the ways in which the model can be developed in the future in addition to this researcher's reflections upon the model building process.

8.1 The Bi-Regional CGE Model of the South West Housing Market

The model developed in this study has a bi-regional structure, representing two distinct sub-regions that exist within the South West. The North sub-region covers the north and southeastern areas of the South West and contains the largest urban centres in the region, these being Bristol, Bath, Bournemouth, Poole, Cheltenham and Swindon. The South sub-region comprises of western and central areas that are primarily rural with smaller urban centres such as Plymouth, Exeter and Torbay. All commodities, factors and households are distinguished by region of origin and thus the model is able to capture the broad structural differences between these two sub-regions.

The model includes three production activities for each sub-region and each activity produces a single commodity. These activities/commodities are a non-housing good, new housing and the housing service commodity. The non-housing good is the only commodity that is used as an intermediate input and is the only traded good. Output from the housing service sector is a measure of the services derived from the ownership of existing housing and thus the price of this commodity is the level of imputed rent.

There are five factors of production in each sub-region: capital, skilled labour, unskilled labour, good quality housing and poor quality housing. The production of both the non-housing commodity and the construction of new housing uses intermediate inputs and the primary factors, capital and labour. The housing service commodity is generated entirely from housing factors and uses no other inputs. Furthermore, it is assumed that capital and the two labour factors are mobile between the non-housing and the new housing construction sector. However, factors are assumed to be geographically immobile unless otherwise stated in the counterfactual scenarios.

Only output from the non-housing sector is traded outside the sub-region and this commodity is combined with imports at the final level of production to produce an Armington composite final demand commodity. Since the model is static and savings and investments are ignored, this implies that imports and exports must balance.

Factor usage is taxed and taxes are paid to the single government sector. All government revenue is redistributed to households in the form of transfer payments.

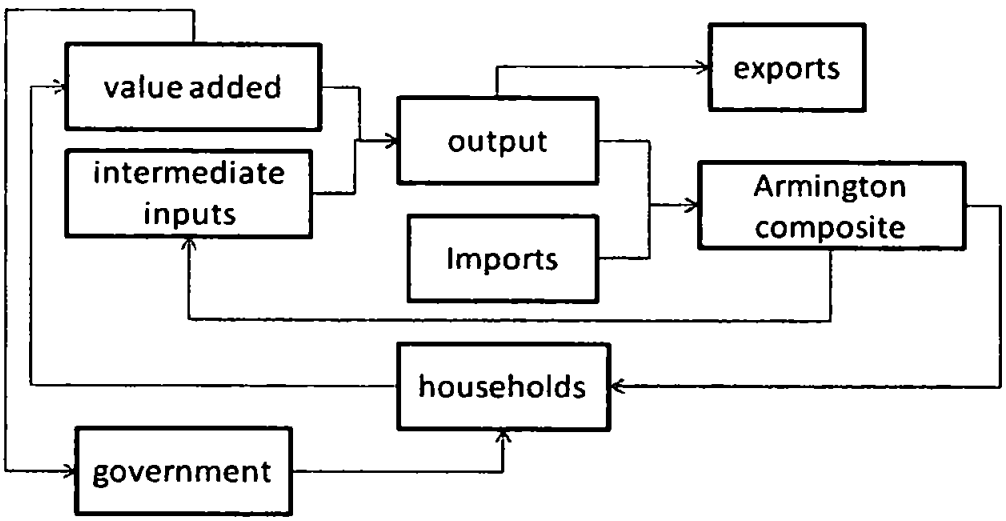
There are five households for each sub-region, each receives income from factor ownership, and some also receive transfer payments. Households own only one type of factor and thus this factor defines each household type. Household income is spent entirely on the consumption of final demand since the model does not include savings. Households optimise their utility by consuming a combination of a composite housing commodity, produced from optimal levels of new housing and the housing service commodities and the non-housing commodity.

The following section discusses the structure of the model and how relationships between the model components will impact the output of the model.

8.1.1 Summary of Model Structure

The model summary diagram is shown again here for reference.

FIGURE 8-1 MODEL STRUCTURE



The level of output from all productive sectors depends upon the level of demand and the quantity of available inputs and thus the price of output depends upon both the price of inputs and the level of demand for output.

The non-housing commodity is sold as final demand to households, as intermediate inputs to the new housing construction sector and as exports and uses inputs of skilled and unskilled labour and capital. Hence, the level of output and price of this commodity will depend upon the availability and relative prices of the three factor inputs, the level of household consumption and the level of production in the new housing sector. Since this is the only sector that either exports or imports and according to the model, exports and imports must balance, then the level of exports has no overall affect on the price of output from the non-housing sector.

Output from the new housing sector is sold entirely as final demand to households and uses inputs of labour and capital and the non-housing commodity. Thus, the level and price of output from new housing construction will result from the relative prices and availability of the factors, the price and availability of intermediate inputs of the non-housing commodity and the level of household consumption.

The housing service commodity is produced entirely from housing factors and sold only to households. Hence, the price of this commodity depends only upon the availability and relative prices of the housing factors and the level of household demand.

Households receive income from factor ownership and from government transfer payments. Since the government gathers revenue from the use of factors of production, household income will depend upon factor endowments and factor usage. For example, since full employment is assumed, if there is an increase in factor endowments, government revenue will also increase and thus household income will increase.

The following section describes the results of the counterfactual scenarios and explains how they result from the structure of the model. For the first set of counterfactual scenarios that model the effects of changes in the number of households and an increase in the supply of new housing, the elasticity of substitution between housing consumption and consumption of the non-housing commodity (ESUBU) in the utility maximization portion of the model is set at 0.8.

This is affords a compromise between the more extreme suggestions of 0.1 and values greater than 1. This means that the change in relative demand for the housing composite commodity and the non-housing commodity will be slightly smaller in magnitude in comparison to any change in their relative price. Thus, the response of household demand to changes in the relative price of the two commodities will be muted.

The results of the scenarios modelling demographic changes and changes in the level of housing supply are followed by an analysis of the effect of different patterns of consumer preferences as modelled by changes to the elasticity of substitution between the housing composite commodity and the non-housing commodity. Thus, the impact of the willingness of consumers to substitute housing consumption for consumption of non-housing commodities can be estimated.

8.2 Results of the Counterfactual Scenarios

The counterfactual scenarios are used to examine how changing numbers of households will affect the housing market and the potential impact of changing the level of housing supply in the South West according to the levels suggested in the *Regional Planning Guidance* document (Government Office for the South West, 2001). Model results are expressed as a percentage change from the benchmark data. Prices are calculated using a Laspeyres price index and a Hicksian equivalent variation measure is used to determine household welfare.

8.2.1 Scenario 1

The results presented here show the model output for the counterfactual scenario incorporating a change in non-housing factor endowments but no change in housing supply (Scenario 1 in Table 7-3 on page 305). Endowments of skilled labour and capital are increased by one percent in the North and by just over two percent in the South. Endowments of unskilled labour are decreased by 0.8 percent in the North and remain constant in the South. A summary of the counterfactual changes is given in Table 8-1 and the results are shown on the following page.

TABLE 8-1 SUMMARY OF COUNTERFACTUAL SCENARIO CHANGES

Region	Changes to factor endowments	
	Factor	% change 2001/02 to 2002/03
North	Skilled labour	1
	Unskilled labour	-0.8
South	Skilled labour	2.2
	Unskilled labour	0

Changes in Endowments of all non-housing factors (Timescale = 1 year)

TABLE 8-2 FACTOR INPUTS (SCENARIO 1)

Region	Sector	Capital	Skilled labour	Unskilled labour	Good quality houses	Poor quality houses
North	Non-housing good	0.969	0.986	-1.078	-	-
	New housing	1.368	1.385	-0.688	-	-
	Housing service	-	-	-	0.000	0.000
	Factor prices	*-0.361*	*-0.382*	*2.223*	*1.037*	*1.037*
South	Non-housing good	1.987	1.994	-0.029	-	-
	New housing	2.075	2.082	0.057	-	-
	Housing service	-	-	-	0.000	0.000
	Factor prices	*-0.473*	*-0.482*	*2.042*	*1.724*	*1.724*

TABLE 8-3 OUTPUT, PRICES AND HOUSEHOLD DEMAND (SCENARIO 1)

Region	Sector	Output	Prices	Total Household Consumption
North	Non-housing good	0.890	-0.155	0.894
	New housing	0.683	0.327	0.683
	Housing service	0.000	1.037	0.000
South	Non-housing good	1.618	-0.230	1.619
	New housing	1.569	0.071	1.569
	Housing service	0.000	1.724	0.000

TABLE 8-4 HOUSEHOLD WELFARE AND CONSUMPTION (SCENARIO 1)

			Consumption		
Region	Households	Welfare	*Non-housing*	*New housing*	*Housing services*
North	Capital	0.662	*0.765*	*0.449*	*-0.257*
	Skilled labour	0.826	*0.861*	*0.544*	*-0.162*
	Unskilled labour	1.060	*1.253*	*0.935*	*0.225*
	Good quality houses	0.850	*1.119*	*0.802*	*0.093*
	Poor quality houses	0.577	*1.056*	-	*0.101*
South	Capital	1.402	*1.629*	*1.551*	*-0.099*
	Skilled labour	1.475	*1.573*	*1.439*	*-0.209*
	Unskilled labour	1.404	*1.769*	*1.690*	*0.039*
	Good quality houses	1.199	*1.805*	*1.727*	*0.075*
	Poor quality houses	0.973	*1.760*	-	*0.194*

TABLE 8-5 REGIONAL IMPACTS (SCENARIO 1)

	South West
Govt Revenue	1.00
GDP	1.04

Following the model framework, changes to factor endowments will result in a change in factor usage as full employment is assumed. Therefore, an increase in factor endowments will be followed by an increase in factor usage and a decline in factor prices and looking at the results in Table 8-2 and Table 8-3, the use of capital and skilled labour in both sub-regions has increased and the price of both factors has decreased. Similarly, decreased endowments of unskilled labour in the North raises the price of unskilled labour. This leads to a reduction in the use of unskilled labour in the North as a result of reduced endowments and some substitution of unskilled labour. Endowments of unskilled labour remain constant in the South but the rise in the use of unskilled labour in the new housing sector leads to an overall increase in the price of this factor.

The output of the productive sectors will be affected by the availability of factors, relative factor prices, the price of intermediate inputs and overall levels of demand. The non-housing sector in both sub-regions is dependent on inputs of capital and skilled labour, using comparatively little unskilled labour and no intermediate inputs from the other two sectors (see the final SAM on page 270). Hence, the price of capital and skilled labour will have a significant influence on the price of output from the non-housing sector. Table 8-3 shows that although household demand for output from the non-housing sector increases, the price of output from this sector declines in both sub-regions due to the fall in the price of capital and skilled labour.

Production in the new housing sector uses inputs from the non-housing sector, capital and both skilled and unskilled labour. The magnitudes of these inputs are largely the same and the price of output from this sector faces competing pressures from both factor prices and changes in household demand. The increase in household demand and increased price of unskilled labour in both regions leads to a rise in price of new housing (Table 8-3) despite the decrease in the price of intermediate inputs and other factor inputs to the sector and the overall increase in output from the sector.

The housing service sector depends solely on inputs of housing factors. Since the endowments of these factors cannot change, the level of output cannot change, thus the price is determined

entirely by changes in household demand. Total household demand for housing services cannot change because output in the sector does not change (see Table 8-3) although patterns of consumption between households does change (see Table 8-4). Capital and skilled labour households reduce their spending on housing services in both regions, whilst all other households increase their consumption. This leads to a positive change in the price of housing services in both regions and the zero profits assumption results in a corresponding positive change in the price of housing factors.

Household welfare is determined by factor ownership, government transfer payments and the price of utility as a Hicksian equivalent measure is used. Although the price of skilled labour and capital declines in both sub-regions, the welfare levels of households owning capital and skilled labour increase (Table 8-4). This is due to rises in both factor usage and government transfer payments. However, the change in welfare also results from a fall in the price of the non-housing good as this commodity accounts for over half of all household consumption. Welfare increases for all households although those receiving income from owning poor quality houses experience the smallest rise.

The overall increase in welfare leads to a rise in consumption since households do not save (Table 8-4 and Table 8-3). Total household consumption of output from the non-housing sector and the new housing construction sector increases largely in line with output as changes in output are driven primarily by household demand. Consumption of housing services does not change since fixed endowments of housing factors mean that output in the sector remains constant. However, patterns of housing services consumption vary. Demand from capital and skilled labour households falls as they experience relatively small changes in welfare and substitute consumption of new housing for housing services. Skilled labour households and owners of good quality houses increase spending on all commodities although consumption of housing services rises by the smallest amount. Owners of poor quality households do not purchase new housing and so their entire income is split between spending on the non-housing commodity and housing services.

According to the SAM (see page 270), the government receives the majority of its revenue from taxes on the use of skilled labour, with taxes on capital and unskilled labour contributing approximately the same amount to government income. Consequently, the increased use of both capital and skilled labour leads to an overall increase in government revenue (Table 8-5). The positive change in government revenue means that there is a positive change to government transfer payments as noted already by the increase in household welfare for those in receipt of transfer payments.

Finally, regional GDP (Table 8-5) also increases as a result of increased output from the non-housing sector and the new housing sector.

To summarise, increased endowments of capital and skilled labour lead to reduced factor prices, increased output in the non-housing and new housing sectors, a decline in the price of output in the non-housing sector and increased government revenue. Changes in factor usage and the rise in government revenue lead to an increase in welfare for all households. The changes in endowments of unskilled labour have little impact other than to raise the price of that factor and to contribute to an increase in the price output from the new housing sector. Increased levels of household welfare lead to a rise in household consumption of the non-housing and new housing commodities. Although the overall consumption of housing services cannot change, unskilled labour households and all home-owners increase their consumption of housing services whilst capital and skilled labour households reduce their spending on housing services.

The greater burden placed on the region's housing market by a rise in the number of factor owners and thus an increase in the number of households, raises the price of new housing and housing services. However, the level of welfare rises for all households and regional output also increases. Thus, over the short term at least, assuming that all markets in the South West are initially in equilibrium, there seems to be little negative effect of allowing the market to determine the level of housing supply without any other intervention. As discussed in Chapter 2, changes in the housing market are slow to manifest, thus the next section investigates changes factor endowments over a longer period of time.

8.2.2 Scenario 2

This scenario incorporates changes in endowments of all non-housing factors of production but over a 5 year period. According to Labour Force Survey data (Table 7-2), endowments of skilled labour increase in both sub-regions although by approximately three percent less in the South (3.3%) than in the North (6.2%). Endowments in unskilled labour in the South increase by just over seven percent, yet endowments in the North decline by just over six percent. These changes are summarised in Table 8-6 and the results of this counterfactual scenario are presented on the following page.

TABLE 8-6 SUMMARY OF COUNTERFACTUAL SCENARIO CHANGES

Region	Changes to factor endowments	
	Factor	% change 2001/02 to 2005/06
North	Skilled labour	6.2
	Unskilled labour	-6.5
South	Skilled labour	3.3
	Unskilled labour	7.2

Changes in endowments of all non-housing factors (Timescale = 5 years)

TABLE 8-7 FACTOR INPUTS (SCENARIO 2)

Region	Sector	Capital	Skilled labour	Unskilled labour	Good quality houses	Poor quality houses
North	Non-housing good	5.877	5.945	-6.284	-	-
	New housing	7.479	7.548	-4.866	-	-
	Housing service	-	-	-	0.000	0.000
	Factor prices	*-1.858*	*-1.937*	*14.310*	*5.487*	*5.487*
South	Non-housing good	2.938	2.971	6.850	-	-
	New housing	3.373	*3.406*	*7.301*	-	-
	Housing service	-	-	-	0.000	0.000
	Factor prices	*-0.006*	*-0.046*	*-4.560*	*3.354*	*3.354*

TABLE 8-8 OUTPUT, PRICES AND HOUSEHOLD DEMAND (SCENARIO 2)

Region	Sector	Output	Prices	Total Household Consumption
North	Non-housing good	4.679	-0.594	4.706
	New housing	3.174	2.316	3.174
	Housing service	0.000	5.487	0.000
South	Non-housing good	3.574	-0.495	3.547
	New housing	4.354	-1.043	4.354
	Housing service	0.000	3.354	0.000

TABLE 8-9 HOUSEHOLD WELFARE AND CONSUMPTION (SCENARIO 2)

Region	Households	Welfare	*Consumption*		
			Non-housing	*New housing*	*Housing services*
North	Capital	3.942	*4.510*	*2.437*	*-0.643*
	Skilled labour	4.251	*4.440*	*2.369*	*-0.709*
	Unskilled labour	5.652	*6.727*	*4.610*	*1.465*
	Good quality houses	3.891	*5.372*	*3.282*	*0.177*
	Poor quality houses	2.100	*4.561*	-	*-0.290*
South	Capital	3.168	*3.503*	*4.414*	*-0.028*
	Skilled labour	3.528	*3.634*	*4.395*	*-0.046*
	Unskilled labour	2.569	*3.103*	*4.011*	*-0.414*
	Good quality houses	2.751	*3.644*	*4.556*	*0.108*
	Poor quality houses	1.912	*3.474*	-	*0.380*

TABLE 8-10 REGIONAL IMPACTS (SCENARIO 2)

	South West
Govt Revenue	3.634
GDP	3.861

The growth in endowments of capital, skilled labour and unskilled labour in the South result in an increase in the use of these factors (Table 8-7) since full employment is assumed. Correspondingly, there is a decline in the price of all of these factors with unskilled labour exhibiting the largest decrease. Change in the use of capital and skilled labour in the South are almost sufficient to offset the negative pressure on prices caused by raised levels of endowments and so the prices of both of these factors remain almost constant.

Since the non-housing sector is largely reliant on skilled labour and capital (see the final SAM on page 270), the price of output from this sector declines in both sub-regions (Table 8-8) as a result of the fall in factor prices. Nevertheless, the overall level of output does increase because of the change in factor availability and rise in demand from households. Output from the new housing sector also rises, whereas the price increases in the North yet decreases in the South. Since this sector uses inputs from all three non-housing factors in roughly equal proportions, the decline in endowments of unskilled labour in the North and the resulting higher price lead to a higher price for new housing and causes some substitution of this factor (Table 8-7). In the South, the decline in factor prices has resulted in a fall in the price of new housing. The level of output of housing services cannot change because endowments of housing factors are fixed, but the price rises due to changes in the spending patterns of households (Table 8-9).

Welfare levels increase for all households (Table 8-9) with unskilled labour households in the North and skilled labour households in the South experiencing the greatest changes. Although the price of capital and skilled labour in both regions declines as does the price of unskilled labour in the South, the increased levels of employment for all these factors will offset some of the effects of the price change on household welfare. Overall welfare levels rise, which is partly a result of changes in factor usage and partly due to transfer payments. The significant decline in unskilled labour endowments in the North leads to a relatively large increase in price, which in turn results in the largest positive change in welfare for these households.

In this scenario, the demographic changes put increased pressure on the housing market. The price of housing services rises in both sub-regions (Table 8-8). However, the rise in factor

endowments in the South and resulting decline in factor prices leads to an overall decrease in the price of new housing in the South. Regardless of the increase in the cost of housing, the impact upon households does not appear to be particularly onerous.

The model does not include any facility for new housing to become housing factors used in the production of housing services. Thus, in reality, endowments of housing factors should increase, leading to a decline in the price of housing factors and possibly a decrease in the price of housing services. However, the model assumes that the markets are in equilibrium and according to research discussed in Chapter 2 and the data presented in Chapters 3 and 4 it is likely that this is an unrealistic assumption. It is widely thought that there is excess demand rather than excess supply in the market (Barker, 2004), resulting in greater pressure on the price of new housing and housing services. This model cannot be used for the analysis of disequilibrium and since any changes to endowments of housing factors are directly related to the level of production in the new housing sector, to incorporate such changes would require a dynamic model. However, the model can be used to analyse the effect of increasing output in the new housing sector and the next two sections discuss the results of such an increase, firstly over a single year and then over 5 years.

8.2.3 Scenario 3

This scenario models the impact of an increase in the supply of new housing and changes to endowments of all non-housing factors measured over a single year. For this scenario, skilled labour and capital increase by one percent in the North and just over two percent in the South. Endowments of unskilled labour in the North decline by just under one percent and remains constant in the South.

The increase in the supply of new housing is estimated using figures from the Survey of Mortgage Lenders (Council of Mortgage Lenders, 2001) and suggested levels of house building outlined in the *Regional Planning Guidance* document (Government Office for the South West, 2001). According to these estimates the proposed value of annual increase in output of new housing building sector is approximately £1.7 million in the North and £1.2 million in the

South. These figures were incorporated into the model by creating a counterfactual scenario that added 1.7 to the value of the benchmark level of output of the new housing sector in the North and 1.2 to the benchmark value of output of the new housing sector in the South.

Table 8-11 summarises the changes included in this scenario and the results are shown the following page.

TABLE 8-11 SUMMARY OF COUNTERFACTUAL SCENARIO CHANGES

Region	Changes to factor endowments		Estimated value of increased supply of new housing (£million)
	Factor	% change 2001/02 to 2002/03	
North	Skilled labour	1	1,670
	Unskilled labour	-0.8	
South	Skilled labour	2.2	1,200
	Unskilled labour	0	

Increased supply of new housing and changes in factor endowments (Timescale = 1 year)

TABLE 8-12 FACTOR INPUTS (SCENARIO 3)

Region	Sector	Capital	Skilled labour	Unskilled labour	Good quality houses	Poor quality houses
North	Non-housing good	1.282	1.126	-0.279		
	New housing	-2.381	-2.531	-3.885		
	Housing service				0.000	0.000
	Factor prices	*1.938*	*2.134*	*3.936*	*-0.053*	*-0.053*
South	Non-housing good	2.372	2.173	0.856		
	New housing	-0.235	-0.428	-1.712		
	Housing service				0.000	0.000
	Factor prices	*1.827*	*2.075*	*3.744*	*1.704*	*1.704*

TABLE 8-13 OUTPUT, PRICES AND HOUSEHOLD DEMAND (SCENARIO 3)

Region	Sector	Output	Prices	Total Household Consumption
North	Non-housing good	1.109	2.241	1.179
	New housing	-2.935	-28.028	38.318
	Housing service	0.000	-0.053	0.000
South	Non-housing good	1.957	2.183	2.049
	New housing	-0.703	-17.436	23.128
	Housing service	0.000	1.704	0.000

TABLE 8-14 HOUSEHOLD WELFARE AND CONSUMPTION (SCENARIO 3)

Region	Households	Welfare	*Consumption*		
			Non-housing	*New housing*	*Housing services*
North	Capital	3.591	1.272	38.587	-0.204
	Skilled labour	1.958	1.193	38.479	-0.282
	Unskilled labour	6.289	1.903	39.449	0.417
	Good quality houses	6.023	-0.065	36.757	-1.522
	Poor quality houses	0.672	-0.237		1.590
South	Capital	4.393	2.162	23.713	0.430
	Skilled labour	3.829	2.158	22.852	-0.269
	Unskilled labour	5.956	2.349	23.940	0.615
	Good quality houses	7.001	0.983	22.285	-0.729
	Poor quality houses	-0.235	-0.422		-0.047

TABLE 8-15 REGIONAL IMPACTS (SCENARIO)

	South West
Govt Revenue	3.588
GDP	0.927

The most notable effect of the increase in the supply of new housing is the significant decline in the price of this commodity (Table 8-13). Since the economy is in equilibrium in the benchmark year, there can be no excess demand. The change in demand resulting from an increase in factor endowments is not sufficient to prevent the price of new housing declining to such an extent that the level of output declines when valued at current prices. In reality, there would be no economic reason why the supply of new housing would reach this level. In order to generate the amount of new supply suggested in the *Regional Planning Guidance* document it would be necessary to subsidise construction of new housing. However, since it is likely that the market is in disequilibrium, it is possible that there would be sufficient excess demand to mitigate the fall in the price of new housing. Without the means to model this possibility, it is difficult to determine whether the actual change in the value of output from this sector would be positive or negative.

Since output in the new housing sector falls, factor usage in this sector also declines (Table 8-12). As full employment is assumed, there is a rise in the use of factors in the non-housing sector with the exception of unskilled labour in the North where endowments of this factor actually decline overall. Although greater levels of endowments put downward pressure on factor prices, changing patterns of factor usage mitigate this effect. The outcome is that the price of non-housing factors rise in both regions. The results from scenario 1 show that the changes in factor endowments cause the prices of capital and skilled labour to fall, and so in this scenario the increase in the supply of new housing leads to changes in factor usage that result in an overall rise the price of these factors.

The results in Table 8-14 show that increased supply of new housing leads to significant rises in the levels of household welfare in comparison to the outcome of Scenario 1 (Table 8-4 on page 316). Much of this increase is a direct result of the positive change in factor prices and transfer payments. However, since the welfare measure is also dependent upon the price of household utility, the dramatic fall in the price of new housing means that welfare rises. Welfare levels increase for homeowners in the North and for the owners of good quality houses in the South. However, those households owning poor quality houses in the South experience a decline in

welfare. Although the price of poor quality houses in the South increases, these households do not receive transfer payments (this is a result of rounding in the SAM rather than any economic reason). Moreover, the owners of poor quality houses do not purchase new housing and thus the price of utility for these households is dependent upon the prices of the non-housing commodity and housing services, both of which increase.

Higher income levels leads to higher levels of demand (Table 8-14) and all households owning labour and capital increase their consumption of the non-housing commodity and new housing to a greater degree than in Scenario 1 (Table 8-4 on page 316). In terms of consumption of housing services, capital and skilled labour households in the North both decrease their consumption of housing services to largely the same extent as in scenario 1. The owners of good quality houses also reduce their spending on housing services as they increase their demand for new housing. Since the total consumption of housing remains the same, this means that both unskilled labour households and the owners of poor quality houses in the North increase their consumption of housing services. The net result of these changes in patterns of demand is a fall in the price of housing services and therefore a decline in the price of housing factors in the North. There is a similar variation in consumer spending on housing services in the South, although capital owners and unskilled labour households increase their consumption whilst all others reduce their consumption. These changes result in a positive change in the price of housing services in the South and corresponding change in the price of housing factors (Table 8-12 and Table 8-13).

In scenario 1, the prices of both types of houses in North rise (Table 8-2 on page 316) but in this scenario these prices fall (Table 8-12). The difference in price changes in the South is not significant but the increase in the prices of houses is slightly smaller in scenario 3. Thus, the effect of increasing the supply of new housing is to reduce the price of existing houses in the North and increase the price of existing houses in the South. Since excess demand cannot be accounted for, in reality there is likely to be sufficient levels of demand to offset any reduction in price caused by the rise in the level of output from the new housing sector.

The levels of government revenue and GDP increase in the South West in this scenario (Table 8-15). However, by comparing these results to those of scenario 1 (Table 8-5 on page 316), it is clear that the effect of increasing the supply of new housing is greater change to the level of government revenue but a more modest change to the level of GDP. This is as a result of the fact that there is insufficient demand for housing to stop the price of new housing falling to such an extent that the value of the new level of output is much lower than before.

The principal outcome of increasing the level of housing supply in both sub-regions is to drive down the price of new housing in both sub-regions and the price of existing housing in the North. Household welfare improves for all except the owners of poor quality houses in the South and total consumption of new housing and the non-housing commodity increase.

In reality, however, if there is insufficient excess demand in the market to offset the effects of the decline in the price of new housing, there will be no economic for firms to reach these new levels of supply. Thus, government would need to subsidise the sector and there could be serious long term implications for the level of competitiveness in the sector from a dramatic fail in price.

8.2.4 Scenario 4

This scenario modelled an increase in the supply of housing together with changes to factor endowments over a time scale of five years. This scenario includes an increase in endowments of capital and skilled labour of 6.2 percent in the North and 3.3 percent in the South. Unskilled labour endowments decrease by 6.5 percent in the North and increase by 7.2 percent in the South. Finally, output of the new housing sector is increased by £8,350 million in the North and £6,000 million in the South. These figures are calculated by multiplying the per annum values for change in housing supply estimated in Section 7.3.8 on page 303 by five to arrive at the change in output arising over 5 years. These changes are shown in Table 8-16 and the results of this scenario are presented on the following page.

TABLE 8-16 SUMMARY OF COUNTERFACTUAL SCENARIO CHANGES

Region	Changes to factor endowments		Estimated value of increased supply of new housing (£million)
	Factor	% change 2001/02 to 2005/06	
North	Skilled labour	6.2	8350
	Unskilled labour	-6.5	
South	Skilled labour	3.3	6000
	Unskilled labour	7.2	

Increased Supply and changes in endowments of all factors (Timescale = 5 years)

TABLE 8-17 FACTOR INPUTS (SCENARIO 4)

Region	Sector	Capital	Skilled labour	Unskilled labour	Good quality houses	Poor quality houses
North	Non-housing good	6.888	6.396	-3.924	-	-
	New housing	-4.658	-5.097	-14.30	-	-
	Housing service	-	-	-	0.000	0.000
	Factor prices	*4.276*	*4.879*	*19.14*	*0.730*	*0.730*
South	Non-housing good	4.337	3.619	10.297	-	-
	New housing	-5.020	-5.673	0.406	-	-
	Housing service	-	-	-	0.000	0.000
	Factor prices	*6.190*	*7.110*	*-0.934*	*0.792*	*0.792*

TABLE 8-18 OUTPUT, PRICES AND HOUSEHOLD DEMAND (SCENARIO 4)

Region	Sector	Output	Prices	Total Household Consumption
North	Non-housing good	5.383	5.905	5.621
	New housing	-8.157	-64.74	182.4
	Housing service	0.000	0.726	0.000
South	Non-housing good	4.795	6.069	5.099
	New housing	-4.031	-52.23	111.1
	Housing service	0.000	0.792	0.000

TABLE 8-19 HOUSEHOLD WELFARE AND CONSUMPTION (SCENARIO 4)

Region	Households	Welfare	*Consumption*		
			Non-housing	*New housing*	*Housing services*
North	Capital	13.55	6.143	184.2	-0.522
	Skilled labour	7.891	5.507	182.5	-1.118
	Unskilled labour	23.48	8.849	191.4	2.013
	Good quality houses	21.18	1.449	171.6	-4.922
	Poor quality houses	2.468	0.438	-	4.549
South	Capital	14.49	5.449	115.1	1.938
	Skilled labour	12.27	5.751	110.4	-0.284
	Unskilled labour	20.12	5.228	114.7	1.725
	Good quality houses	25.60	0.477	105.0	-2.869
	Poor quality houses	-2.53	-4.490	-	-0.510

TABLE 8-20 REGIONAL IMPACTS (SCENARIO 4)

	South West
Govt Revenue	10.95
GDP	2.567

As with the previous scenario, the most significant effect of an increase in the supply of new housing is a relatively large decline in the price of housing Table 8-18. This drives down the value of output from the sector to such a degree as to result in a negative change in the value of output. Despite changes to factor endowments, there is still insufficient demand to result in a positive change in the value of output from the new housing sector.

Table 8-17 shows that a negative change in output in the new housing sector leads to a negative change in factor usage apart from the unskilled labour in the South , where employment of this factor increases by 0.4 percent. This increase is partly a result of the fall in the price of unskilled labour because of the 7.2 percent rise in endowments of this factor.

Apart from unskilled labour in the South, the prices of all other factors increase because of changes in employment (Table 8-17). Since factor employment in the new housing sector decreases overall, factor employment in the non-housing sector rises, with the exception of unskilled labour in the North where endowments decline significantly and thus employment of this factor falls in both productive sectors. By comparing these results to those of scenario 2 (Table 8-7 on page 321), the positive change in the prices of capital and skilled labour are due to the increase in the supply of new housing. This is because full employment is assumed and therefore the decline in factor employment in the new housing sector must be met with an increase in employment in the non-housing sector.

The change in factor usage contributes to an increase in output from the non-housing sector in both sub-regions and a rise in the price of this commodity (Table 8-18). Output is also affected by consumer demand for the non-housing commodity. The rise in prices of most non-housing factors leads to an increase in welfare for almost all households (Table 8-19) which in turn leads to higher levels of consumer demand for new housing and the non-housing commodity. As previously mentioned, however, the rise in demand for new housing is not sufficient to prevent the price declining to such an extent to prevent a negative change in the value of output from this sector.

Total household spending on housing services remains constant but as with the other scenarios, the patterns of consumer spending on this commodity change (Table 8-19), leading to a change in the price of this commodity (Table 8-18). Rises in factor prices and increases in transfer payments as a result of the increase in government revenue (Table 8-20), lead to arise in the level of welfare that is sufficient for unskilled labour households in the North and South and capital households in the South to increase consumption of all three commodities. Capital and skilled labour households in the North substitute some of their spending on housing services for increased levels of spending on new housing. A similar pattern is observed for skilled labour households and the owners of good quality houses in the South.

The price of housing services, and thus the price of existing houses, increases slightly although to a lesser extent than in scenario 2 (Table 8-7 on page 321 where the impacts of changes in factor endowments are modelled over 5 years. Thus, the changes to the supply of new housing, depress the rise in price of existing housing.

Despite the positive change in the price of existing houses, the welfare level for the owners of poor quality houses in the South declines. As explained for scenario 3, these households do not receive transfer payments as a result of rounding in the SAM and since the rise in the price of houses is relatively small, the rise in the price of utility will be relatively higher than the rise in the income of these households leading to a decline in welfare.

In summary, the result of increasing the supply of housing over a 5 year period is an increase in the price of the non-housing commodity and housing services and a significant decline in the price of new housing. Overall, welfare levels of almost all households increase. Government revenue increases significantly (Table 8-20) as a result of changes in factor employment patterns, although the change in regional output is not as high as the scenario 2 (Table 8-10), which did not include a change in the output of the new housing sector. The problem is that without excess demand, the overall change in the value of output from this sector is negative which will put downward pressure on regional GDP.

8.2.5 Summary

This modelling process has illustrated the potential impacts of changes to factor endowments and the level of supply of new housing within the South West region. These results show that demographic changes put greater pressure on the housing market, leading to a rise in the price of both new housing and housing services. However, this does not have a particularly detrimental effect either on firms or households, since overall output rises and welfare levels also increase.

Increasing the supply of houses as well as the changes to endowments of factors has a generally positive effect on the region. Regional output still increases although to a lesser extent that in the case where just demographic changes are considered due to the decline in the value of output from the new housing sector. In general, households benefit as they experience a significant rise in their level of welfare with the exception of the owners of poor quality houses in the South.

The problems with this modelling process arise partly because the model assumes that the economy is in equilibrium in the benchmark year. Thus, situations of excess demand are not included and in this case, any increase in demand from changes in factor endowments is not sufficient to balance with the new levels of supply in the new housing sector. In reality, there may be excess demand for housing i.e. the market is in disequilibrium, and thus there is likely to be sufficient demand to meet the change in supply of new housing. This would mean that the decline in the price of new housing would be less dramatic than in the simulations presented here and would result in less downward pressure on the price of existing housing.

Furthermore, the structure of the SAM also has an effect on the results. A particular problem arises from the process of rounding that occurred during model development, which means, for example, that the owners of poor quality houses receive no transfer payments. This leads to lower levels of welfare than are likely to be seen in reality.

The simulations carried out in this section assume that the elasticity of substitution between the non-housing commodity and the housing composite in the utility maximisation block is 0.8 and thus the change in relative demand for the two commodities will be slightly less than the change in the relative price of the two. The next section examines the effect of changes in the patterns of consumer preferences by changing the elasticity of substitution between the housing composite and the non-housing commodity in the utility maximisation equation.

8.2.6 The Effects of Consumer Preferences

The impact of consumer preferences on the housing market and the local economy is modelled by changing the elasticity of substitution between the housing composite commodity and the non-housing commodity (ESUBU) in the utility maximisation block. This varies the degree to which the demand for housing is affected by changes in the relative prices of the housing composite and the non-housing commodity. The values of ESUBU used in this analysis range from 0.1 to 1.6. The value of 0.1 implies that the commodities are consumed in relatively fixed proportions so the change in the relative prices of the two commodities has little effect in the change in their relative demand. At the other extreme, an elasticity of 1.6 implies that the proportionate change in the relative demand of the two commodities will change to a greater degree than the proportionate change in the relative prices of the two commodities. If the price of housing declines relative to the price of the non-housing commodity then we would expect that households would be more willing to consume the housing composite at the expense of the non-housing commodity.

The results discussed in this section use the same changes to factor endowments and the supply of new housing as those used in scenario 4. The structure of the model is then altered slightly by varying the value of ESUBU.

Table 8-21 shows the effect that the value of ESUBU has on commodity prices.

TABLE 8-21 CHANGES IN COMMODITY PRICES

Region	Sector	0.1	0.6	1.1	1.6
North	Non-housing good	11.27	7.081	4.502	2.812
	New housing	-63.78	-64.54	-64.96	-65.18
	Housing service	-49.67	-10.60	14.59	31.80
South	Non-housing good	11.68	7.306	4.585	2.783
	New housing	-50.67	-51.89	-52.65	-53.11
	Housing service	-44.91	-8.96	12.11	25.26

These results show that whilst the value of ESUBU has a limited effect on the price of new housing, it has a more significant impact on the prices of the other two commodities. Changes in the price of the non-housing good are significantly higher for smaller values of ESUBU. Moreover, price changes in the housing services sector decline when the value of ESUBU is 0.6 or less and increase when ESUBU is 1.1 or greater. This is explained by the fact that as the elasticity increases, the housing composite becomes relative more attractive to consumers. Thus, demand for both housing commodities increases relative to demand for the non-housing product. Since the supply of housing services cannot change, when demand for housing rises, so the price of housing services rises. Supply in the new housing sector is not governed entirely by the market because the value of supply in this sector is increased as part of the counterfactual scenario. Therefore, household demand will have only a limited effect on the price of new housing.

Since price are expressed in terms of a Laspeyres price index, prices are measured against the overall price level. Since the change in price of housing services is positive and relatively large for higher values of ESUBU, there is a relative decline in the magnitude of the change in price of new housing.

Table 8-22 shows the effect of changes in consumer preferences on total household demand for each commodity.

TABLE 8-22 CHANGES IN TOTAL HOUSEHOLD DEMAND

Region	Sector	0.1	0.6	1.1	1.6
North	Non-housing good	9.431	6.559	4.385	2.670
	New housing	35.27	146.5	229.4	294.1
	Housing service	0.000	0.000	0.000	0.000
South	Non-housing good	12.46	6.803	2.908	-0.133
	New housing	21.99	90.69	137.3	173.4
	Housing service	0.000	0.000	0.000	0.000

Recalling the discussion of the results of scenarios 3 and 4, the effect of increasing supply in the new housing sector is to drive down the price of new housing. Therefore, household demand for new housing increases and spending on this commodity rises, whilst spending on the relatively more expensive housing services commodity declines. As the housing composite becomes less expensive relative to the non-housing commodity, household spending on the latter will decline.

The results indicate that increasing the elasticity of substitution makes new housing relatively more attractive to consumers as would be expected. The decline in the price of new housing has a much greater effect on the demand for housing when ESUBU is equal to 1.6 in comparison to the case when ESUBU is equal to 0.1. Although consumption for both new housing and the non-housing commodity increase overall, when the elasticity is high, the decline in the price of new housing encourages households to substitute the housing composite for the non-housing commodity. Chapter 2 discusses how consumers' views of housing have change over the last century. In particular, houses are treated as a store of wealth much more frequently since changes in the financial sector made it easier to buy and sell property. Therefore, it is very possible that consumers are becoming more responsive to changes in the relative price of housing.

The results in Table 8-23 show the effect on output levels of changing the value of ESUBU.

TABLE 8-23 CHANGES IN OUTPUT

Region	Sector	0.1	0.6	1.1	1.6
North	Non-housing good	8.302	6.104	4.432	3.109
	New housing	-56.01	-19.84	7.131	28.16
	Housing service	0.000	0.000	0.000	0.000
South	Non-housing good	10.56	6.133	3.073	0.681
	New housing	-44.55	-13.32	7.853	24.27
	Housing service	0.000	0.000	0.000	0.000

The value of ESUBU has a significant effect on the level of output in both the new housing and non-housing sectors. When the elasticity of substitution is high, the level of output in the new housing sector rises. This is a direct result of the increase consumer demand, which is much greater when consumers are more responsive to changes in the relative price of housing. Despite the fact that the economy is assumed to be in equilibrium in the benchmark year and therefore there is no excess demand, when ESUBU is high, the rise in demand for new housing is sufficient to offset the change in the price and thus results in a positive change in output.

If the elasticity of substitution is high, this means that as the increase in supply drives down the price of new housing, households become more willing to substitute consumption of the non-housing commodity for the relatively less expensive housing composite. This then contributes to increased demand for new housing (Table 8-22) and compensates for the decline in the price of output, resulting in a positive change in the value of output from the new housing sector.

At higher values of ESUBU, output in the non-housing sector increases by much less as the change in consumer demand for this commodity also declines. This suggests that as housing supply increases and when the elasticity of substitution is relatively high, consumers desire for the non-housing commodity remains relatively fixed and thus output in this sector changes relatively little.

The changes in factor price resulting when the value of ESUBU is varied are shown in Table 8-24.

TABLE 8-24 CHANGES IN FACTOR PRICES

Region	Factor	0.1	0.6	1.1	1.6
North	Capital	8.382	5.146	3.272	2.133
	Skilled labour	11.98	6.464	2.951	0.557
	Unskilled labour	13.98	17.76	21.09	24.03
	Good quality houses	-49.67	-10.60	14.59	31.80
	Poor quality houses	-49.67	-10.60	14.59	31.80
South	Capital	9.906	6.99	5.267	4.246
	Skilled labour	15.68	8.991	4.827	1.965
	Unskilled labour	-8.708	-2.726	1.422	4.877
	Good quality houses	-44.91	-8.96	12.11	25.26
	Poor quality houses	-44.91	-8.96	12.11	25.26

Increasing the value of ESUBU causes changes in the price of capital and skilled labour to become smaller. This occurs because both these factors are employed primarily in the non-housing sector and as the change in output of this commodity becomes smaller, changes in factor employment in this sector will also become smaller. Similarly, unskilled labour is employed mainly in the new housing sector and so changes in the price of this factor reflect changes in the level of output from this sector.

Since endowments of housing factors cannot change and thus output of housing services cannot change, the variation in factor price matches the variation in the price of housing services. Thus, as housing services become relatively more attractive (because the households become more responsive to changes in the relative price of the housing composite and the non-housing good), existing houses become relatively more expensive.

Changes in welfare levels are given in Table 8-25.

TABLE 8-25 CHANGES IN WELFARE

Region	Factor	0.1	0.6	1.1	1.6
North	Capital	14.50	13.75	13.32	13.09
	Skilled labour	10.36	8.490	7.114	6.060
	Unskilled labour	21.36	22.87	24.38	25.82
	Good quality houses	-22.92	11.42	32.98	47.41
	Poor quality houses	5.519	3.133	2.062	2.621
South	Capital	18.18	15.24	13.66	12.80
	Skilled labour	15.87	13.04	11.37	10.27
	Unskilled labour	21.58	20.27	20.20	20.82
	Good quality houses	-22.92	15.86	36.60	49.04
	Poor quality houses	-33.54	-8.015	3.542	10.72

As a Hicksian equivalent measure is used in this model, welfare levels are directly influenced by factor incomes, transfer payments and the overall price of utility.

Variations in the levels of welfare largely follow the patterns of changes in factor prices. For example, the change in welfare levels of capital and skilled labour households decrease as housing becomes relatively more attractive. However, changes in the welfare level of the owners of poor quality houses in the South actually become smaller as the value of ESUBU becomes larger and changes in the price of this factor become larger. This occurs for two reasons. Firstly, these households receive a significant proportion of their income from transfer payments, and the level of transfer payments does not change to the same extent as factor prices. Secondly, these homeowners do not consume new housing and so the price of utility for these households is dominated by the price of the non-housing commodity and housing services.

8.2.7 Summary

The analysis in Sections 8.2.3 and 8.2.4 has shown that if consumer demand is not sufficient to absorb the increase in housing supply, then there is no economic incentive for firms to produce at that level. In reality, suppliers of new housing would have to be subsidised to encourage them to increase output to the levels used in the model. However, changing the elasticity of substitution between housing and the non-housing commodity in the utility maximization problem shows that if consumers are relatively responsive to changes in the price of housing,

the new levels of housing supply are absorbed. Hence, there is a positive change in the level of output in the new housing sector and suppliers would not have to be subsidised. Moreover, if household demand is more responsive to changes in the relative price of housing, welfare levels increase for all households.

This analysis presented here has shown the effect that demographic changes may have on the housing market and the wider economy in the South West. It has also illustrated the impact of increasing the supply of new housing according to levels suggested in the *Regional Planning Guidance* document (Government Office for the South West, 2001).

The next section discussion presents a sensitivity analysis of the model. This tests the robustness of the model output to changes in model parameters.

8.3 Sensitivity Analysis

A sensitivity analysis is carried out in order to assess the robustness of the model with regard to changes in model parameters. It this case, the model elasticites are being tested. A summary of the elasticities in the model are given in the table below.

TABLE 8-26 MODEL ELASTICITIES

Elasticity	Description	Initial model value
ELASVA	Elasticity of substitution for production of composite VA	0.8
ELASS	Elasticity of substitution for top level of domestic production	0
ELASARM	Armington elasticity	2
ESUBH	Elasticity of substitution for housing consumption	1
ESUBU	Elasticity of substitution for all consumption	0.1

In order to conduct the sensitivity analysis, the model was set up with changes to endowments of capital and skilled labour but no increase in the supply of housing although the effects of counterfactual are not of importance and this is used merely as a comparison to analyse the effects of changing elasticities. The variable used to compare the outcomes of the counterfactual experiments was welfare.

8.3.1 Results of the Sensitivity Analysis

The sensitivity analysis was carried out by running a series of counterfactual experiments that substitute different values for each elasticity. The first experiment involves the elasticity, ELAVA, used in the production of the composite value added good.

TABLE 8-27 ELASTICITY OF SUBSTITUTION BETWEEN FACTORS (ELASVA)

		Value of Elasticity				
		0.1	0.5	1	2	8
North	Capital	-0.185	0.607	0.717	0.774	0.817
	Skilled labour	-1.278	0.892	1.035	1.098	1.143
	Unskilled labour.	5.021	1.709	0.927	0.562	0.299
	Good houses.	-0.003	2.245	1.945	1.806	1.706
	Poor houses	-2.33	0.878	0.896	0.902	0.907
South	Capital	-56.547	1.944	2.518	2.802	3.013
	Skilled labour	-65.818	2.037	2.662	2.934	3.124
	Unskilled labour.	196.481	4.142	1.825	0.771	0.019
	Good houses.	119.086	5.519	4.424	3.938	3.597
	Poor houses	73.251	4.357	3.402	2.976	2.676

It should be noted that the model would not converge with a value of 0 for ELASVA. Therefore, factors could not be combined in fixed proportions. Low levels of factor substitutability result in large increases in factor income for those factors that are relatively scarce. For example, in the South, the benchmark data set shows that unskilled labour is relatively scarce and yet is used in the production of both new houses and the non-housing good. Therefore, reducing the level of substitutability will push up the price for unskilled labour and hence will increase factor income. By contrast, as the elasticity of substitution increases, factor income for unskilled labour still increases but increase become relatively small in comparison to those factors that are in abundance such as skilled labour.

TABLE 8-28 ELASTICITY OF SUBSTITUTION VALUE ADDED AND INTERMEDIATE INPUTS (ELASS)

		Value of Elasticity				
		0	0.5	1	2	8
North	Capital	0.689	0.688	0.687	0.686	0.677
	Skilled labour	1.001	1.003	1.005	1.009	1.033
	Unskilled labour.	1.115	1.109	1.103	1.092	1.03
	Good houses.	2.017	2.015	2.014	2.01	1.993
	Poor houses	0.892	0.893	0.894	0.896	0.909
South	Capital	2.376	2.374	2.373	2.371	2.359
	Skilled labour	2.516	2.523	2.529	2.542	2.613
	Unskilled labour.	2.376	2.362	2.347	2.319	2.16
	Good houses.	4.682	4.673	4.664	4.647	4.551
	Poor houses	3.627	3.62	3.612	3.597	3.514

Table 8-3 shows that changing the level of substitutability between the value added composite good and intermediate inputs has very little effect on factor incomes. Factor incomes change by almost the same quantity regardless of the value of the elasticity. This is likely to be a result of the fact that only the new housing sector uses intermediate inputs and therefore this has very little impact on the model.

TABLE 8-29 ARMINGTON ELASTICITY (ELASARM)

		Value of Elasticity		
		0	1	2
North	Capital	0.732	0.692	0.689
	Skilled labour	0.786	0.985	1.001
	Unskilled labour.	0.863	1.097	1.115
	Good houses.	1.396	1.972	2.017
	Poor houses	0.413	0.857	0.892
South	Capital	2.475	2.383	2.376
	Skilled labour	2.876	2.541	2.516
	Unskilled labour.	2.95	2.417	2.376
	Good houses.	5.315	4.726	4.682
	Poor houses	4.093	3.661	3.627

Only the non-housing goods use imports and hence changes in the degree of substitutability between imports and domestic output are unlikely to have an effect on the model. This is confirmed by the results shown in Table 8-30 that indicate very little sensitivity to changes in the Armington elasticity.

TABLE 8-30 ELASTICITY OF SUBSTITUTION IN HOUSING CONSUMPTION (ESUBH)

		Value of Elasticity				
		0	0.5	1	2	8
North	Capital	3.629	0.452	0.689	0.79	0.86
	Skilled labour	2.118	0.907	1.001	1.041	1.068
	Unskilled labour.	6.439	0.7	1.115	1.293	1.416
	Good houses.	-21.964	3.888	2.017	1.215	0.66
	Poor houses	1.408	0.873	0.892	0.9	0.906
South	Capital	5.057	-0.195	2.376	2.866	3.125
	Skilled labour	3.781	1.288	2.516	2.747	2.868
	Unskilled labour.	6.266	-1.197	2.376	3.072	3.442
	Good houses.	-9.945	18.403	4.682	2.026	0.617
	Poor houses	-7.489	13.264	3.627	1.675	0.627

The results in Table 8-30 show that the model is particularly sensitive to changes in the elasticity of substitution of housing. Changing from a Leontief specification (elasticity = 0) to an elasticity of 0.5 actually results in a sign change for some of the variables. For instance, income from good housing in the North decreases when a Leontief specification is used possibly because endowments of good quality housing are four times the endowments of poor quality housing. Consequently, when housing are used in fixed proportions, scarcity of poor houses therefore governs the output of the housing service sector.

The model is less sensitive to changes in values that are close to 1. The actual value chosen for the model was 1. Although this was not based upon any previous analysis, a Cobb-Douglas specification was chosen because it was a compromise between Leontief, which is unrealistic for the choice between the housing service and new housing, or a CES where the value chosen would be rather arbitrary.

TABLE 8-31 CONSUMPTION ELASTICITY OF SUBSTITUTION FOR ALL COMMODITIES (ESUBU)

		Value of Elasticity				
		0	0.5	1	2	8
North	Capital	0.664	0.747	0.781	0.812	0.846
	Skilled labour	0.975	1.061	1.096	1.128	1.168
	Unskilled labour.	1.099	1.152	1.173	1.191	1.202
	Good houses.	2.266	1.435	1.091	0.785	0.429
	Poor houses	0.88	0.917	0.931	0.944	0.96
South	Capital	2.258	2.648	2.808	2.949	3.103
	Skilled labour	2.417	2.748	2.885	3.009	3.171
	Unskilled labour.	2.292	2.572	2.685	2.779	2.834
	Good houses.	5.409	2.984	1.986	1.099	0.069
	Poor houses	4.154	2.379	1.632	0.959	0.166

The table above shows that changing the elasticity of substitution in the top level of the utility function has very little effect on the outcome of the model. Only good quality housing both regions and poor quality housing in the South appear to be sensitive to changes in this elasticity. Since housing factors are used only in the production of the housing service, any changes that may reduce the consumption of this commodity will have a significant effect on the use of the housing factors. In this case, because increasing the degree of substitutability between all goods

will impact consumption patterns, the housing factors will be affected more than the factors, such as capital, that are used in the production of both the non-housing good and new housing.

8.4 Conclusions

This final section of the thesis establishes the importance of the housing market in the UK and in the UK regions and thus the importance of furthering our understanding of the operation of the market and the impact of changes to the housing market, particularly in the South West. The economic model developed in this research is assessed and finally, areas for future development of this model are discussed.

8.4.1 Why is the housing market important?

Housing is linked to the health of the UK economy through various channels, perhaps most significantly through the use of housing as a store of household wealth and thus its relationship with household consumption. The owner occupied sector represents the largest of the tenure groups with approximately 70 percent of households in the UK owning or buying their own property. Rising house prices increase the value of housing assets belonging to home owners, that can be used to fund consumption by liquidating these assets or by accessing secured credit (Cocco et al., 2005; Silos, 2007). This of particular importance to credit constrained households whereby increasing housing wealth may give them greater access to credit. Consequently, links between rising house prices and levels of household indebtedness have also been found (Disney et al., 2003).

It is widely acknowledged that fluctuations in the housing are responsible for significant proportion of the volatility in the UK macro economy (Cooper, 2004) in addition to being a major driver of urban economies (Gibb and Hoesli, 2003; Kenny, 1999; Muellbauer and Murphy, 1997). Research has indicated the existence of significant correlations between real house price growth and variables such as real GDP, unemployment, interest rates and inflation (Borio and McGuire, 2004; Capozza et al., 2002; Englund and Ioannides, 1997; Tsatsaronis and Zhu, 2004). Furthermore, there is also empirical evidence to suggest that housing cycles and overall cycles of economic growth are also linked (HM Treasury, 2003; Miles, 2004; Muellbauer and Murphy, 1997).

In terms of the micro economy, there are significant welfare and distributional effects associated with changes in the price of housing, in addition to effects on the corporate sector. Homeowners benefit from increasing prices resulting in rising housing wealth, whilst those who do not already own their own property find themselves with problems of affordability (Barker, 2003; Miles, 1994). Thus, rising house prices serve to widen the welfare gap between those who do and those who do not own dwellings. Furthermore, empirical research points to a possible link between property prices and the rate of business failures because entrepreneurs often fund business activities from collateral raised against property that they own (Vlieghe, 2001). Hence when house prices are rising, creditors are less likely to force debtors into insolvency because the risk to loan repayment has been reduced (Fabling and Grimes, 2005).

Important links between the housing market and the labour market have been shown where the mobility of workers is significantly affected by relative house price differentials between regions (Harrigan et al., 1986; Jackman and Savouri, 1992; Potepan, 1994). Flexibility in the labour market is compromised when high relative house prices discourage migration and this in turn has a negative effect on unemployment rates in addition to serious wage effects in tight labour markets. Rising house prices may also lead to an expectation of an increase in future wages, which has been found to depress firm migration (Cameron and Muellbauer, 2001).

Thus, the housing market affects the micro and macro economies in a variety of ways. However, understanding the housing market is particularly challenging and modelling the behaviour of the housing market even more so.

Understanding the Housing Market

As a commodity market, the housing market is anomalous for several reasons. The dual nature of housing (it is both a provider of services and a store of wealth), inelastic supply, a well-developed secondary market and a high level of informational inefficiency mean that housing is a particularly complex commodity to analyse.

Demand for housing is driven primarily by price, household income, interest rates and other factors such as transactions costs (Wilkinson, 1973). Theory suggests that changes in the price of results in three distinct effects on demand (Harrington, 1989; Nordvik, 2001):

- a direct effect - increasing prices means decreasing demand;
- a wealth effect - increasing prices means the value of life-time income decreases, reducing demand;
- a transactions effect - high prices, reduces demand and reduces the volume of transactions.

Reality is never so clearly defined as, for example, rising prices mean that housing assets are more valuable and thus become attractive as a store of household wealth or as a means of securing credit (Campbell and Cocco, 2007; Case et al., 2003; Muellbauer and Murphy, 1990; Ortalo-Magné and Rady, 2006).

Empirical research has demonstrated that the supply of housing in the UK is price inelastic in the short run, although it is more responsive to price changes in the long-run. Yet estimates of the magnitude vary widely. For the UK, Malpezzi (1996) estimated a long run elasticity of supply of between 0.9 and 2.1 (using post 1945 data) whilst estimates for English counties by Bramley (1993) ranged from 0.15 to 1.8. The degree of inelasticity of housing supply is due partly to such factors as the time taken for construction, the availability of land with suitable planning permission and the nature of planning regulations in the locality (Monk and Whitehead, 1996).

Over the long run, supply and demand of housing tends to be more elastic. Nevertheless, the market does not adjust smoothly to the new equilibrium after shocks in demand or supply because of the spatial fixity of housing, the productivity of the construction sector, availability of land and so on (Evans, 1996; Le Grand et al., 1992). Thus, disequilibrium is a common characteristic of the housing market (Maclennan, 1982).

8.4.2 The UK Housing Market

During the early part of the last century, UK government policy was aimed primarily at increasing the supply of housing in order to overcome shortages after the Second World War. Once the most pressing shortages had been addressed and inner city slums were cleared, the focus of policy initiatives shifted from supply to demand. In the latter half of the 20th century successive UK governments proceeded to deregulate and privatise the housing market in an attempt to make it more efficient. Social housing was vastly reduced and households were encouraged, through a series of policies including the liberalisation of the mortgage market, to become owner-occupiers. These policies have largely succeeded and the proportion of homeowners in the UK has gradually increased, reaching the point where 70 percent of households are now owner occupiers.

Despite increasing levels of home ownership, recent trends in the housing market have been of concern. Specifically, the rise in mortgage debt has led to UK housing market becoming increasingly sensitive to changes in interest rates. This effect is due specifically to the proliferation of variable rate mortgages in the UK and has serious consequences for the use of the interest rate as a monetary policy instrument.

The relative inelasticity of housing supply has already had a serious impact on the UK economy. A study by Blake (2003) estimated that increasing the price elasticity of housing supply between 1994 and 2002 would have resulted in the following:

- An estimated 82,000 to 380,000 new houses would have been constructed;
- UK GDP would have likely increased anything up to £16 billion;
- An extra 150,000 to 650,000 new jobs would have been created.

Thus, UK housing policy is now aimed at stimulating the supply of new housing. The planning process is under reform and changes such as the recycling brownfield land have been incorporated, in addition to funding being made available for new infrastructure.

8.4.3 UK Regional Housing Markets

Regional housing markets in the UK are diverse, which has significant implications for the macro and micro economy. Tenure structure, relative house prices and employment opportunities influence household migration with net flows observed from regions with high house prices to regions with low house prices. Households in areas with a high degree of owner-occupation and/or high a proportion of social renting are generally less mobile than households located in areas with a large private rental sector. Supply and demand mismatch has resulted in rising house prices and significant increases in the ratio of house prices to average income in all areas.

Thus, regional housing markets have a significant influence on the UK economy, primarily via the effects of tenure structure and price differentials on labour mobility. This in turn affects national levels of unemployment and wages. Moreover, at the local level, housing markets can influence levels of population, unemployment and migration of both firms and households.

Despite the importance of regional housing markets, specific regional housing policies set by regional housing bodies is a recent phenomenon, only becoming part of the UK policy framework in the 1990s. However, regional governments are now required to produce regional planning documents that set out the location and quantity of new housing development.

8.4.4 The South West Housing Market

The South West "is one of the most desirable parts of the country in which to live." (South West Regional Assembly, 2008). In recent years, the region has made population gains from net in-migration, largely from age groups over 25 and with an age structure skewed towards older residents, there is also a greater proportion of owner-occupiers and private renters in the South West when compared to the national averages for England, Wales, Scotland and Northern Ireland.

With the increase in population comes an increase in the number of households and greater pressure in the regional housing market. The policy document, *Regional Planning Guidance for*

the South West (Government Office for the South West, 2001) set out levels of net additional housing required in the region in order to meet increasing demand and to address the issue of undersupply. These calculations are based on population projections and forecasts of household formation rates and have been called into doubt due to the possibilities of over or underestimation (Gallent, 2005). Either situation would have serious consequences for the region: under estimation would result in insufficient housing thus upward pressure on prices, and over estimation resulting in vacant properties or local infrastructure being overwhelmed.

It is therefore important to be able to assess any possible effects of changes in the housing market prior to the implementation of any policy.

8.4.5 Regional Economic Modelling

Modelling the impacts of exogenous shocks in regional economies is generally accomplished by using one of five general approaches and these are multipliers, input-output (IO) models, econometric models, social accounting matrices (SAM) and finally, computable general equilibrium models (CGE). Multipliers are relatively simple and inexpensive and yet still provide estimates of the magnitudes of impacts. However, this technique incorporates a limited level of detail and so is useful for studies where only the overall impact is of interest. By contrast, IO and SAM models are much more detailed and can be used to trace expenditure impacts through the productive sectors, in the case of IO models, and through both the productive sectors and household sectors in the case of SAM models. The major problem with these techniques results from the detail incorporated into the transactions tables, which places heavy burden on data requirements.

The overall aim of this study is the development of a model to analyse the economic impact of increasing the level of supply within the housing market in the South West. Thus, techniques that are unable to model changes to supply were immediately ruled out. As such, the final choice was made between econometric IO models (an amalgamation of the econometric and IO approaches) and CGE models. The CGE technique was selected for three key reasons. Firstly, it is possible to examine supply-side shocks using CGE models, something that cannot be

accomplished with IO models for example. Secondly, distributional detail is achieved via the incorporation of a benchmark data set in the form of a SAM. Finally, a clear economic framework is integral to the approach, which avoids the need to choose an economic structure for the model. Since policy-makers are commonly interested in the direct and indirect effects of both national and regional policy measures, CGE models have an advantage over other forms of economic modelling because they avoid the need for excessive aggregation yet account for the interaction of the different macro and micro interrelationships (Iqbal and Siddiqui, 2001).

8.4.6 A Bi-Regional Model of the South West Housing Market: An Assessment

The final version of the model captures the principal characteristics of the production of output and household behaviour within the economy. It is able to model the primary transactions between the key components of the economy, albeit using a static approach. Furthermore, the model incorporates a relatively unusual treatment of the housing sector in that it allows consumers to choose to allocate spending between new housing and existing housing (in the form of housing services). Since the latter is captured via a measure of imputed rent, this also incorporates the housing rental sector, albeit in a rather rudimentary fashion. Thus, the model can be used to estimate the implications of changes to the housing sector, which is one the primary aims of this. The model is not limited to supply side shocks but could potentially assess demand side shocks such as changes in the number of households, which could be achieved by changing endowments of the different factors of production.

Standard functional forms have been used to represent both the production of industrial output and the production of utility for two main reasons: firstly, to increase the likelihood of finding a model solution and secondly, they are easily understood and therefore transparent in terms of their operation. Although there has been considerable debate about the applicability of standard functional forms (Partridge and Rickman, 1998), more general forms incorporate a greater number of parameters and hence may lead to solution issues. Since models provide 'insights' rather than 'truths', transparency in the construction of the model is of key importance. Thus, choosing standard function forms that can adequately represent the productive elements of the

model whilst retaining a degree of intelligibility is an acceptable compromise. Moreover, functions can be nested using suitable elasticities of substitution to represent interim stages in the production process, thus incorporating a greater degree of flexibility in the specification of the model.

The static nature of the model means that producers and households are myopic. However, housing produces a flow of services over multiple time-periods. Thus, in reality, consumption of housing takes into account the flow of services. The model is therefore likely to underestimate the importance of housing in the consumption decisions of households and hence will affect the estimated impact the housing market has on the region. Nonetheless, the omission of savings from the model means that there is no alternative source of wealth for households. Household income is therefore spent entirely on consumption, which could potentially over estimate the importance of housing. Both issues could be resolved by incorporating a time dimension into the model and hence making it a dynamic CGE.

Since each household receives returns on only one type of factor, this has repercussions for any assessment of the distribution of impacts resulting from shocks to the economy. In aggregate, this issue would have a limited effect. However, if the purpose of analysis were to examine the welfare effects of an exogenous shock, the stylised structure of the household block would afford few insights. A more realistic approach would allow households to receive income from multiple sources. The model was driven to this structure by the requirements of the MPS/GE software. Thus, a resolution to this issue would be to develop the full mathematical description of the model that could then be used with a suitable programming language or mathematical optimisation software to create a fully specified CGE. Although set up costs would be higher both in terms of time and expertise, there are fewer restrictions on what can be achieved in terms of model structure.

Although the model requires some development before being used to inform policy decisions, for example it would need a less restrictive household specification, it still achieves much of what was planned for this study. It can estimate the impact of changes to housing supply by

following the principal transactions in the regional economy, and gives estimates of the magnitude of these changes on productive sectors, households and government.

8.5 Further Research

The first step in taking the research forward would involve developing the social accounting matrix. It would be useful to have more finely disaggregated sectors that would enable the use of the SAM as a modelling tool in its own right. With a more detail, it would be possible to use the SAM to generate multipliers that could estimate overall impacts of exogenous shocks prior to running the CGE model. Apart from its use as an impact analysis tool, result generated from multiplier analysis could be used in conjunction with results from the CGE model in order to provide more robust estimates of the impacts of policy shocks.

During development of the model, some sectors were aggregated in an attempt to aid the generation of a solution set of parameters for the model. Since the primary focus of the study was the housing market, which is more closely linked to households, it was felt that the productive sectors could be aggregated without significantly influencing the usability of the model. However, this may have caused further problems due to significant differences in the magnitudes of, for instance, output for each of the sectors. One of the issues with the software is that the MPS/GE package is sensitive to large differences in magnitudes of entries in the benchmark data set and this can have a negative effect on the likelihood of finding a solution to the model. Therefore, when a new SAM is generated, particular attention would be paid to the relative magnitudes of the SAM entries and sectors would be chosen in such a way as to minimise heterogeneity between the various elements of the matrix.

The most significant change made to the CGE model itself would be a reformulation of the model in a different software package. Significant issues were encountered when formulating the model in the MPS/GE software since it placed restrictions on the way the model was constructed and thus constrained the degree of realism that could be incorporated. For example, one of the key issues already noted is that households were only able to receive income from one type of factor.

The primary problem with the MPS/GE software results from what is also one of its strengths, in that a model builder requires relatively few programming skills in order to generate a CGE.

Since the basic framework of a CGE is incorporated directly into the MPS/GE software, the model builder need only supply suitable data and parameter values, such as elasticities, in order to fully specify the model. Although this is very useful when one is learning how to develop CGE models and can also be used successfully, particularly at the national level, it places severe constraints on what can be achieved in terms of more idiosyncratic formulations. When a model is defined mathematically, a detailed understanding of the nature of the equations is required thus making it much easier to anticipate potential problems such as functions that may be non-convex, at least in the domains being used. Thus, it would be useful to reformulate the model in an alternative software package that incorporates optimisation algorithms.

Significant problems were encountered when solving the model thus restricting it to a static framework. Several versions of a dynamic model were developed including an overlapping generations model and a recursive model, however neither version converged to a solution during the time span of this research. This then prevented the incorporation of time-dependent variables such as endogenous migration levels. However, a limited specification of migration was incorporated into the model but levels were determined exogenously.

The most effective dynamic specification for a housing market model would be an overlapping generations approach. This captures the choices made by consumers at different points in their lifecycle. As discussed in Chapter 2, research indicates the existence of a relationship between the stage of a consumer's lifecycle and their demand for housing characteristics (Straszheim, 1973). Moreover, this approach would be better able to capture the effects of housing as a means of wealth accumulation. The permanent income hypothesis suggests that households spend evenly over their life; borrowing in early age, saving during their working lives and dis-saving in later years (Boone and Girouard, 2002). Thus it would be possible to model the choices consumers make between financial and housing assets when generating wealth to provide for their consumption in later life.

Migration is also a significant issue for regional housing markets and thus incorporating endogenous migration would be beneficial in terms of the quality of the model. Endogenous

migration has been included in a limited number of studies, primarily using the Harris-Todaro approach, which links wages, unemployment and migration. For an example, see Kuster et al. (2007). The benefit of using this approach is that not only can migration be incorporated but the full employment assumption can be relaxed thus resulting in a more realistic specification of the labour market. Given that the costs of building such models have come down, the net benefit of making CGE models dynamic is clearly positive, and possibly quite large (Devarajan, 2001).

8.5.1 Final Thoughts and Reflections on the development of the South West Model

"...I realized that my attempts of dynamic modelling were akin to building a spaceship with a screwdriver." (Paltsev, 2004)

This quote quite adequately summarises my feelings after attempting to develop a dynamic CGE model. I believe that the development of models of this type require a team of experts rather than just one individual for two important reasons. Firstly, although software such as MPS/GE have made the development of CGEs easier in principal, this masks the underlying structure of the model, making it difficult to ascertain the source of any potential problems. For instance, in the case of this study, solving the model was exceptionally problematic and finding the potential source of these problems was virtually impossible.

As discussed in the previous section, a full mathematical specification of the model would be far more informative in regard to identifying sources of potential problems within the model. Therefore, this illustrates my reasoning for recommending a team approach to model building. It would be useful, for instance, to have the services of either an applied mathematician or physicist when specifying the mathematical structure, since either of these individuals would be likely to have experience in the specification and solution of optimisation problems. It would also be helpful to employ a computer programmer who would be able to translate the mathematical formulation of the model into a suitable programming language, since packages such as the MPS/GE software used in this study are structurally restrictive.

Of course, at least one economist would be required but two would be more beneficial, and this brings me to the second reason for choosing a team approach to building such models and that is because a variety of perspectives on the overall economic framework of the model would help to provide insights that an individual would miss. Given that economics is a subjective science, it is important to gain a variety of perspectives such that the most appropriate structure can be chosen.

Despite the resources required and difficulties encountered when constructing CGE models, I feel that there is great potential for models of this type to be incorporated into the policy and planning framework more regularly than they are. Certainly, CGE models have been used successfully in this manner, for instance AMOS, the CGE model for Scotland (Gillespie et al., 2001). One of the key advantages of using the general equilibrium approach is that the underlying economic framework is integral to the approach. This acts as a convincing counter argument to those who dismiss the approach as a 'black box'. Provided the assumptions that have been made are clear, it should be possible to explain the operation of any CGE model since it is built according to the general equilibrium framework. This research study demonstrates that even a relatively simple model will be theoretically sound and with some further development, could prove to be a very useful decision making tool.

APPENDIX 1: MPS/GE MODEL CODE

```
*-----------------------------------------------------------------------
*     Bi-regional CGE model of the South West housing market
*-----------------------------------------------------------------------



*-----------------------------------------------------------------------
*  Declare sets
*-----------------------------------------------------------------------


SETS

 G            commodities    /NM,NNH,NHS,SM,SNH,SHS/,
 NIND(G)     north industries /NM,NNH/,
 SIND(G)     south industries /SM,SNH/,
 NNHS(G)      housing service in North /NHS/,
 NSHS(G)     housing service in South /SHS/,
 NHO(G)       new houses /NNH,SNH/,
 CNH(G)       commodities minus new houses /NM,NHS,SM,SHS/,
 HO(G)        housing commodities /NNH,NHS,SNH,SHS/,
 M(G)         non housing commodities /NM,SM/,
 F            primary factors /NK,NLS,NLU,NGH,NPH,SK,SLS,SLU,SGH,SPH/,
 MF(F)        mobile factors /NK,NLS,SK,SLS/,
 NMF(F)      non mobile factors /NLU,NGH,NPH,SLU,SGH,SPH/,
 LU(F)        unskilled labour /NLU,SLU/,
 LS(F)        skilled labour /NLS,SLS/,
 UK(F)        capital /NK,SK/,
 NOH(F)       north old houses /NGH,NPH/,
 SOH(F)       south old houses /SGH,SPH/,
 H            households /NHK,NHLS,NHLU,NGHO,NPHO,SHK,SHLS,SHLU,SGHO,SPHO/,
 HN(H)        north households /NHK,NHLS,NHLU,NGHO,NPHO/,
 HS(H)        south households /SHK,SHLS,SHLU,SGHO,SPHO/,
 TAX          taxes  /TK,TLS,TLU/
 R            region  /N, S/;

ALIAS (S,G), (M,MM);


*-----------------------------------------------------------------------
*  Declare Parameters
*-----------------------------------------------------------------------


PARAMETERS

   ZBAR(G)              benchmark output,
   DBAR(G,S)        benchmark intermediate input,
   FDBAR(F,G)       benchmark factor input,
   T(F,G)           tax payment by factor by sector,
   TF(F,G)          factor tax rate,
   GREV             benchmark government revenue,
   PF(F,G)          benchmark factor prices gross of tax,
   TRN(H)           benchmark government transfer payments,
   MNET(G)          net imports,
   XNET(G)          net exports,
   MGROSS(G)        gross imports,
   XGROSS(G)        gross exports,
   CBAR(G,H)        benchmark final consumption by household,
   UBAR(H)          benchmark expenditure by household,
   ENDOW(F,H)       benchmark factor endowments by household,
   THETA(G)         weights in numeraire price index,
   ESUBH(H)         elasticity of substitution for housing consumption
   ESUBU(H)         elasticity of substitution for housing and commodites
   consumption;
```

```
*-----------------------------------------------------------------------
*  Declare Benchmark Data Set
*-----------------------------------------------------------------------

table SAM(*,*)  benchmark social accounts

   NM  NNH     NHS     SM      SNH
NM 58  -1      0       0       0
NNH    0       4       0       0       0
NHS    0       0       5       0       0
SM 0   0       0       30      -1
SNH    0       0       0       0       5
SHS    0       0       0       0       0
NK -12 -1      0       0       0
NLS    -28     -1      0       0       0
NLU    -4      -1      0       0       0
NGH    0       0       -4      0       0
NPH    0       0       -1      0       0
SK 0   0       0       -6      -1
SLS    0       0       0       -14     -1
SLU    0       0       0       -2      -1
SGH    0       0       0       0       0
SPH    0       0       0       0       0
PFX    0       0       0       0       0
TK -2  0       0       -1      0
TLS    -11     0       0       -6      -1
TLU    -1      0       0       -1      0
TRN    0       0       0       0       0

+  SHS NHK     NHLS    NHLU    NGHO
NM 0   -11     -37     -5      -3
NNH    0       -1      -1      -1      -1
NHS    0       -1      -1      -1      -1
SM 0   0       0       0       0
SNH    0       0       0       0       0
SHS    5       0       0       0       0
NK 0   13      0       0       0
NLS    0       0       29      0       0
NLU    0       0       0       5       0
NGH    0       0       0       0       4
NPH    0       0       0       0       0
SK 0   0       0       0       0
SLS    0       0       0       0       0
SLU    0       0       0       0       0
SGH    -3      0       0       0       0
SPH    -2      0       0       0       0
PFX    0       0       0       0       0
TK 0   0       0       0       0
TLS    0       0       0       0       0
TLU    0       0       0       0       0
TRN    0       0       10      2       1

+  NPHOSHK     SHLS    SHLU    SGHO
NM -1  0       0       0       0
NNH    0       0       0       0       0
NHS    -1      0       0       0       0
SM 0   -6      -18     -3      -1
SNH    0       -1      -2      -1      -1
SHS    0       -1      -1      -1      -1
NK 0   0       0       0       0
NLS    0       0       0       0       0
NLU    0       0       0       0       0
NGH    0       0       0       0       0
NPH    1       0       0       0       0
SK 0   7       0       0       0
SLS    0       0       15      0       0
SLU    0       0       0       3       0
SGH    0       0       0       0       3
SPH    0       0       0       0       0
```

```
PFX     0       0       0       0       0
TK 0    0       0       0       0
TLS     0       0       0       0       0
TLU     0       0       0       0       0
TRN     1       1       6       2       0

+  SPHOEROW     IROW    Govt
NM 0    -36     36      0
NNH     0       0       0       0
NHS     0       0       0       0
SM -1   -19     19      0
SNH     0       0       0       0
SHS     -1      0       0       0
NK 0    0       0       0
NLS     0       0       0       0
NLU     0       0       0       0
NGH     0       0       0       0
NPH     0       0       0       0
SK 0    0       0       0
SLS     0       0       0       0
SLU     0       0       0       0
SGH     0       0       0       0
SPH     2       0       0       0
PFX     0       55      -55     0
TK 0    0       0       3
TLS     0       0       0       18
TLU     0       0       0       2
TRN     0       0       0       -23

;

*-----------------------------------------------------------------------
* Set initial values for parameters
*-----------------------------------------------------------------------


   ZBAR(G) = SAM(G,G);
   DBAR(G,S) = MAX(0,-SAM(G,S));
   FDBAR(F,G) = -SAM(F,G);
   XGROSS(G) = -SAM(G,"EROW");
   MGROSS(G) = SAM(G,"IROW");
   MNET(G) = MAX(0,MGROSS(G)- XGROSS(G));
   XNET(G) = MAX(0,XGROSS(G)- MGROSS(G));
   CBAR(G,H) = -SAM(G,H);
   UBAR(H) = SUM(G,CBAR(G,H));
   ENDOW(F,H) = SAM(F,H);
   T("NK",G) = -SAM("TK",G);
   T("NLS",G)= -SAM("TLS",G);
   T("NLU",G)= -SAM("TLU",G);
   T("SK",G) = -SAM("TK",G);
   T("SLS",G)= -SAM("TLS",G);
   T("SLU",G)= -SAM("TLU",G);
   TRN(H) = SAM("TRN",H);
   GREV = SUM(H,TRN(H));
   TF(F,G) = T(F,G)/MAX(0.0001,FDBAR(F,G));
   PF(F,G) = 1 + TF(F,G);
   ESUBH(H)=1;
   ESUBU(H)=0.1;
   THETA(G)=SUM(H,CBAR(G,H));
   THETA(G)=THETA(G)/SUM(S,THETA(S));

*-----------------------------------------------------------------------
* Model declaration
*-----------------------------------------------------------------------


$ONTEXT

$MODEL:housemod
```

```
$SECTORS:
   Z(S)        ! sectoral output index
   A(S)        ! Armington good
   X(S)        ! export index
   U(H)        ! utility index

$COMMODITIES:
   PFX         ! price of foreign exchange
   P(S)             ! domestic goods price index
   C(S)        ! cost index
   PA(S)            ! Armington composite price
   W(F)        ! factor price index
   PU(H)       ! utility price
   PT               ! transfers

$CONSUMERS:
   RA(H)            ! representative agent income
   GOVT             ! government

$PROD:Z(S)  S:0 VA:0.8
   O:C(S)           Q:ZBAR(S)
   I:PA(G)     Q:DBAR(G,S)
   I:W(F)      Q:FDBAR(F,S) P:PF(F,S) A:GOVT T:TF(F,S) VA:

$PROD:X(S)
   O:P(S)           Q:(ZBAR(S) - XGROSS(S))
   O:PFX            Q:XGROSS(S)
   I:C(S)           Q:ZBAR(S)

$PROD:A(S)    S:2
   O:PA(S)          Q:(ZBAR(S) - XGROSS(S) + MGROSS(S))
   I:PFX            Q:MGROSS(S)
   I:P(S)           Q:(ZBAR(S) - XGROSS(S))

$PROD:U(H) S:ESUBU(H) VA:ESUBH(H)
   O:PU(H)     Q:(SUM(S,CBAR(S,H)))
   I:PA(M)     Q:CBAR(M,H)
   I:PA(HO)    Q:CBAR(HO,H) VA:

$DEMAND:RA(H)
   D:PU(H)     Q:(SUM(S,CBAR(S,H)))
   E:W(F)      Q:ENDOW(F,H)
   E:PT             Q:TRN(H)

$DEMAND:GOVT
   D:PT             Q:GREV

$REPORT:
   V:WLF(H)              W:RA(H)
   V:DNLU(NIND)     I:W("NLU")    PROD:Z(NIND)
   V:DSLU(SIND)     I:W("SLU")    PROD:Z(SIND)
   V:DNLS(NIND)     I:W("NLS")    PROD:Z(NIND)
   V:DSLS(SIND)     I:W("SLS")    PROD:Z(SIND)
   V:DNK(NIND)           I:W("NK")            PROD:Z(NIND)
   V:DSK(SIND)           I:W("SK")            PROD:Z(SIND)
   V:DNGH(NNHS)     I:W("NGH")    PROD:Z(NNHS)
   V:DNPH(NNHS)     I:W("NPH")    PROD:Z(NNHS)
   V:DSGH(NSHS)     I:W("SGH")    PROD:Z(NSHS)
   V:DSPH(NSHS)     I:W("PGH")    PROD:Z(NSHS)
   V:DF(S,F)             I:W(F)               PROD:Z(S)
   V:OUTP(S)             O:C(S)               PROD:Z(S)
   V:CDEM(H)             D:PU(H)                     DEMAND:RA(H)
   V:HDEM(H,HO)     I:PA(HO)          PROD:U(H)


$OFFTEXT

$SYSINCLUDE mpsgeset housemod
```

```
housemod.ITERLIM = 0;

$INCLUDE housemod.GEN
SOLVE housemod USING MCP;

ABORT$(ABS(housemod.OBJVAL) GT 1.E-4)
       "**** housemod benchmark does not calibrate.";
housemod.ITERLIM = 2000;

*-----------------------------------------------------------------
*  Counterfactuals
*-----------------------------------------------------------------
*
*  MIGONLY - migration only, 1 year
*  MIGONLY5 - migration onnly, 5 year time scale
*
* Regional Planning Guidance Scenarios
*
* RPGM0  Regional Planning Guidance levels zero migration
*
* RPGM1 Regional Planning Guidance levels annual migration
*
* RPGM05 RPG levels 5 year zero migration
* RPGMM5 RPG levels 5 year migration
*
* IN39  39% increase in supply
*

SETS

SC counterfactuals /
     MIGONLY
     RPGM0
     RPGM1
     MIGONLY5
     RPGM05
     RPGMM5
     IN39            /
;

PARAMETER     HSUP(NHO,SC)
       MIG(F,H,SC)
       REPORT(*,*,*,SC)
       PINDEX;
*-----------------------------------------------------------
*  Migration only - no increase in housing supply, 1 year
*-----------------------------------------------------------
HSUP(NHO,"MIGONLY")=ZBAR(NHO);
MIG("NK",H,"MIGONLY")=ENDOW("NK",H)*1.01;
MIG("SK",H,"MIGONLY")=ENDOW("SK",H)*1.04;
MIG("NLS",H,"MIGONLY")=ENDOW("NLS",H)*1.01;
MIG("SLS",H,"MIGONLY")=ENDOW("SLS",H)*1.04;
MIG(NMF,H,"MIGONLY")=ENDOW(NMF,H);

*-----------------------------------------------------------
*  Migration only - no increase in housing supply, 5 years
*-----------------------------------------------------------
HSUP(NHO,"MIGONLY5")=ZBAR(NHO);
MIG("NK",H,"MIGONLY5")=ENDOW("NK",H)*1.08;
MIG("SK",H,"MIGONLY5")=ENDOW("SK",H)*1.24;
MIG("NLS",H,"MIGONLY5")=ENDOW("NLS",H)*1.08;
MIG("SLS",H,"MIGONLY5")=ENDOW("SLS",H)*1.24;
MIG(NMF,H,"MIGONLY5")=ENDOW(NMF,H);

*-----------------------------------------------------------
*  RPG Scenarios, 1 year
*-----------------------------------------------------------
HSUP("NNH","RPGM0")=ZBAR("NNH") + 1.7;
HSUP("SNH","RPGM0")=ZBAR("SNH") + 1.2;
MIG(F,H,"RPGM0")=ENDOW(F,H);
```

```
HSUP("NNH","RPGM1")=ZBAR("NNH") + 1.7;
HSUP("SNH","RPGM1")=ZBAR("SNH") + 1.2;
MIG("NK",H,"RPGM1")=ENDOW("NK",H)*1.01;
MIG("SK",H,"RPGM1")=ENDOW("SK",H)*1.04;
MIG("NLS",H,"RPGM1")=ENDOW("NLS",H)*1.01;
MIG("SLS",H,"RPGM1")=ENDOW("SLS",H)*1.04;
MIG(NMF,H,"RPGM1")=ENDOW(NMF,H);

*-------------------------------------------------------
*  RPG Scenarios, 5 years
*-------------------------------------------------------
HSUP("NNH","RPGM05")=ZBAR("NNH") + 8.3;
HSUP("SNH","RPGM05")=ZBAR("SNH") + 6.0;
MIG(F,H,"RPGM05")=ENDOW(F,H);
HSUP("NNH","RPGMM5")=ZBAR("NNH") + 8.3;
HSUP("SNH","RPGMM5")=ZBAR("SNH") + 6.0;
MIG("NK",H,"RPGMM5")=ENDOW("NK",H)*1.08;
MIG("SK",H,"RPGMM5")=ENDOW("SK",H)*1.24;
MIG("NLS",H,"RPGMM5")=ENDOW("NLS",H)*1.08;
MIG("SLS",H,"RPGMM5")=ENDOW("SLS",H)*1.24;
MIG(NMF,H,"RPGMM5")=ENDOW(NMF,H);

*-------------------------------------------------------
*  IN39
*-------------------------------------------------------
HSUP("NNH","IN39")=ZBAR("NNH")*1.139;
HSUP("SNH","IN39")=ZBAR("SNH")*1.139;
MIG("NK",H,"IN39")=ENDOW("NK",H)*1.01;
MIG("SK",H,"IN39")=ENDOW("SK",H)*1.04;
MIG("NLS",H,"IN39")=ENDOW("NLS",H)*1.01;
MIG("SLS",H,"IN39")=ENDOW("SLS",H)*1.04;
MIG(NMF,H,"IN39")=ENDOW(NMF,H);

LOOP(SC,
  ZBAR(NHO) = HSUP(NHO,SC);
  ENDOW(F,H) = MIG(F,H,SC);

$INCLUDE housemod.GEN
SOLVE housemod USING MCP;
housemod.ITERLIM = 2000;

PINDEX = SUM(G,PA.L(G)*THETA(G));

REPORT("WELFARE-H",H," ",SC)=100*(WLF.L(H) - 1);
REPORT("REVENUE-","","",SC)=100*(PT.L/PINDEX - 1);

REPORT("EMPLU",NIND,"-",SC)=100*(DNLU.L(NIND)/FDBAR("NLU",NIND) - 1);
REPORT("EMPLS",NIND,"-",SC)=100*(DNLS.L(NIND)/FDBAR("NLS",NIND) - 1);
REPORT("EMPGH","NHS",NNHS,SC)=100*(DNGH.L(NNHS)/FDBAR("NGH",NNHS) - 1);
REPORT("EMPPH","NHS",NNHS,SC)=100*(DNPH.L(NNHS)/FDBAR("NPH",NNHS) - 1);

REPORT("EMPLU",SIND,"-",SC)=100*(DSLU.L(SIND)/FDBAR("SLU",SIND) - 1);
REPORT("EMPLS",SIND,"-",SC)=100*(DSLS.L(SIND)/FDBAR("SLS",SIND) - 1);
REPORT("EMPGH","SHS",NSHS,SC)=100*(DSGH.L(NSHS)/FDBAR("SGH",NSHS) - 1);
REPORT("EMPPH","SHS",NSHS,SC)=100*(DSPH.L(NSHS)/FDBAR("SPH",NSHS) - 1);

REPORT("FPRICE -",F," - ",SC)=100*(W.L(F)/PINDEX - 1);
REPORT("OUTPUT ",S,"",SC) = 100*((OUTP.L(S)/ZBAR(S)) - 1);
REPORT("ZBAR",S,"",SC)=ZBAR(S);
REPORT("PRICES",S,"",SC)=100*(PA.L(S)/PINDEX - 1);
REPORT("GDP -","","",SC)=100*(SUM(S,OUTP.L(S))/SUM(S,ZBAR(S)) - 1);
REPORT("CDEM -",H,"",SC)=100*(CDEM.L(H) - 1);

REPORT("PINDEX","","",SC)=PINDEX;
 );
DISPLAY REPORT;
```

APPENDIX 2: GAMS CODE FOR BALANCING THE SAM

```
$TITLE Cross Entropy SAM Estimation
$OFFSYMLIST OFFSYMXREF OFFUPPER
*###########################################################################
*
*
* CE-SAM illustrates a cross entropy technique for estimating the cells
* of a consistent SAM assuming that the initial data are inconsistent
* and measured with error. The method is applied to a stylized macro
* SAM for Mozambique. Some macro control totals are assumed known with
* error, and also all the row and column totals are assumed
* known only with error. We assume that the user can specify
* a prior estimate of the standard error of the estimates of the row
* and column sums and of the macro control totals.
*
* Programmed by Sherman Robinson and Moataz El-Said, November 2000.
* Trade and Macroeconomics Division
* International Food Policy Research Institute (IFPRI)
* 2033 K Street, N.W.
* Washington, DC 20006 USA
* Email: S.Robinson@CGIAR.ORG
*        M.El-Said@CGIAR.ORG
*
* The method is described in S. Robinson, A. Cattaneo and, M. El Said
* (2001) "Updating and Estimating a Social Accounting Matrix Using
* Cross Entropy Methods." Economic Systems Research, Vol. 13, No. 1,
* pp. 47-64.
*
* Discussion paper #58 is an earlier version of the Economic
* Systems Research paper. A copy can be downloaded from the IFPRI
* web page using the following link:
*      http://www.ifpri.cgiar.org/divs/tmd/tmdpubs.htm#dp
*
* See also A. Golan, G. Judge, and D. Miller, Maximum Entropy
* Econometrics, John Wiley & Sons, 1996.
*
* Data set is based on a SAM developed by C. Arndt, A. S. Cruz, H. T.
* Jensen, S. Robinson, and F. Tarp, "Social Accounting Matrices
* for Mozambique - 1994 and 1995." TMD Discussion Paper No. 28, IFPRI,
* July 1998.
*
*###########################################################################

SETS

 i      sam accounts   / AM
                         ANS
                         ANH
                         ANA
                         AHS
                         COM
                           K
                          LP
                          LI
                          LU
                          GH
                          GA
                          PH
                          PA
                          HH
                         INV
                         ROW
                        Govt
                       Total  /

 ii(i)  all acounts in i except Total
                       / AM
```

```
                        ANS
                        ANH
                        ANA
                        AHS
                        COM
                          K
                         LP
                         LI
                         LU
                         GH
                         GA
                         PH
                         PA
                         HH
                        INV
                        ROW
                       Govt /

FAC(ii)  factors
                     /    K
                         LP
                         LI
                         LU
                         GH
                         GA
                         PH
                         PA  /

AC(ii) activities
                    /  AM
                       ANS
                       ANH
                       ANA
                       AHS  /

 macro  macro controls  /gdpfc2, gdp2 /

* The set jwt defines the dimension of the support set for the error
* distribution and the number of weights that must be estimated for each
* error. In this case, we specify a five parameter error distribution.
* For a three parameter distribution, jwt is set to /1*3/.

 jwt    set of weights for errors in variables
                      / 1*5 /
;

* ii(i)       = YES;
* ii("Total") = NO;

ALIAS (i,j), (ii,jj);

*##########################    SAM DATABASE       ##########################
TABLE SAM(i,j)  social accounting matrix

          AM       ANS    ANH    ANA    AHS
AM         0         0      0      0      0
ANS        0         0      0      0      0
ANH        0         0      0      0      0
ANA        0         0      0      0      0
AHS        0         0      0      0      0
COM    13649     18820    601     66      0
K       4675     16205    170     19      0
LP     10654     32765    241     27      0
LI      5020     10552    280     31      0
LU      2756      4726     39      4      0
GH         0         0      0      0   5271
GA         0         0      0      0    927
PH         0         0      0      0    512
PA         0         0      0      0    149
HH         0         0      0      0      0
```

INV	0	0	0	0	0
ROW	0	0	0	0	0
Govt	0	0	0	0	0
Total	36754	83068	1332	147	6858

+	COM	K	LP	LI	LU
AM	47897	0	0	0	0
ANS	83598	0	0	0	0
ANH	1522	0	0	0	0
ANA	168	0	0	0	0
AHS	6858	0	0	0	0
COM	0	0	0	0	0
K	0	0	0	0	0
LP	0	0	0	0	0
LI	0	0	0	0	0
LU	0	0	0	0	0
GH	0	0	0	0	0
GA	0	0	0	0	0
PH	0	0	0	0	0
PA	0	0	0	0	0
HH	0	19275	31574	11452	5528
INV	0	0	0	0	0
ROW	56808	0	0	0	0
Govt	0	2513	12113	4430	1998
Total	196851	21788	43687	15882	7526

+	GH	GA	PH	PA	HH
AM	0	0	0	0	0
ANS	0	0	0	0	0
ANH	0	0	0	0	0
ANA	0	0	0	0	0
AHS	0	0	0	0	0
COM	0	0	0	0	78731
K	0	0	0	0	0
LP	0	0	0	0	0
LI	0	0	0	0	0
LU	0	0	0	0	0
GH	0	0	0	0	0
GA	0	0	0	0	0
PH	0	0	0	0	0
PA	0	0	0	0	0
HH	5271	927	512	149	0
INV	0	0	0	0	1158
ROW	0	0	0	0	0
Govt	0	0	0	0	0
Total	5271	927	512	149	79889

+	INV	ROW	Govt	Total
AM	0	0	0	47897
ANS	0	0	0	83598
ANH	0	0	0	1522
ANA	0	0	0	168
AHS	0	0	0	6858
COM	13174	43506	17363	185911
K	0	0	0	21069
LP	0	0	0	43687
LI	0	0	0	15882
LU	0	0	0	7526
GH	0	0	0	5271
GA	0	0	0	927
PH	0	0	0	512
PA	0	0	0	149
HH	0	0	5384	80071
INV	0	12000	0	13158
ROW	0	0	0	56808
Govt	0	0	0	21054
Total	13174	55506	22747	

```
*############################  Parameters and Scalars ######################
PARAMETER

 SAM0(i,j)          Base SAM transactions matrix
 T0(i,j)            Matrix of SAM transactions (flow matrix)
 T1(i,j)            SAM transactions Adjusted to eliminate negative entries
 Abar0(i,j)         Prior SAM coefficient matrix
 Abar1(i,j)         Prior SAM adjusted to eliminate negative coefficients
 Target0(i)         Targets for macro SAM column totals
 vbar1(i,jwt)       Error support set 1
 vbar2(macro,jwt)   Error support set 2
 wbar1(i,jwt)       Weights on error support set 1
 wbar2(macro,jwt)   Weights on error support set 2
 sigmay1(i)         Prior standard error of column sums
 sigmay2(macro)     Prior standard error of macro aggregates
 epsilon            Tolerance to allow zero entries in SAM
;

SCALARS

 gdp0           base GDP
 gdp00          GDP from final SAM
 gdpfc0         GDP at factor cost
;

*################### Initializing Parameters
 SAM("TOTAL",jj)       = sum(ii, SAM(ii,jj));
 SAM(ii,"TOTAL")       = sum(jj, SAM(ii,jj));
 sam0(i,j)             = sam(i,j);

*###################
* Divide SAM entries by 1000 for better scaling.
* The SAM is scaled to enhance solver efficiency. Nonlinear solvers are
* more efficient if variables are scaled similarly. In this case,
* coefficients to be estimated range between 0 and 1, so SAM values
* are also scaled.

 Scalar scalesam Scaling value  /1000/ ;

 sam(i,j)                  = sam(i,j)/scalesam ;
 Abar0(ii,jj)$SAM(ii,jj)   = SAM(ii,jj)/SAM("TOTAL",jj) ;

 T0(ii,jj)                 = SAM(ii,jj);
 T0("TOTAL",jj)            = sum(ii, SAM(ii,jj));
 T0(ii,"TOTAL")            = sum(jj, SAM(ii,jj));

 epsilon                   = .00001;

 Display T0, Abar0 ;
*############################  CROSS ENTROPY  ################################


*############################  RED ALERT!!!   ################################

* The ENTROPY DIFFERENCE procedure uses LOGARITHMS: negative flows in
* the SAM are NOT GOOD!!!
*
* The option used here is to detect any negative flows and net them out
* of their respective symmetric cells, e.g.
*     negative flow column to row is set to zero
*     and added to corresponding row to column as a positive number.
* The entropy difference method can then be implemented.
* After balancing, the negative SAM values are returned to their
* original cells for printing.

SET
 red(i,j)           Set of negative SAM flows
;
```

```
Parameter
 redsam(i,j)          Negative SAM values only
 rtot(i)              Row total
 ctot(i)              Column total
;

 rtot(ii)                              = sum(jj, T0(ii,jj));
 ctot(jj)                              = sum(ii, T0(ii,jj));

 red(ii,jj)$(T0(ii,jj) LT 0)           = yes ;
 redsam(ii,jj)                         = 0;
 redsam(ii,jj)$red(ii,jj)              = T0(ii,jj);
 redsam(jj,ii)$red(ii,jj)              = T0(ii,jj);

*Note that redsam includes each entry twice, in corresponding row
*and column. So, redsam need only be subtracted from T0.
 T1(ii,jj)                             = T0(ii,jj) - redsam(ii,jj);
 T1("Total",jj)                        = sum(ii, T1(ii,jj));
 T1(ii,"Total")                        = sum(jj, T1(ii,jj));

 redsam("total",jj)                    = sum(ii, redsam(ii,jj));
 redsam(ii,"total")                    = sum(jj, redsam(ii,jj));

 sam(ii,"total")                       = sum(jj, T1(ii,jj));
 sam("total",jj)                       = sum(ii, T1(ii,jj));

 rtot(ii)                              = sum(jj, T1(ii,jj));
 ctot(jj)                              = sum(ii, T1(ii,jj));

 Abar1(ii,jj)                          = T1(ii,jj)/sam("total",jj);

 display "NON-NEGATIVE SAM" ;
 display redsam, T1, Abar0, Abar1, rtot, ctot ;

* Define set of elements of SAM that can be nonzero. In this case, only
* elements which are nonzero in initial SAM.
 SET NONZERO(i,j)  SAM elements that can be nonzero ;

 NONZERO(ii,jj)$(Abar1(ii,jj)) = yes ;

*#### Initializing Parameters after accounting for negative values #####
*   Note that target column sums are being set to average of initial
*   row and column sums. Initial column sums or other values
*   could have been used instead, depending on knowledge of data quality
*   and any other prior information.

 target0(ii)          = (sam(ii,"total") +  sam("total",ii))/2 ;
 gdpfc0               = sum((FAC,AC),T1(FAC,AC));
 gdp0                 = sum((FAC,AC),T1(FAC,AC))
                          + SUM(AC,T1("Govt",AC))
                        - SUM(AC,T1(AC,"Govt")) + T1("Govt","COM") ;
Display gdpfc0, gdp0;

*################## Define variable bounds on errors ###################
* Start from assumed prior knowledge of the standard error (perhaps due
* to measurement error) of the column sums. Below, we assume that all
* column sums have a standard error of 5%. This is a Bayesian prior,
* not a maintained hypothesis.
* The estimated error is weighted sum of elements in an error support
* set:
*   ERR(ii) = SUM(jwt, W(ii,jwt)*VBAR(ii,jwt))
* where the W's are estimated in the CE procedure.
* The prior variance of these errors is given by:
*   (sigmay(ii))**2 = SUM(jwt, WBAR(ii,jwt)*(VBAR(ii,jwt))**2 )
* where the WBAR's are the prior on the weights.
* The VBARs are chosen to define a domain for the support set of +/- 3
* standard errors. The prior on the weights, WBAR, are then calculated
* to yield the specified prior on the standard error, sigmay.
* In Robinson, Cattaneo, and El-Said (2001), we specify prior weights
* (WBAR) that are uniform and set the prior standard error by the
```

```
* choice of support set, VBAR. In that paper, we use a three-weight
* specification (jwt /1*3/);
*
* We define two sets of errors with separate weights, W1 and W2. The
* first is for specifying errors on column sums, the second for errors
* on macro aggregates (defined in the set macro).

* First, define standard error for errors on column sums.

  sigmay1(ii)     = 0.05 * target0(ii) ;

* This code assumes a prior mean of zero and a two-parameter
* distribution with specified prior standard error. There are three
* weights, W(ii,jwt), to be estimated. The actual moments are estimated
* as part of the estimation procedure.
$ontext
* Set constants for 3-weight error distribution
  vbar1(ii,"1")   = -3 * sigmay1(ii);
  vbar1(ii,"2")   =  0             ;
  vbar1(ii,"3")   = -3 * sigmay1(ii);

  wbar1(ii,"1")   =  1/18  ;
  wbar1(ii,"2")   = 16/18  ;
  wbar1(ii,"3")   =  1/18  ;
$offtext

* This code assumes a prior mean of zero and a prior value of kurtosis
* consistent with a prior normal distribution with mean zero, variance
* sigmay**2, and kurtosis equal to 3*sigmay**4. The addition of a prior
* on kurtosis requires estimation of 5 weights (jwt = 5);
* The prior weights wbar are specified so that:
* SUM(jwt, wbar(ii,jwt)*vbar(ii,jwt)**4) = 3*sigmay(ii,jwt)**4
* as well as defining the variance as above.
* The prior weights and support set are also symmetric, so the prior
* on all odd moments is zero. The choice of +/- 1 standard error
* for vbar(ii,"2") and vbar(ii,"4") is arbitrary.
* The actual moments are estimated as part of the estimation procedure.

* Set constants for 5-weight error distribution
  vbar1(ii,"1")   = -3 * sigmay1(ii) ;
  vbar1(ii,"2")   = -1 * sigmay1(ii) ;
  vbar1(ii,"3")   =  0               ;
  vbar1(ii,"4")   = +1 * sigmay1(ii) ;
  vbar1(ii,"5")   = +3 * sigmay1(ii) ;

  wbar1(ii,"1")   =   1/72        ;
  wbar1(ii,"2")   =  27/72        ;
  wbar1(ii,"3")   =  16/72        ;
  wbar1(ii,"4")   =  27/72        ;
  wbar1(ii,"5")   =   1/72        ;

* Second, define standard errors for errors on macro aggregates

  sigmay2("gdpfc2")   = 0.05*gdpfc0  ;
  sigmay2("gdp2")     = 0.05*gdp0 ;

$ontext
* Set constants for 3-weight error distribution
  vbar2(ii,"1")   = -3 * sigmay2(ii);
  vbar2(ii,"2")   =  0             ;
  vbar2(ii,"3")   = -3 * sigmay2(ii);

  wbar2(ii,"1")   =  1/18  ;
  wbar2(ii,"2")   = 16/18  ;
  wbar2(ii,"3")   =  1/18  ;
$offtext

* Set constants for 5-weight error distribution
  vbar2(macro,"1")   = -3 * sigmay2(macro) ;
  vbar2(macro,"2")   = -1 * sigmay2(macro) ;
```

```
 vbar2(macro,"3")  =  0                    ;
 vbar2(macro,"4")  = +1 * sigmay2(macro)   ;
 vbar2(macro,"5")  = +3 * sigmay2(macro)   ;

 wbar2(macro,"1")  =   1/72          ;
 wbar2(macro,"2")  =  27/72          ;
 wbar2(macro,"3")  =  16/72          ;
 wbar2(macro,"4")  =  27/72          ;
 wbar2(macro,"5")  =   1/72          ;

Display vbar1, vbar2, sigmay1, sigmay2 ;

*######################## VARIABLES ###################################
VARIABLES
A(ii,jj)        Post SAM coefficient matrix
TSAM(ii,jj)     Post matrix of SAM transactions
Y(ii)           row sum of SAM
X(ii)           column sum of SAM
ERR1(ii)        Error value on column sums
ERR2(macro)     Error value for macro aggregates
W1(ii,jwt)      Error weights
W2(macro,jwt)   Error weights
DENTROPY        Entropy difference (objective)
GDPFC           GDP at factor cost
GDP             GDP at market prices
 ;

*############################ INITIALIZE VARIABLES ###################

A.L(ii,jj)           = Abar1(ii,jj) ;
TSAM.L(ii,jj)        = T1(ii,jj)    ;
Y.L(ii)              = target0(ii)  ;
X.L(ii)              = target0(ii)  ;
ERR1.L(ii)           = 0.0          ;
ERR2.L(macro)        = 0.0          ;
W1.L(ii,jwt)         = wbar1(ii,jwt) ;
W2.L(macro,jwt)      = wbar2(macro,jwt) ;
DENTROPY.L           = 0            ;
GDPFC.L              = gdpfc0       ;
GDP.L                = gdp0         ;

*############## CORE EQUATIONS
EQUATIONS

SAMEQ(i)         row and column sum constraint
SAMMAKE(i,j)     make SAM flows
ERROR1EQ(i)      definition of error term 1
ERROR2EQ(macro)  definition of error term 2
SUMW1(i)         Sum of weights 1
SUMW2(macro)     Sum of weights 2
ENTROPY          Entropy difference definition
ROWSUM(i)        row target
COLSUM(j)        column target
GDPFCDEF         define GDP at factor cost
GDPDEF           define GDP
;

*CORE EQUATIONS=============================================================

SAMEQ(ii)..    Y(ii)       =E= X(ii) + ERR1(ii) ;

SAMMAKE(ii,jj)$nonzero(ii,jj)..
                TSAM(ii,jj) =E= A(ii,jj) * (X(jj) + ERR1(jj)) ;

ERROR1EQ(ii).. ERR1(ii)    =E= SUM(jwt, W1(ii,jwt)*vbar1(ii,jwt)) ;

SUMW1(ii)..    SUM(jwt, W1(ii,jwt)) =E= 1 ;

ENTROPY..      DENTROPY    =E= SUM((ii,jj)$nonzero(ii,jj),
                               A(ii,jj)*(LOG(A(ii,jj) + epsilon)
```

```
                              - LOG(Abar1(ii,jj) + epsilon)))
                              +
                                SUM((ii,jwt), W1(ii,jwt)
                              * (LOG(W1(ii,jwt) + epsilon)
                              - LOG(wbar1(ii,jwt) + epsilon)))
                              +
                                SUM((macro,jwt), W2(macro,jwt)
                              * (LOG(W2(macro,jwt) + epsilon)
                              - LOG(wbar2(macro,jwt) + epsilon))) ;

* Note that we exclude one rowsum equation since if all but one column
* and rowsum are equal, the last one must also be equal. Walras' Law
* at work.

 ROWSUM(ii)$(NOT SAMEAS(ii,"ROW"))..   SUM(jj, TSAM(ii,jj)) =E= Y(ii) ;

 COLSUM(jj)..      SUM(ii, TSAM(ii,jj)) =E= (X(jj) + ERR1(jj)) ;

*ADDITIONAL MACRO CONTROL-TOTAL EQUATIONS============================

 GDPFCDEF..          GDPFC =E= SUM((FAC,AC),TSAM(FAC,AC))
                             + ERR2("gdpfc2") ;

 GDPDEF..            GDP   =E= SUM((FAC,AC),TSAM(FAC,AC))
                             + SUM(AC,TSAM("Govt",AC))
                             - SUM(AC,TSAM(AC,"Govt"))
                             + TSAM("Govt","COM")
                             + ERR2("gdp2") ;

 ERROR2EQ(macro)..   ERR2(macro)
                           =E= SUM(jwt, W2(macro,jwt)*vbar2(macro,jwt)) ;

 SUMW2(macro)..      SUM(jwt, W2(macro,jwt)) =E= 1 ;

*#################  Define bounds for cell values  ######################

* Defining equation SAMMAKE over non-zero elements of A ($Abar1(ii,jj))
* guarantees that the zero structure of the original SAM is maintained
* in the estimated SAM. Fixing all the zero entries to zero greatly
* reduces the size of the estimation problem. If it is desired to
* allow a zero entry to become nonzero in the estimated SAM, then
* the condition $ABAR1(ii,jj) must be replaced with a new set that
* does not include cells which are currently zero but may be nonzero.

 A.LO(ii,jj)$nonzero(ii,jj)          = 0 ;
 A.UP(ii,jj)$nonzero(ii,jj)          = 1 ;
 A.FX(ii,jj)$(NOT nonzero(ii,jj))    = 0;

 TSAM.lo(ii,jj)                      = 0.0 ;
 TSAM.up(ii,jj)                      = +inf ;
 TSAM.FX(ii,jj)$(NOT nonzero(ii,jj)) = 0 ;

* Upper and lower bounds on the error weights
 W1.LO(ii,jwt)                       = 0   ;
 W1.UP(ii,jwt)                       = 1   ;
 W2.LO(macro,jwt)                    = 0   ;
 W2.UP(macro,jwt)                    = 1   ;

* Set target column sums, X. If these are not fixed, then the column sum
* constraints will not be binding and the solution values or ERR1 will
* be 0.

  X.FX(ii)                             = TARGET0(ii) ;

* Fix Macro aggregates.
* If these are not fixed, then the macro constraints will not be binding
* and the solution values of ERR2 will be zero.
  GDP.FX                = GDP0 ;
  GDPFC.FX              = GDPFC0 ;
```

```
*########################## DEFINE MODEL ##############################

 MODEL SAMEN / ALL /

*########################## SOLVE MODEL ###############################

 OPTION ITERLIM       = 5000;
 OPTION LIMROW        = 0,    LIMCOL    = 0;
 OPTION SOLPRINT      = ON;


* SAMEN.optfile    = 1 ;
  SAMEN.HOLDFIXED = 1 ;
  option NLP          = CONOPT ;
* OPTION NLP          = CONOPT;
* SAMEN.WORKSPACE = 25.0;

*############################ Solve statenment ########################

  SOLVE SAMEN using NLP minimizing dentropy ;

*#########################################################################


*##(alternative formulation)#### MCP Formulation ###################

* Add code restating the nonlinear-programming (NLP) minimization
* problem as an MCP problem solved using the MCP solver.
$include CE-MCP.INC

*#########################################################################


*---------------- Parameters for reporting results
Parameters
 Macsam1(i,j)        Assigned new balanced SAM flows from CE
 Macsam2(i,j)        Balanced SAM flows from entropy diff x scalesam
 SEM                 Squared Error Measure
 percent1(i,j)       percent change of new SAM from original SAM
 PosUnbal(i,j)       Positive unbalanced SAM
 PosBalan(i,j)       Positive balanced SAM
 Diffrnce(i,j)       Differnce btw original SAM and Final SAM in values
 NormEntrop          Normalized Entropy a measure of total uncertainty
 ;

 macsam1(ii,jj)          = TSAM.l(ii,jj);
 macsam1("total",jj)     = SUM(ii, macsam1(ii,jj)) ;
 macsam1(ii,"total")     = SUM(jj, macsam1(ii,jj)) ;
 macsam2(i,j)            = macsam1(i,j) * scalesam ;
 SEM                     = Sum((ii,jj), SQR(A.L(ii,jj)
                                  - Abar1(ii,jj)))/SQR(card(ii));
 percent1(i,j)$(T1(i,j))= 100*(macsam1(i,j)-T1(i,j))/T1(i,j);
 PosUnbal(i,j)           = T1(i,j) * scalesam;
 PosBalan(i,j)           = macsam2(i,j);
 Diffrnce(i,j)           = PosBalan(i,j) - PosUnbal(i,j);
 NormEntrop              = SUM((ii,jj)$(Abar1(ii,jj)), A.L(ii,jj)*
                           LOG (A.L(ii,jj))) / SUM((ii,jj)$(Abar1(ii,jj)),
                           Abar1(ii,jj)* LOG (Abar1(ii,jj)))
 ;
 display macsam1, macsam2, percent1, sem, dentropy.l, PosUnbal,
         PosBalan, NormEntrop, Diffrnce ;

*############ Return negative flows to initial cell position ##########

 macsam1(ii,jj)          = macsam1(ii,jj) + redsam(ii,jj) ;
 macsam1("total",jj)     = SUM(ii, macsam1(ii,jj)) ;
 macsam1(ii,"total")     = SUM(jj, macsam1(ii,jj)) ;
 macsam2(i,j)            = macsam1(i,j) * scalesam ;
```

```
 gdp00                    = SUM((FAC,AC),macsam1(FAC,AC))
                            + SUM(AC,macsam1("Govt",AC))
                            - SUM(AC,macsam1(AC,"Govt"))
                            + macsam1("Govt","COM") ;

 display macsam1, macsam2 ;
 display gdp0, gdp00, gdp.l, gdpfc0, gdpfc.l ;

*#######
 Parameter ANEW(i,j) ;
* print some stuff
 ANEW("total",jj)    = SUM(ii, A.L(ii,jj)) ;
 ANEW(ii,"total")    = SUM(jj, A.L(ii,jj)) ;

 ABAR1("total",jj) = SUM(ii, ABAR1(ii,jj)) ;
 ABAR1(ii,"total") = SUM(jj, ABAR1(ii,jj)) ;

 Display ANEW, ABAR1 ;

 scalar meanerr1, meanerr2 ;
 meanerr1 = SUM(ii, abs(err1.l(ii)))/card(ii) ;
 meanerr2 = SUM(macro, abs(err2.l(macro)))/card(macro) ;
 display meanerr1, meanerr2 ;

* Use the following code to specify that the column sums are known
* exactly. The errors are thus fixed to zero and two equations are
* dropped from the estimation procedure. The computational gains are
* that the constraints are all linear and the estimation problem is
* considerably smaller.

*######
$ontext
*######

 ERR1.FX(ii)        = 0.0 ;
 W1.FX(ii,jwt)      = WBAR1(ii,jwt) ;

 MODEL SAMEN2 /SAMEQ
                  SAMMAKE
*                 ERROR1EQ
*                 SUMW1
                  ERROR2EQ
                  SUMW2
                  ENTROPY
                  ROWSUM
                  COLSUM
                  GDPFCDEF
                  GDPDEF
                           /
;
 SAMEN2.holdfixed = 1 ;

*############################ Solve statenment ####################

 SOLVE SAMEN2 using nlp minimizing dentropy ;

*#########################################################################

*#######
$offtext
*#######

*#*#*#*#*#*#*#*#*#*#*#*#*#* THE END *#*#*#*#*#*#*#*#*#*#*#
```

REFERENCES

Aaronson D. (1999) *A Note on the Benefits of Homeownership*, Federal Reserve Bank of Chicago, Chicago, IL.

Abler D. G., Rodri'guez A. G. and Shortle J. S. (1998) Labor Force Growth and the Environment in Costa Rica, *Economic Modelling*, **15**(4), pp 477 - 499.

Acs Z. J., Audretsch D. B. and Feldman M. P. (1994) R&D Spillovers and Recipient Firms Size, *Review of Economics and Statistics*, **76**(2), pp 336 - 340.

Adair A., Berry J. and McGreal S. (2003) Financing Property's Contribution to Regeneration, *Urban Studies*, **40**(5-6), pp 1065 - 1080.

Adair A., McGreal S., Smyth A., Cooper J. and Ryley T. (2000) House Prices and Accessibility: The Testing of Relationships within the Belfast Urban Area, *Housing Studies*, **15**(5), pp 699-716.

Adair A. S., Berry J. N. and McGreal W. S. (1996) Hedonic Modelling, Housing Submarkets and Residential Valuation, *Journal of Property Research*, **13**(1), pp 67-83.

Adams D. and Watkins C. (2002) *Greenfields, Brownfields and Housing Development*, Blackwell, Oxford.

Adams P. D. and Parmenter B. R. (1995) An Applied General Equilibrium Analysis of the Economic Effects of Tourism in a Quite Small, Quite Open Economy, *Applied Economics*, **27**(10), pp 985-994.

Alden J. and Offord C. (1996) Regional Planning Guidance, in Tewdwr-Jones M. (Ed) *British Planning Policy in Transition*. UCL Press, London.

Alexander C. and Barrow M. (1994) Seasonality and Cointegration of Regional House Prices in the UK, *Urban Studies*, **31**(10), pp 1667-1690.

Allan G., McGregor P. G., Swales J. K. and Turner K. (2007) Impact of Alternative Electricity Generation Technologies on the Scottish Economy: An Illustrative Input—Output Analysis, *Proceedings of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy*, **221**(2), pp 243-254.

Alperovich G., Bergsman J. and Ehemann C. (1977) An Econometric Model of Migration between US Metropolitan Areas, *Urban Studies*, **14**(2), pp 135-145.

Anas A. and Arnott R. J. (1993) Development and Testing of the Chicago Prototype Housing Market Model, *Journal of Housing Research*, **4**(1), pp 73–129.

Anas A. and Kim I. (1996) General Equilibrium Models of Polycentric Urban Land Use with Endogenous Congestion and Job Agglomeration, *Journal of Urban Economics*, **40**(2), pp 232-256.

Ando A. and Modigliani F. (1963) The Life-Cycle Hypothesis of Saving, *American Economic Review*, **53**(1), pp 55-74.

Aoki K., Proudman J. and Vlieghe G. (2004) House Prices, Consumption, and Monetary Policy: A Financial Accelerator Approach, *Journal of Financial Intermediation*, **13**(4), pp 414-435.

Aoki K., Proudman J. and Vlieghe G. W. (2002) Houses as Collateral: Has the Link between House Prices and Consumption in the UK Changed?, *Economic Policy Review*, **8**(1), pp 163-178.

Apps P. (1974) An Approach to Urban Modelling and Evaluation: A Residential Model - Demand Equations for Housing Services, *Environment and Planning A*, **6**, pp 11-31.

Armstrong H. W. and Taylor J. (2000) *Regional Economics and Policy (3rd Edition)*, Blackwell, Oxford.

Arnott R. (1987) Economic Theory and Housing, *Handbook of Regional and Urban Economics*, **2**, pp 959-988.

Arnott R. J. (1980) A Simple Urban Growth Model with Durable Housing, *Regional Science and Urban Economics*, **10**(1), pp 53-76.

Aron J. and Muellbauer J. (2006) *Housing Wealth, Credit Conditions and Consumption*, Working paper 9, Centre for the Study of African Economics, Oxford University, Oxford.

Attanasio O. P. and Weber G. (1994) The UK Consumption Boom of the Late 1980s: Aggregate Implications of Microeconomic Evidence, *Economic Journal*, **104**(427), pp 1269-1302.

Audretsch D. B. and Feldman M. P. (1996) R&D Spillovers and the Geography of Innovation and Production, *American Economic Review*, 86(3), pp 630–640.

Azzoni C. R. and Kadota D. K. (2001) *An Econometric Input-Output Model for Sao Paulo State*, Structure and Structural Change in the Brazilian Economy, Universidade de São Paulo.

Bajic V. (1984) An Analysis of the Demand for Housing Attributes, *Applied Economics*, 16(4), pp 597-610.

Baker M. and Wong C. (1997) Planning for Housing Land in the English Regions: A Critique of Household Projections and Regional Planning Guidance Mechanisms, *Environment and Planning C*, 15(1), pp 73-87.

Balchin P. N. (1998) An Overview of Pre-Thatcherite Housing Policy, in Balchin P. N. and Rhoden M. (Eds) *Housing: The Essential Foundations*. Routledge, London.

Ball M. (2003) Markets and the Structure of the Housebuilding Industry: An International Perspective, *Urban Studies*, 40(5), pp 897-916.

Ball M. and Wood A. (1999) Housing Investment: Long Run International Trends and Volatility, *Housing Studies*, 14(2), pp 185-209.

Ball M. J. and Kirwan R. M. (1977) Urban Housing Demand: Some Evidence from Cross-Sectional Data, *Applied Economics*, 9(4), pp 343-66.

Ballard C. L., Fullerton D., Shoven J. B. and Whalley J. (1985) *A General Equilibrium Model for Tax Policy Evaluation*, University of Chicago Press, Chicago.

Bank of England (2008) *Annual Average of Official Bank Rate: Iuaa Bedr*. Available online at: http://www.bankofengland.co.uk/mfsd/iadb/index.asp?Travel=NIxIRx&levels=2&FullPage=&FullPageHistory=&Nodes=&SectionRequired=I&HideNums=-1&ExtraInfo=true&A3687XNode3687.x=4&A3687XNode3687.y=1 (accessed: 04/08/2008)

Banks J., Blundell R. and Smith J. P. (2003) Understanding Differences in Household Financial Wealth between the United States and Great Britain, *Journal of Human Resources*, 38(2), pp 241-279.

Barcelo C. (2006) *Housing Tenure and Labour Mobility: A Comparison across European Countries*, CEMFI Working Paper No. 0302, Bank of Spain, Barcelona.

Barker K. (2003) *Review of Housing Supply - Interim Report*, HM Treasury, London

Barker K. (2004) *Review of Housing Supply - Final Report - Recommendations*, delivering stability : securing our future housing needs, HM Treasury, London

Barker K. (2008) Planning Policy, Planning Practice, and Housing Supply, *Oxford Review of Economic Policy*, 24(1), pp 34-49.

Barr N. A. (1993) *The Economics of the Welfare State*, Stanford University Press, Stanford, California.

Barrell R. J., Choy A. and Riley R. (2003) Consumption and Housing Wealth in the UK, *National Institute Economic Review*, 186(1), pp 53-56.

Bartik T. J. (1987) The Estimation of Demand Parameters in Hedonic Price Models, *Journal of Political Economy*, 95(1), pp 81-88.

Batey P. W. J. and Weeks M. J. (1989) The Effects of Household Disaggregation in Extended Input-Output Models in Miller R. E., Polenske K. and Rose A. Z. (Eds) *Frontiers of Input-Output Analysis*. Oxford University Press, New York.

Bayer P. J., McMillan R. and Rueben K. (2004) *An Equilibrium Model of Sorting in an Urban Housing Market*, NBER Working Paper No. W10865

Bazerman M. H. (2006) *Judgment in Managerial Decision Making*, John Wiley and Sons, Chichester.

Beeson P. E. and Eberts R. W. (1989) Identifying Productivity and Amenity Effects in Interurban Wage Differentials, *Review of Economics and Statistics*, 71(3), pp 443-52.

Bell D. E., Raiffa H. and Tversky A. (1988) *Decision Making: Descriptive, Normative, and Prescriptive Interactions*, Cambridge University Press, Cambridge.

Benito A. (2006) The Down-Payment Constraint and UK Housing Market: Does the Theory Fit the Facts?, *Journal of Housing Economics*, 15(1), pp 1-20.

Bennett R. and Hordijk L. (1986) Regional Econometric and Dynamic Models, in Nijkamp P. (Ed) *Handbook of Regional and Urban Economics*, pp. 407-441.

Berger M. C. and Blomquist G. C. (1992) Mobility and Destination in Migration Decisions: The Roles of Earnings, Quality of Life, and Housing Prices, *Journal of Housing Economics*, 2(1), pp 37-59.

Bernanke B., Gertler M. and Gilchrist S. (1998) *The Financial Accelerator in a Quantitative Business Cycle Framework*, NBER Working Paper.

Berndt E. R. and Christensen L. R. (1973) The Translog Function and the Substitution of Equipment, Structures, and Labor in US Manufacturing 1929-68, *Journal of Econometrics*, 1(1), pp 81-114.

Bester H. (1985) Screening Vs. Rationing in Credit Markets with Incomplete Information, *American Economic Review*, 75(4), pp 850-855.

Bishop P. (1998) Higher Education, in Gripaios P. (Ed) *The South West Economy: Trends and Prospects (10th Edition)*. University of Plymouth, Plymouth.

Black J., de Meza D. and Jeffreys D. (1996) House Prices, the Supply of Collateral and the Enterprise Economy, *The Economic Journal*, 106(434), pp 60-75.

Blackaby D. H. and Manning D. N. (1992) Regional Earnings and Unemployment–a Simultaneous Approach, *Oxford Bulletin of Economics and Statistics*, 54(4), pp 481-501.

Blake N. (2003) *The Economic Impact of Restrictions on Housing Supply: An Investigation for the Barker Review*, Experian Business Strategies.

Boddy M. (1980) *The Building Societies*, Macmillan, London.

Boehm T. P. and McKenzie J. A. (1982) Inflation, Taxes, and the Demand for Housing, *Real Estate Economics*, 10(1), pp 25-38.

Boelhouwer P. and van der Heijden H. (1993) Housing Systems in Europe—a Research Project, *Housing, Theory and Society*, 10(1), pp 37-42.

Bogart W. T. and Cromwell B. A. (1997) How Much More Is a Good School District Worth?, *National Tax Journal*, 70(2), pp 215-32.

Boone L. and Girouard N. (2002) The Stock Market, the Housing Market and Consumer Behaviour, *OECD Economic Studies*, 35(2), pp 175-200.

Bordo M. D. (1998) International Rescues Versus Bailouts: A Historical Perspective, *Cato Institute's 16th Annual Conference* pp. 81-167, Washington D.C.

Borio C. and McGuire P. (2004) Twin Peaks in Equity and Housing Prices?, *BIS Quarterly Review*, 7(2), pp 79–96.

Bourassa S. C. (1996) Measuring the Affordability of Home-Ownership, *Urban Studies*, 33(10), pp 1867-1877.

Bourguignon F., Branson W. H. and De Melo J. (1989) *Adjustment and Income Distribution: A Counterfactual Analysis*, NBER Working Paper.

Bover O., Muellbauer J. and Murphy A. (1989) Housing, Wages and UK Labour Markets, *Oxford Bulletin of Economics and Statistics*, 51(2), pp 97-136.

Bowen A. (1994) Housing and the Macroeconomy in the United Kingdom, *Housing Policy Debate*, 5(3), pp 241-251.

Boyle P. (1995) Public Housing as a Barrier to Long-Distance Migration, *International Journal of Population Geography*, 1(2), pp 147-64.

Bradbury C., Case K. and Mayer C. (1997) *School Quality, Local Budgets and Property Values*, Federal Reserve Bank of Boston Working Paper, Federal Reserve, Boston.

Bramley G. (1993a) The Impact of Land Use Planning and Tax Subsidies on the Supply and Price of Housing in Britain, *Urban Studies*, 30(1), pp 5-30.

Bramley G. (1993b) Land-Use Planning and the Housing Market in Britain: The Impact on Housebuilding and House Prices, *Environment and Planning A*, 25(7), pp 1021-1021.

Bramley G. (1998) Signs of Panic in Middle England: The Implications of Household Growth for Policy and Planning, *New Economy*, 5(3), pp 168-173.

Bramley G. (1999) Housing Market Adjustment and Land-Supply Constraints, *Environment and Planning A*, 31(7), pp 1169-88.

Bramley G. (2003) *Affordability and the Intermediate Market* Barker Inquiry on Housing Supply, Herriot-Watt University, Edinburgh.

Bramley G. (2004) *Increasing Housing Supply: Achieving Increases and Estimating Their Impact on Price, Affordability and Need* Barker Inquiry on Housing Supply, Herriot-Watt University Edinburgh.

Bramley G. (2007) The Sudden Rediscovery of Housing Supply as a Key Policy Challenge, *Housing Studies*, 22(2), pp 221 - 241.

Bramley G. and Leishman C. (2005) Planning and Housing Supply in Two-Speed Britain: Modelling Local Market Outcomes, *Urban Studies*, 42(12), pp 2213-2244.

Bramley G., Munro M. and Pawson H. (2004) *Key Issues in Housing: Policies and Markets in 21st Century Britain*, Palgrave Macmillan, Hampshire.

Bramley G. and Pawson H. (2002) Low Demand for Housing: Incidence, Causes and UK National Policy Implications, *Urban Studies*, 39(3), pp 393-422.

Bramley G., Pawson H., Third H., Parker J. and McIntosh S. (2000) *Low Demand Housing and Unpopular Neighborhoods*, Department of the Environment, Transport and the Regions, London

Bramley G. and Watkins C. (1995) *Circular Projections: Household Growth*, Housing Development and the Household Projections Council for the Protection of Rural England, London.

Brayton F., Levin A., Lyon R. and Williams J. C. (1997) *The Evolution of Macro Models at the Federal Reserve Board*, Carnegie-Rochester Conference Series on Public Policy.

Breheny M. and Hall P. (1996) *The People: Where Will They Go*, Town and Country Planning Association, London.

Bridges S., Disney R. and Henley A. (2004) Housing Wealth and the Accumulation of Financial Debt: Evidence from UK Households, in Bertola G., Disney R. and Grant C. (Eds) *The Economics of Consumer Credit*, pp. 135–180. MIT Press, Cambridge, Mass.

Burchell R. W. and Listokin D. (1995) Influences on United States Housing Policy, *Housing Policy Debate*, 6(3), pp 559–617.

Buxton T., Chapman P. G. and Temple P. (1998) *Britain's Economic Performance*, Routledge, London.

Cameron G. and Muellbauer J. (1998) The Housing Market and Regional Commuting and Migration Choices, *Scottish Journal of Political Economy*, 45(4), pp 420–446.

Cameron G. and Muellbauer J. (2000) *Earnings, Unemployment, and Housing: Evidence from a Panel of British Regions*, Discussion Paper No. 2404, Centre for Economic Policy Research.

Cameron G. and Muellbauer J. (2001) Earnings, Unemployment and Housing in Britain, *Journal of Applied Econometrics*, 16(3), pp 203-220.

Cameron G., Muellbauer J. and Murphy A. (2005) *Booms, Busts and Ripples in British Regional Housing Markets*, University of Oxford Working Paper, November.

Campbell J. Y. and Cocco J. F. (2007) How Do House Prices Affect Consumption? Evidence from Micro Data, *Journal of Monetary Economics*, 54(3), pp 591-621.

Canning P. and Wang Z. H. I. (2004) A Flexible Modeling Framework to Estimate Interregional Trade Patterns and Input-Output Accounts, *Journal of Regional Science*, 43(3), pp 539-563.

Capozza D. R., Hendershott P. H., Mack C. and Mayer C. J. (2002) *Determinants of Real House Price Dynamics*, NBER Working Paper.

Capstick M. (1987) *Housing Dilemmas in the Lake District*, Centre for North-West Regional Studies, University of Lancaster.

Carliner G. (1973) Income Elasticity of Housing Demand, *Review of Economics and Statistics*, 55(4), pp 528–532.

Carroll C. (2004) *Housing Wealth and Consumption Expenditure*, MIMEO, John Hopkins University.

Carruth A. and Henley A. (1990) The Housing Market and Consumer Spending, *Fiscal Studies*, 11(3), pp 27-38.

Casado-Díaz J. M. (2000) Local Labour Market Areas in Spain: A Case Study, *Regional studies*, 34(9), pp 843-856.

Case K., Quigley J. and Shiller R. (2003) Home-Buyers, Housing and the Macroeconomy, *2003 Conference on Asset Prices and Monetary Policy*. Reserve Bank of Australia.

Case K. E. (2000) Real Estate and the Macroeconomy, *Brookings Papers on Economic Activity*, pp 119-145.

Case K. E. and Shiller R. J. (1989) The Behavior of Home Buyers in Boom and Post-Boom Markets. National Bureau of Economic Research Cambridge, Mass., USA.

Charles S. (1977) *Housing Economics*, Macmillan, London.

Chartered Institute of Housing Cymru (2005) *Action on Housing in Wales*, Welsh Assembly, Cardiff

Chen M. C. and Patel K. (1996) *House Price Volatility in the UK New Dwelling Market: Based on Vector Error Correction Method*, MIMEO, Department of Land Economy, University of Cambridge.

Cheshire P. and Sheppard S. (1995) On the Price of Land and the Value of Amenities, *Economica*, 62(246), pp 247-67.

Cheshire P. and Sheppard S. (1998) Estimating the Demand for Housing, Land, and Neighbourhood Characteristics, *Oxford Bulletin of Economics and Statistics*, 60(3), pp 357-382.

Chevan A. (1989) The Growth of Home Ownership: 1940–1980, *Demography*, 26(2), pp 249-66.

Chris M. and Sommerville C. (2000) Land Use Regulation and New Construction, *Regional Science and Urban Economics*, 30(6), pp 639-662.

Clapham D. (1996) Housing and the Economy: Broadening Comparative Housing Research, *Urban Studies*, 33(4), pp 631-647.

Clark W. and Huang Y. (2004) Linking Migration and Mobility: Individual and Contextual Effects in Housing Markets in the UK, *Regional studies*, 38(6), pp 617-628.

Clark W. A. V., Deurloo M. C. and Dieleman F. M. (1984) Housing Consumption and Residential Mobility, *Annals of the Association of American Geographers*, 74(1), pp 29-43.

Coates D. and Humphreys B. R. (2002) The Economic Impact of Postseason Play in Professional Sports, *Journal of Sports Economics*, 3(3), pp 291-299.

Cocco J. F., Gomes F. J. and Maenhout P. J. (2005) Consumption and Portfolio Choice over the Life Cycle, *Review of Financial Studies*, 18(2), pp 491-533.

Cole I. (2003) The Development of Housing Policy in the English Regions: Trends and Prospects, *Housing Studies*, 18(2), pp 219-234.

Commission for Rural Communities (2006a) *The Use of the Second Homes Council Tax Discount in Cornwall: A Long Term Approach*, Countryside Agency.

Commission for Rural Communities (2006b) *The Use of the Second Homes Council Tax Discount in Devon: Returning the Extra Resources*, Countryside Agency.

Conway Jr R. S. (1977) The Stability of Regional Input-Output Multipliers, *Environment and Planning A*, 9, pp 197-214.

Cook S. (2003) The Convergence of Regional House Prices in the UK, *Urban Studies*, 40(11), pp 2285-2294.

Cook S. and Thomas C. (2003) An Alternative Approach to Examining the Ripple Effect in UK House Prices, *Applied Economics Letters*, 10(13), pp 849-851.

Cooley T. F., LeRoy S. F. and Raymon N. (1984) Econometric Policy Evaluation: Note, *American Economic Review*, 74(3), pp 467-470.

Cooper A. (2004) The Impact of Interest Rates and the Housing Market on the UK Economy, *Economic Outlook*, 28(2), pp 10 - 18.

Coopers and Lybrand (1985) *Land-Use Planning and Indicators of Housing Demand*, Coopers and Lybrand, London.

Corkindale J. (1999) Land Development in the United Kingdom: Private Property Rights and Public Policy Objectives, *Environment and Planning A*, 31(11), pp 2053-2070.

Council of Mortgage Lenders (2001) *Survey of Mortgage Lenders*. Available online at: http://www.data-archive.ac.uk/findingData/smlTitles.asp (accessed: 07/04/2007)

Council of Mortgage Lenders (2008) *Table Ml5: Fixed and Variable Rate Lending - House Purchases and Remortgages*. Available online at: http://www.cml.org.uk/cml/statistics (accessed: 04/08/2008)

Counsell D. and Haughton G. (2002) *Regional Report 5 the South West of England*, Sustainable Development in Regional Planning Guidance, Centre for City and Regional Studies Hull.

Creedy J. (1974) Inter-Regional Mobility: A Cross-Section Analysis, *Scottish Journal of Political Economy*, 21(1), pp 41-53.

Cullingworth J. B. (1997) British Land-Use Planning: A Failure to Cope with Change?, *Urban Studies*, 34(5-6), pp 945-960.

Cullingworth J. B. and Nadin V. (2002) *Town and Country Planning in the UK*, Routledge, London.

Cutler H. and Strelnikova I. (2004) The Impact of the US Sales Tax Rate on City Size and Economic Activity: A CGE Approach, *Urban Studies*, 41(4), pp 875-885.

Davis M. A. and Martin R. F. (2005) *Housing, House Prices, and the Equity Premium Puzzle*. Available online at: http://ssrn.com/abstract=688451 (accessed: June 2009).

de Leeuw F. (1971) The Demand for Housing: A Review of Cross Section Evidence, *Review of Economics and Statistics*, 53(1), pp 1-10.

Department for Business Enterprise and Regulatory Reform (2007) *Output*, Construction Statistics Annual 2007, Department for Business Enterprise and Regulatory Reform, London

Department for Communities and Local Government (2007) *Homes for the Future: More Affordable, More Sustainable*, Department for Communities and Local Government,, London

Department for Communities and Local Government (2008) *Housing - New Growth Points*. Available online (accessed: 06/08/2008).

Department for the Environment Food and Rural Affairs (2005) *The Future – UK Government Sustainable Development Strategy*, CM 6467, HMSO, London

Department of Communities and Local Government (2006) *Delivering Affordable Housing*, Communities and Local Government Publications, Wetherby, West Yorkshire

Department of Communities and Local Government (2007a) *Table 101: Dwelling Stock: By Tenure, United Kingdom* Available online at: www.communities.gov.uk/documents/housing/xls/table-101.xls (accessed: 03/08/2008)

Department of Communities and Local Government (2007b) *Table 801: Household Characteristics: Tenure Trend, from 1918*. Available online at: www.communities.gov.uk/documents/housing/xls/141491.xls (accessed: 22/07/08)

Department of Communities and Local Government (2008a) *Regional Housing Strategies*. Available online at: http://www.communities.gov.uk/housing/strategiesandreviews/regionalhousingstrategies/ (accessed: August).

Department of Communities and Local Government (2008b) *Table 117: Dwelling Stock: Type of Accommodation, by Region* Available online at: http://www.communities.gov.uk/documents/housing/xls/table-117.xls (accessed: 27/07/2008)

Department of Communities and Local Government (2008c) *Table 241: House Building: Permanent Dwellings Completed by Tenure*. Available online at: www.communities.gov.uk/documents/housing/xls/141242.xls (accessed: 05/08/2008)

Department of Communities and Local Government (2008d) *Table 502: Housing Market: House Prices from 1930, Annual House Price Inflation, United Kingdom, from 1970*. Available online at: www.communities.gov.uk/documents/housing/xls/141272.xls (accessed: 05/08/2008)

Department of Communities and Local Government (2008e) *Table 503: Simple Average House Prices by New/Other Dwellings, Type of Buyer and Region*. Available online at: http://www.communities.gov.uk/documents/housing/xls/140951.xls (accessed: 25/06/2008)

Department of Communities and Local Government (2008f) *Table 513: Housing Market: Simple Average House Prices, Mortgage Advances and Incomes of Borrowers*. Available online at: http://www.communities.gov.uk/documents/housing/xls/141380.xls (accessed: 27/07/2008)

Department of Communities and Local Government (2008g) *Table 576: Ratio of Lower Quartile House Price to Lower Quartile Earnings by District, from 1997* Available online at: http://www.communities.gov.uk/documents/housing/xls/152924.xls (accessed: 04/09/2008)

Department of Communities and Local Government (2008h) *Table 577: Ratio of Median House Price to Median Earnings by District.* Available online at: http://www.communities.gov.uk/documents/housing/xls/322286.xls (accessed: 01/09/2008)

Department of Communities and Local Government (2008i) *Table 801: Household Characteristics: Tenure Trend, from 1918.* Available online at: www.communities.gov.uk/documents/housing/xls/141491.xls (accessed: 22/07/08)

Department of Communities and Local Government (2008j) *Table 810: Household Size by Type of Accommodation and by Number of Bedrooms* Available online at: http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/household characteristics/livetables/ (accessed: August 2008)

Department of Communities and Local Government (2008k) *Table S356: Location of Second Homes in England* Available online at: http://www.communities.gov.uk/documents/housing/xls/139868.xls (accessed: 17/08/2008)

Department of the Environment (1971) *Local Government in England: Government Proposals for Reorganisation* CM 4584, HMSO, London

Department of the Environment (1989) *The Future of Development Plans* CM 569, HMSO, London

Devarajan S. (2001) *Notes on Dynamics in CGE Models*, World Bank, Washington DC.

Devarajan S. and Robinson S. (2002) The Impact of Computable General Equilibrium Models on Policy, *Frontiers in Applied General Equilibrium Modeling*, pp. 5-6, Yale University.

Dewatripont M. and Michel G. (1987) On Closure Rules, Homogeneity and Dynamics in Applied General Equilibrium Models, *Journal of Development Economics*, **26**(1), pp 65-76.

Dewhurst J. H. L. (1992) Using the Ras Technique as a Test of Hybrid Methods of Regional Input–Output Table Updating, *Regional studies*, **26**(1), pp 81-91.

Dewhurst J. H. L. and West G. R. (1990) Closing Interregional Input-Output Models with Econometrically Determined Relationships, *New Directions in Regional Analysis: Integrated and Multiregional Approaches*, pp 171–186.

Dicks M. J. (1990) *A Simple Model of the Housing Market*, Discussion Paper no. 49, Bank of England.

Dieleman F. M. and Schouw R. J. (1989) Divorce, Mobility and Housing Demand, *European journal of population*, **5**(3), pp 235-52.

Dipasquale D. (1999) Why Don't We Know More About Housing Supply?, *The Journal of Real Estate Finance and Economics*, **18**(1), pp 9-23.

Dipasquale D. and Wheaton W. C. (1992) The Markets for Real Estate Assets and Space: A Conceptual Framework, *Real Estate Economics*, **20**(2), pp 181-198.

Dipasquale D. and Wheaton W. C. (1994) Housing Market Dynamics and the Future of Housing Prices, *Journal of Urban Economics*, **35**(1), pp 1-27.

Disney R., Henley A. and Jevons D. (2003) *House Price Shocks, Negative Equity and Household Consumption in the UK*, MIMEO, University of Nottingham, Nottingham.

Dixon P. B., Parmenter B. R., Sutton J. and Vincent D. P. (1982) *Orani, a Multisectoral Model of the Australian Economy*, North-Holland, New York.

Doling J. (2001) Housing Studies and the Structure-Agency Dualism, *Housing, Theory and Society*, **18**(1-2), pp 25-26.

Dorosh P. A. and Sahn D. E. (2000) A General Equilibrium Analysis of the Effect of Macroeconomic Adjustment on Poverty in Africa, *Journal of Policy Modeling*, **22**(6), pp 753-776.

Drake L. (1995) Testing for Convergence between UK Regional House Prices, *Regional Studies*, **29**(4), pp 357-366.

Ebrahim M. S. and Mathur I. (2004) A Modified General Equilibrium Analysis of House Prices and Interest Rates, *Maastricht-Cambridge Symposium* The Department of Land Economy, University of Cambridge, Maastricht University.

El-Haram M. A. and Horner M. W. (2002) Factors Affecting Housing Maintenance Cost, *Journal of Quality in Maintenance Engineering*, 8(2), pp 115-123.

Elekdag S., Lalonde R., Laxton D., Muir D. and Pesenti P. A. (2008) *Oil Price Movements and the Global Economy: A Model-Based Assessment*, IMF Staff Papers, International Monetary Fund.

Elias P. and Molho I. (1982) Regional Labour Supply: An Economic/Demographic Model, *Population Change and Regional Labour Markets*, University of Durham.

Englund P. and Ioannides Y. M. (1993) The Dynamics of Housing Prices: An International Perspective, *World Congress of the International Economic Association*, Moscow.

Englund P. and Ioannides Y. M. (1997) House Price Dynamics: An International Empirical Perspective, *Journal of Housing Economics*, 6(2), pp 119-136.

Ermisch J. F., Findlay J. and Gibb K. (1996) The Price Elasticity of Housing Demand in Britain: Issues of Sample Selection, *Journal of Housing Economics*, 5(1), pp 64-86.

European Commission (2000) *European Spatial Development Perspective*, Office for Official Publications of the European Communities, Luxembourg

European Commission (2007) *Regional Policy Sourcebook: Methods and Techniques*. Available online at:
http://ec.europa.eu/regional_policy/sources/docgener/evaluation/evalsed/sourcebooks/method_techniques/index_en.htm (accessed: August 2008).

Evans A. W. (1996) The Impact of Land Use Planning and Tax Subsidies on the Supply and Price of Housing in Britain: A Comment, *Urban Studies*, 33(3), pp 581-586.

Everaert L. U. C. and Schule W. (2006) *Structural Reforms in the Euro Area: Economic Impact and Role of Synchronization across Markets and Countries*, IMF Staff Papers, International Monetary Fund.

Experian (2008) *Regional Household Forecasts and Scenarios*, National Housing and Planning Advice Unit.

Fabling R. and Grimes A. (2005) Insolvency and Economic Development: Regional Variation and Adjustment, *Journal of Economics and Business*, 57(4), pp 339-359.

Fair R. C. (1972) Disequilibrium in Housing Models, *Journal of Finance*, 27(2), pp 207-21.

Fannin J. M. (2000) Construction of a Social Accounting Matrix for County Fermanagh, Northern Ireland, *Annual Meeting of the Southern Regional Science Association*, Miami, FL.

Farmer K. and Wendner R. (2004) Dynamic Multi-Sector CGE Modeling and the Specification of Capital, *Structural Change and Economic Dynamics*, 15(4), pp 469-492.

Feins J. D. and Lane T. S. (1981) *How Much for Housing: New Perspectives on Affordability and Risk*, Abt Books, Cambridge, MA.

Ferguson L., McGregor P. G., Swales J. K., Turner K. R. and Yin Y. P. (2005) Incorporating Sustainability Indicators into a Computable General Equilibrium Model of the Scottish Economy, *Economic Systems Research*, 17(2), pp 103-140.

Fielder S. and Smith R. (1996) *Vacant Dwellings in the Private Sector*, HMSO, London.

Fisher E. M. and Fisher R. M. (1954) *Urban Real Estate*, Henry Holt, New York.

Flavin M. and Nakagawa S. (2008) A Model of Housing in the Presence of Adjustment Costs: A Structural Interpretation of Habit Persistence, *American Economic Review*, 98(1), pp 474-495.

Fofana I., Lemelin A. and Cockburn J. (2002) *Balancing a Social Accounting Matrix*, CREFA, Université Laval, Quebec.

Follain J. R. (1979) The Price Elasticity of the Long Run Supply of New Housing Construction, *Land Economics*, 55(2), pp 190-199.

Follain J. R. (1982) Does Inflation Affect Real Behavior: The Case of Housing, *Southern Economic Journal*, 48(3), pp 570-582.

Follain Jr J. R. (1982) Does Inflation Affect Real Behavior: The Case of Housing, *Southern Economic Journal*, 48(3), pp 570.

Forrest R. (1987) Spatial Mobility, Tenure Mobility, and Emerging Social Divisions in the UK Housing Market, *Environment and Planning A*, 19(12), pp 1611-1630.

Forrest R. and Murie A. (1994) Home Ownership in Recession, *Housing Studies*, 9(1), pp 55-74.

Frank L. D. and Pivo G. (1994) Impacts of Mixed Use and Density on Utilization of Three Modes of Travel: Single-Occupant Vehicle, Transit, and Walking, *Transportation Research Record*, 1466, pp 44-44.

Frick J. R. and Grabka M. M. (2003) Imputed Rent and Income Inequality: A Decomposition Analysis for Great Britain, West Germany and the U.S, *Review of Income & Wealth*, 49(4), pp 513-537.

Gallent N. (2005) Regional Housing Figures in England: Policy, Politics and Ownership, *Housing Studies*, 20(6), pp 973 - 988.

Gallent N., Baker M. and Wong C. (1998) Securing Housing Choice: New Opportunities for the UK Planning System, *Housing Studies*, 13(3), pp 425-437.

Gallent N., Mace A., Tewdwr-Jones M. and Agency G. B. C. (2002) *Second Homes in Rural Areas of England*, Countryside Agency.

Galster G. (1997) Comparing Demand-Side and Supply-Side Housing Policies: Sub-Market and Spatial Perspectives, *Housing Studies*, 12(4), pp 561-577.

GAMS (2007) *An Introduction to Gams*. Available online at: http://www.gams.com/ (accessed: 20/06/07).

Garasky S., Haurin R. J. and Haurin D. R. (2001) Group Living Decisions as Youths Transition to Adulthood, *Journal of Population Economics*, 14(2), pp 329-349.

General Register Office for Scotland (2008) *Household Composition - Census 1991, 2001*. Available online at: http://www.gro-scotland.gov.uk/statistics/index.html (accessed: 02/08/2008)

Gentle C., Dorling D. and Comford J. (1994) Negative Equity and British Housing in the 1990s: Cause and Effect, *Urban Studies*, 31(2), pp 181-199.

Gibb K. (2000) Modelling Housing Choice and Demand in a Social Housing System: The Case of Glasgow, *Berkeley Program on Housing and Urban Policy Seminar and Conference Papers*. University of California, Berkeley.

Gibb K. and Hoesli M. (2003) Developments in Urban Housing and Property Markets, *Urban Studies*, 40, pp 887-896.

Gillespie G., McGregor P. G., Swales J. K. and Yin Y. P. (2001) The Displacement and Multiplier Effects of Regional Selective Assistance: A Computable General Equilibrium Analysis, *Regional Studies*, 35(2), pp 125-139.

Gitlesen J. P. and Thorsen I. (2000) A Competing Destinations Approach to Modeling Commuting Flows: A Theoretical Interpretation and an Empirical Application of the Model, *Environment and Planning A*, 32(11), pp 2057-2074.

Gittus E. (1976) *Flats, Families and the under-Fives*, Routledge, London.

Giuliano G. and Small K. A. (1993) Is the Journey to Work Explained by Urban Structure?, *Urban Studies*, 30(9), pp 1485-1500.

Giussani B. and Hadjimatheou G. (1991a) Modelling Regional House Prices in the UK, *Papers in Regional Science*, 70(2), pp 201-219.

Giussani B. and Hadjimatheou G. (1991b) *Modelling the North/South Divide in House Prices* Discussion Papers in Urban and Regional Economics Series C, University of Reading.

Glaeser E. L. and Gyourko J. (2003) The Impact of Building Restrictions on Housing Affordability, *Economic Policy Review*, 9(2), pp 21-39.

Glaeser E. L., Gyourko J. and Saks R. E. (2006) Urban Growth and Housing Supply, *Journal of Economic Geography*, 6(1), pp 71-89.

Glaeser E. L., Kallal H. D., Scheinkman J. A. and Shleifer A. (1992) Growth in Cities, *Journal of Political Economy*, 100(6), pp 1126-1152.

Goodman A. C. and Kawai M. (1982) Permanent Income, Hedonic Prices, and Demand for Housing: New Evidence, *Journal of Urban Economics*, **12**(2), pp 214-237.

Goodman A. C. and Thibodeau T. G. (1998) Housing Market Segmentation, *Journal of Housing Economics*, **7**(2), pp 121-143.

Gordon I. (1985) The Cyclical Interaction between Regional Migration, Employment and Unemployment: A Time Series Analysis for Scotland, *Scottish Journal of Political Economy*, **32**(2), pp 135–158.

Government Office for the South West (2001) *Regional Planning Guidance*, DTLR,http://www.gos.gov.uk/497666/docs/166217/regional_planning_guidance

Green A. E. (1997) A Question of Compromise? Case Study Evidence on the Location and Mobility Strategies of Dual Career Households, *Regional studies*, **31**(7), pp 641-657.

Green R. and Hendershott P. H. (1996) Age, Housing Demand, and Real House Prices, *Regional Science and Urban Economics*, **26**(5), pp 465-480.

Greenaway D., Leybourne S., Reed G. V. and Whalley J. (1993) *Applied General Equilibrium Modelling: Applications, Limitations and Future Development*, HMSO, London.

Gunluk-Senesen G. and Bates J. M. (1994) Some Experiments with Methods of Adjusting Unbalanced Data Matrices, *Journal of the Royal Statistical Society A*, **151**, pp 473-490.

Gyourko J., Linneman P. and Center W. R. E. (1997) The Changing Influences of Education, Income, Family Structure, and Race on Homeownership by Age over Time, *Journal of Housing Research* **8**(1), pp 1-26.

Hall P., Thomas R., Gracey H. and Drewett R. (1974) The Containment of Urban England, *The Geographical Journal*, **4**(3), pp 386–417.

Hall R. E. (1978) Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence, *Journal of Political Economy*, **86**(6), pp 971-987.

Hancock K. and Maclennan D. (1989) *House Price Monitoring Systems and Housing Planning in Scotland: A Feasibility Study*, a report for the Scottish Office, Centre for Housing Research, Glasgow University, Glasgow.

Hanley N. D., McGregor P. G., Swales J. K. and Turner K. (2006) The Impact of a Stimulus to Energy Efficiency on the Economy and the Environment: A Regional Computable General Equilibrium Analysis, *Renewable Energy*, **31**(2), pp 161-171.

Hansen L. P. and Heckman J. J. (1996) The Empirical Foundations of Calibration, *Journal of Economic Perspectives*, **10**, pp 87-104.

Hanushek E. and Quigley J. (1978) An Explicit Model of Residential Mobility, *Land Economics*, **54**, pp 411-429.

Hanushek E. A. and Quigley J. M. (1979) The Dynamics of the Housing Market: A Stock Adjustment Model of Housing Consumption, *Journal of Urban Economics*, **6**(1), pp 90-111.

Hanushek E. A. and Quigley J. M. (1980) What Is the Price Elasticity of Housing Demand?, *Review of Economics and Statistics*, **62**(3), pp 449-54.

Hardman A. M. and Ioannides Y. M. (1999) Residential Mobility and the Housing Market in a Two-Sector Neoclassical Growth Model, *Scandinavian Journal of Economics*, **101**(2), pp 315-335.

Harmon O. R. and Potepan M. J. (1988) Housing Adjustment Costs: Their Impact on Mobility and Housing Demand Elasticities, *Real Estate Economics*, **16**(4), pp 459-478.

Harrigan F. (1993) Software Reviews, *Economic Journal*, **103**(419), pp 1088-1104.

Harrigan F., McGregor P. G. and Swales J. K. (1996) The System-Wide Impact on the Recipient Region of a Regional Labour Subsidy, *Oxford Economic Papers*, **48**(1), pp 105-133.

Harrigan F. J., Jenkins I. and McGregor P. G. (1986) *A Behavioural Model of Migration: An Evaluation of Neoclassical and Keynesian Alternatives*, Fraser of Allander Institute Discussion Paper, Fraser of Allander Institute, Strathclyde.

Harrington D. E. (1989) An Intertemporal Model of Housing Demand: Implications for the Price Elasticity, *Journal of Urban Economics*, **25**, pp 230–246.

Harris J. R. and Todaro M. P. (1970) Migration, Unemployment and Development: A Two-Sector Analysis, *American Economic Review*, 60(1), pp 126-142.

Harris R. and Cundell I. (1995) Changing the Property Mindset by Making Research Relevant, *Journal of Property Research*, 12(1), pp 75-78.

Harris R. I. D. and Liu A. (1998) Input–Output Modelling of the Urban and Regional Economy: The Importance of External Trade, *Regional studies*, 32(9), pp 851-862.

Haurin D. R. and Brasington D. (1996) School Quality and Real House Prices: Inter-and Intrametropolitan Effects, *Journal of Housing Economics*, 5(4), pp 351-368.

Haurin D. R. and Gill H. L. (2002) The Impact of Transaction Costs and the Expected Length of Stay on Homeownership, *Journal of Urban Economics*, 51(3), pp 563-584.

Haurin D. R., Hendershott P. H. and Wachter S. M. (1996) *Borrowing Constraints and the Tenure Choice of Young Households*, Working Paper, NBER

Haurin D. R. and Rosenthal S. S. (2007) The Influence of Household Formation on Homeownership Rates across Time and Race, *Real Estate Economics*, 35(4), pp 411-450.

HBOS (2008a) Halifax House Price Index, *Press Release Issued May 2008*.

HBOS (2008b) *Historical House Price Data*. Available online at: http://www.lloydsbankinggroup.com/media1/research/halifax_hpi.asp (accessed: 03/08/2009)

Hendershott P. H. (1980) Real User Costs and the Demand for Single-Family Housing, *Brookings Papers on Economic Activity*, 2(1980), pp 401-444.

Hendershott P. H. and Shilling J. D. (1980) *The Economics of Tenure Choice: 1955-79*, NBER Working Paper.

Henderson V., Kuncoro A. and Turner M. (1995) Industrial Development in Cities, *Journal of Political Economy*, 103, pp 1065-1090.

Henley A. (1998a) Changes in the Distribution of Housing Wealth in Great Britain, 1985-91, *Economica*, 65, pp 363-380.

Henley A. (1998b) Residential Mobility, Housing Equity and the Labour Market, *The Economic Journal*, 108(447), pp 414-427.

Her Majesty's Revenue and Customs (2008) *Number of Property Transactions* Available online at: http://www.hmrc.gov.uk/stats/survey_of_prop/menu.htm (accessed: 04/08/2008)

Hewings G. and Jensen R. (1986) *Regional, Interregional and Multiregional Input-Output Analysis. Handbook of Regional and Urban Economics, Vol. I*, North-Holland Publishing Co., Amsterdam.

Hewings G. J. D. (1970) Regional Planning: Problems in the Application of Inter-Regional Input-Output Analysis to State Planning and Program Activities, *The Annals of Regional Science*, 4(1), pp 114-122.

Hewings G. J. D. and Jensen R. C. (1988) Emerging Challenges in Regional Input-Output Analysis, *The Annals of Regional Science*, 22, pp 43-53.

Hirschman A. O. (1997) Against Parsimony: Three Easy Ways of Complicating Some Categories of Economic Discourse, *FRONTIER ISSUES IN ECONOMIC THOUGHT*, 3, pp 184-187.

Hitt L. M. and Snir E. M. (1999) The Role of Information Technology in Modern Production: Complement or Substitute to Other Inputs?, *Workshop on Information Systems and Economics*. University of Pennsylvania, Philadelphia, PA.

HM Treasury (2003) *Housing, Consumption and EMU*, EMU Study, TSO, London

Hoffmann S., Robinson S. and Subramanian S. (1996) The Role of Defense Cuts in the California Recession Computable General Equilibrium Models and Interstate Factor Mobility, *Journal of Regional Science*, 36(4), pp 571-595.

Holmans A. E. (1987) *Housing Policy in Britain: A History*, Croom Helm, London.

Holmans A. E. (2001) *Housing Demand and Need in England 1996-2016*, Town and Country Planning Association: National Housing Federation.

Hoover E. M. and Giarratani F. (1999) Introduction to Regional Economics, in Loveridge S. (Ed) *The Web Book of Regional Science* Regional Research Institute, West Virginia University, Morgantown, WV.

Horner M. W. (2004) Spatial Dimensions of Urban Commuting: A Review of Major Issues and Their Implications for Future Geographic Research, *The Professional Geographer*, 56(2), pp 160-173.

Hughes G. and McCormick B. (1981) Do Council Housing Policies Reduce Migration between Regions, *Economic Journal*, 91(364), pp 919-937.

Hughes G. and McCormick B. (1987) Housing Markets, Unemployment and Labour Market Flexibility in the UK, *European Economic Review*, 31(3), pp 615-641.

Hughes G. and McCormick B. (1994) Did Migration in the 1980s Narrow the North-South Divide?, *Economica*, 61(244), pp 509–527.

Hulchanski J. D. (1995) The Concept of Housing Affordability: Six Contemporary Uses of the Housing Expenditure-to-Income Ratio, *Housing Studies*, 10(4), pp 471-491.

Hunt B. and Rebucci A. (2005) The US Dollar and the Trade Deficit: What Accounts for the Late 1990s?*, *International Finance*, 8(3), pp 399-434.

Hunt L., Slaymaker J. and Snell M. (1996) Comparative Properties of UK Regional Econometric Models, *Regional Studies*, 30(8), pp 773-782.

Iacoviello M. (2004) Consumption, House Prices, and Collateral Constraints: A Structural Econometric Analysis, *Journal of Housing Economics*, 13(4), pp 304-320.

International Monetary Fund (2003) *World Economic Outlook*, April 2003, IMF, Washington D.C.

International Monetary Fund (2008) *World Economic Outlook*, July 2008, IMF, Washington D.C.

Iqbal Z. and Siddiqui R. (2001) *Critical Review of Literature on Computable General Equilibrium Models*, MIMAP Technical Paper Series, Pakistan Institute of Development Economics, Islamabad.

Isard W., Azis I. J., Drennan M. P., Miller R. E., Saltzman S. and Thorbecke E. (1998) *Methods of Interregional and Regional Analysis*, Ashgate Brookfield, Vermont.

Israilevich P. R., Hewings G. J. D., Sonis M. and Schindler G. R. (1997) Forecasting Structural Change with a Regional Econometric Input-Output Model, *Journal of Regional Science*, 37(4), pp 565-590.

Jackman R. and Savouri S. (1992) Regional Migration in Britain, *The Economic Journal*, 102, pp 1433-1450.

Janis I. L. (1982) *Groupthink: Psychological Studies of Policy Decisions and Fiascoes*, Houghton Mifflin Boston.

Jarvis H. (1999) Housing Mobility as a Function of Household Structure: Towards a Deeper Explanation of Housing-Related Disadvantage, *Housing Studies*, 14(4), pp 491-505.

Jarvis H. (2003) Dispelling the Myth That Preference Makes Practice in Residential Location and Transport Behaviour, *Housing Studies*, 18(4), pp 587-606.

Jensen R. C. (1980) The Concept of Accuracy in Input-Output, *International Regional Science Review*, 5, pp 139-154.

Johnes G. and Hyclak T. (1999) House Prices and Regional Labor Markets, *The Annals of Regional Science*, 33(1), pp 33-49.

Johnston E. (2003) *A Source of Contention: Affordable Housing in Rural Wales*, Institute of Welsh Affairs, Cardiff.

Jones C., Leishman C. and Watkins C. (2003) Structural Change in a Local Urban Housing Market, *Environment and Planning A*, 35(7), pp 1315-1326.

Jones C., Leishman C. and Watkins C. (2004) Intra-Urban Migration and Housing Submarkets: Theory and Evidence, *Housing Studies*, 19(2), pp 269-283.

Jones R., Whalley J., Dept. of E., Centre for the Study of International Economic R. and University of Western O. (1986) *A Canadian Regional General Equilibrium Model and Some Applications*, Dept. of Economics, University of Western Ontario.

Jones R., Whalley J., Wigle R. M., Dept. of E., Centre for the Study of International Economic R. and University of Western O. (1985) *Regional Impacts of Tariffs in Canada: Preliminary Results from a Small Dimensional Numerical General Equilibrium Model*, Dept. of Economics, University of Western Ontario.

Jorgenson D. W. and Wilcoxen P. J. (1993) Reducing US Carbon Emissions: An Econometric General Equilibrium Assessment, *Resource and Energy Economics*, 15(1), pp 7-25.

Julia-Wise R., Cooke S. C. and Holland D. (2002) A Computable General Equilibrium Analysis of a Property Tax Limitation Initiative in Idaho, *Land Economics*, 78(2), pp 207-227.

Kahneman D., Slovic P. and Tversky A. (1982) *Judgment under Uncertainty: Heuristics and Biases*, Cambridge University Press, Cambridge.

Kahneman D. and Tversky A. (2000) *Choices, Values, and Frames*, Cambridge University Press, Cambridge.

Kearl J. R. (1979) Inflation, Mortgages, and Housing, *Journal of Political Economy*, 87(5), pp 1115-1138.

Keenan P., Lowe S. and Spencer S. (1999) Housing Abandonment in Inner Cities-the Politics of Low Demand for Housing, *Housing Studies*, 14(5), pp 703-716.

Kenny G. (1999) Modelling the Demand and Supply Sides of the Housing Market: Evidence from Ireland, *Economic Modelling*, 16(3), pp 389-409.

Kilkenny M. (1993) Agricultural Liberalization in Segmented or Integrated Markets, with Scale Economies, *Journal of Economic Integration*, 8, pp 201–218.

Kim E. and Ju J. (2003) Growth and Distributional Impacts of Urban Housing Supply: An Application of Urban Land Use and a CGE Model for Seoul, *Review of Urban & Regional Development Studies*, 15(1), pp 66-81.

King B. B. (1985) What Is a Sam?, in Pyatt G. and Round J. (Eds) *Social Accounting Matrices: A Basis for Planning*. World Bank, Washington D.C.

King M. A. (1990) Discussion Of "Is the UK Balance of Payments Sustainable?" by John Muellbauer and Anthony Murphy, *Economic Policy*, 11, pp 383-387.

Koh Y. K., Schreiner D. F. and Shin H. (1993) Comparisons of Regional Fixed Price and General Equilibrium Models, *Regional Science Perspectives*, 23, pp 33-80.

Kraev E. (2003) *Modeling Macroeconomic and Distributional Impacts of Stabilization and Adjustment Packages: Current Literature and Challenges*, CEPA Working Papers, New School University, New York.

Kraybill D. S., Johnson T. G. and Orden D. (1992) Macroeconomic Imbalances: A Multiregional General Equilibrium Analysis, *American Journal of Agricultural Economics*, 74(3), pp 726-36.

Küster R., Ellersdorfer I. and Fahl U. (2007) *A CGE-Analysis of Energy Policies Considering Labor Market Imperfections and Technology Specifications*, Fondazione Eni Enrico Mattei Working Papers.

Kullback S. and Leibler R. A. (1951) On Information and Sufficiency, *Annals of Mathematical Statistics*, 22(1), pp 79-86.

Kuosmanen T. (2003) Duality Theory of Non-Convex Technologies, *Journal of Productivity Analysis*, 20(3), pp 273-304.

Lahr M. (2004) Biproportional Techniques in Input-Output Analysis: Table Updating and Structural Analysis, *Economic Systems Research*, 16(2), pp 115-134.

Lansley S. (1979) *Housing and Public Policy*, Routledge, London.

Le Grand J., Propper C. and Robinson R. (1992) *The Economics of Social Problems*, Macmillan, London.

Learmonth D., McGregor P. D., Swales J. K., Turner K. R., Yin Y. P. and Glasgow U. K. (2001) Modelling the Economic and Environmental Impacts of Population Policy in Jersey: A Multi-Period Computable General Equilibrium Analysis, *Fraser of Allander Institute, Department of Economics, University of Strathclyde, Glasgow, pp*, pp 1-21.

Leatherman J. C. and Marcouiller D. W. (1999) Moving Beyond the Modeling of Regional Economic Growth: A Study of How Income Is Distributed to Rural Households, *Economic Development Quarterly*, 13(1), pp 38-45.

Lee T. H. and Kong C. M. (1977) Elasticities of Housing Demand, *Southern Economic Journal*, 44(2), pp 298-315.

Leech D. and Campos E. (2003) Is Comprehensive Education Really Free?: A Case-Study of the Effects of Secondary School Admissions Policies on House Prices in One Local Area, *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, **166**(1), pp 135-154.

Leontief W. W. (1986) *Input-Output Economics*, Oxford University Press, Oxford.

Li P. C. and Rose A. (1995) Global Warming Policy and the Pennsylvania Economy: A Computable General Equilibrium Analysis, *Economic Systems Research*, **7**(2), pp 151-172.

Li W. and Yao R. U. I. (2007) The Life-Cycle Effects of House Price Changes, *Journal of Money, Credit and Banking*, **39**(6), pp 1375-1409.

Linneman P. D. and Megbolugbe I. F. (1992a) Housing Affordability: Myth or Reality?, *Urban Studies*, **29**(3), pp 369 - 392.

Linneman P. D. and Megbolugbe I. F. (1992b) Housing Affordability: Myth or Reality?, *Urban Studies*, **29**(3), pp 369-392.

Loveridge S. (2004) A Typology and Assessment of Multi-Sector Regional Economic Impact Models, *Regional studies*, **38**(3), pp 305-317.

Luk F. K. (1993) A General Equilibrium Simulation Model of Housing Markets with Indivisibility, *Regional Science and Urban Economics*, **23**, pp 153-169.

Maclennan D. (1982) *Housing Economics : An Applied Approach*, Longman, London.

Maclennan D. (1986) *The Demand for Housing: An Economic Perspective*, Scottish Development Office, Edinburgh

Maclennan D. (1992) *Housing Search and Choice in a Regional Housing System: New Housing in Strathclyde*, report to the Housing Research Federation, University of Glasgow, Glasgow.

Maclennan D. (1997) The UK Housing Market: Up, Down and Where Next, in Williams P. (Ed) *Directions in Housing Policy: Towards Sustainable Housing Policies for the UK*, pp. 22-53. Paul Chapman Publishing Ltd, London.

Maclennan D., Muellbauer J. and Stephens M. (1998) Asymmetries in Housing and Financial Market Institutions and EMU, *Oxford Review of Economic Policy*, **14**(3), pp 54-80.

Maclennan D. and Tu Y. (1996) Economic Perspectives on the Structure of Local Housing Systems, *Housing Studies*, **11**(3), pp 387 - 406.

Madden M. and Trigg A. B. (1990) Interregional Migration in an Extended Input-Output Model, *International Regional Science Review*, **13**(1-2), pp 65-85.

Madsen B. and Jensen-Butler C. (2004) Theoretical and Operational Issues in Sub-Regional Economic Modelling, Illustrated through the Development and Application of the Line Model, *Economic Modelling*, **21**(3), pp 471-508.

Malpass P. (1990) *Reshaping Housing Policy: Subsidies, Rents, and Residualisation*, Routledge, London.

Malpass P. (1996) The Unravelling of Housing Policy in Britain, *Housing Studies*, **11**(3), pp 459-470.

Malpass P. and Murie A. (1999a) *Housing Policy and Practice*, Macmillan, London.

Malpass P. and Murie A. (1999b) *Housing Policy and Practice.(5th Edn.)* Macmillan, London.

Malpezzi S. (1990) Urban Housing and Financial Markets: Some International Comparisons, *Urban Studies*, **27**(6), pp 971-1022.

Malpezzi S. (1996) Housing Prices, Externalities, and Regulation in US Metropolitan Areas, *Journal of Housing Research*, **7**, pp 209-242.

Malpezzi S. and Maclennan D. (2001) The Long-Run Price Elasticity of Supply of New Residential Construction in the United States and the United Kingdom, *Journal of Housing Economics*, **10**(3), pp 278-306.

Mansur E. T., Quigley J. M., Raphael S. and Smolensky E. (2002) Examining Policies to Reduce Homelessness Using a General Equilibrium Model of the Housing Market, *Journal of Urban Economics*, **52**(2), pp 316-340.

Marsh A. and Gibb K. (1999) Emerging Issues in Housing Economics: Expectations, *HSA Conference*.

Masnick G. S. (2002) The New Demographics of Housing, *Housing Policy Debate*, **13**(2), pp 275-322.

Mattas K., Pagoulatos A. and Debertin D. L. (1984) *Building Input/Output Models Using Non-Survey Techniques: An Application to Kentucky*, Mississippi State University, Mississippi.

McCormick B. (1997) Regional Unemployment and Labour Mobility in the UK, *European Economic Review*, **41**(3-5), pp 581-589.

McCrone G. and Stephens M. (1995) *Housing Policy in Britain and Europe*, UCL Press, London.

McDonald S. and Thierfelder K. (2004) *Deriving a Global Social Accounting Matrix from Gtap Version 5 Data*, GTAP Technical Paper, Purdue University, West Lafayette, IN.

McDougall R. A. (1999) *Entropy Theory and Ras Are Friends*, GTAP Working Papers, Center for Global Trade Analysis, Purdue University, West Lafayette, IN.

McGregor P. G., Swales J. K. and Yin Y. P. (1996) A Long-Run Interpretation of Regional Input-Output Analysis*, *Journal of Regional Science*, **36**(3), pp 479-501.

Meen D. and Meen G. (2003) Social Behaviour as a Basis for Modelling the Urban Housing Market: A Review, *Urban Studies*, **40**(5-6), pp 917-935.

Meen G. (1996a) Ten Propositions in UK Housing Macroeconomics: An Overview of the 1980s and Early 1990s, *Urban Studies*, **33**(3), pp 425.

Meen G. (1996b) Ten Propositions in UK Housing Macroeconomics: An Overview of the 1980s and Early 1990s, *Urban Studies*, **33**(3), pp 425-444.

Meen G. (1999) Regional House Prices and the Ripple Effect: A New Interpretation, *Housing Studies*, **14**(6), pp 733-753.

Meen G. (2000) Housing Cycles and Efficiency, *Scottish Journal of Political Economy*, **47**(2), pp 114-140.

Meen G. (2001) Is the Housing Market Set to Fall?, *Economic outlook*, **25**(4), pp 11-15.

Meen G. (2002) The Time-Series Behavior of House Prices: A Transatlantic Divide?, *Journal of Housing Economics*, **11**(1), pp 1-23.

Meen G. (2003) *Regional Housing Supply Elasticities in England*, prepared for Barker Review of Housing Supply, University of Reading, Reading.

Meen G. (2005) On the Economics of the Barker Review of Housing Supply, *Housing Studies*, 20(6), pp 949 - 971.

Meen G. and Andrew M. (2008) Planning for Housing in the Post-Barker Era: Affordability, Household Formation, and Tenure Choice, *Oxford Review of Economic Policy*, **24**(1), pp 79-98.

Meen G. P. (1990) The Measurement of Rationing and the Treatment of Structural Change in the UK Mortgage Market, *Journal of Applied Econometrics*, 5(2), pp 167-187.

Mendelsohn R. (1977) Empirical Evidence on Home Improvements, *Journal of Urban Economics*, 4(4), pp 459-468.

Merrett S. (1979) *State Housing in Britain*, Routledge, London.

Michaels R. G. and Smith V. K. (1990) Market Segmentation and Valuing Amenities with Hedonic Models: The Case of Hazardous Waste Sites, *Journal of Urban Economics*, **28**(2), pp 223-242.

Miles D. (1994) *Housing, Financial Markets and the Wider Economy*, John Wiley & Sons, Chichester.

Miles D. (2004) *The UK Mortgage Market: Taking a Longer-Term View*, HMSO, London

Minford P., Peel M. and Ashton P. (1987) *The Housing Morass: Regulation, Immobility and Unempolyment*, Institute of Economic Affairs, London.

Minford P., Stoney P., Riley J. and Webb B. (1994) An Econometric Model of Merseyside: Validation and Policy Simulations, *Regional Studies*, **28**(6), pp 563-575.

Ministry of Housing and Local Government (1965) *The Housing Programme 1965-70*, CM 2838, HMSO, London

Mitra-Kahn B. H. (2008) *Debunking the Myths of Computable General Equilibrium Models*, SCEPA Working Paper 2008-1. , Schwarz Center for Economi Policy Analysis, The New School for Social Research, New York.

Monk S. (2000) The 'Key Worker' Problem: The Link between Employment and Housing, in Monk S. and Whitehead C. (Eds) *Restructuring Housing Systems: From Social to Affordable Housing*. Joseph Rowntree Foundation, York.

Monk S. and Whitehead C. M. E. (1996) Land Supply and Housing: A Case-Study, *Housing Studies*, 11(3), pp 407-423.

Moore E. G. and Clark W. A. V. (1990) Housing and Households in American Cities: Structure and Change in Population Mobility, 1974–1982, *Housing Demography: Linking Demographic Structure and Housing Markets*, pp 203–231.

Morgan W., Mutti J. and Rickman D. (1996) Tax Exporting, Regional Economic Growth, and Welfare, *Journal of Urban Economics*, 39(2), pp 131-159.

Muellbauer J. (1990) The Housing Market and the UK Economy: Problems and Opportunities, in Ermisch J. F. (Ed) *Housing and the National Economy*, pp. 48–71. Gower, Aldershot

Muellbauer J. (1997) Measuring Financial Liberalisation in the UK Mortgage Market, *Econometric Society European Meeting*, Tolouse.

Muellbauer J. and Murphy A. (1990) Is the UK Balance of Payments Sustainable?, *Economic Policy*, 11, pp 345-83.

Muellbauer J. and Murphy A. (1994) *Explaining Regional House Prices in the UK*, Department of Economics Working Paper WP94/29, University College Dublin, Dublin.

Muellbauer J. and Murphy A. (1995) Explaining Regional Consumption in the UK, *IFS-Bank of Portugal Conference*, Lisbon.

Muellbauer J. and Murphy A. (1997) Booms and Busts in the UK Housing Market, *Economic Journal*, 107(445), pp 1701-1727.

Muth R. F. (1960) The Demand for Non-Farm Housing, in Harberger A. C. (Ed) *The Demand for Durable Goods*, pp. 29-96. University of Chicago Press, Chicago.

Muth R. F. (1964) The Derived Demand Curve for a Productive Factor and the Industry Supply Curve, *Oxford Economic Papers*, 16(2), pp 221-234.

Muth R. F. (1969) *Cities and Housing*, University of Chicago Press, Chicago.

Muth R. F. (1971) The Derived Demand for Urban Residential Land, *Urban Studies*, 8(3), pp 243-254.

Muth R. F. (1974) Moving Costs and Housing Expenditure, *Journal of Urban Economics*, 1(1), pp 108-125.

Mutti J., Morgan W. and Partridge M. (1989) The Incidence of Regional Taxes in a General Equilibrium Framework, *Journal of Public Economics*, 39, pp 83-107.

Myers D. (2004) *Cohorts and Socioeconomic Progress*, Russell Sage Foundation.

Nationwide Building Society (2008) *UK House Prices since 1952*. Available online at: http://www.nationwide.co.uk/hpi/historical.htm (accessed: 20/072008)

Nicol C. (2002) *The Formulation of Local Housing Strategies: A Critical Evaluation*, Ashgate.

Nordvik V. (2001) Moving Costs and the Dynamics of Housing Demand, *Urban Studies*, 38(3), pp 519-533.

O'Sullivan T., Gibb K. and Maclennan D. (2003) *Housing Economics and Public Policy*, Blackwell Publishers.

O'Donoghue J., McDonnell C. and Placek M. (2006) Consumer Price Inflation, 1947-2004, *Economic Trends*, pp 38-54.

Odland J. (1993) Interdependencies in the Timing of Migration and Mobility Events, *Papers in Regional Science*, 72(3), pp 221-237.

Office for National Statistics (2000) Income and Wealth, *Social Trends 30*. TSO.

Office for National Statistics (2001) *Family Expenditure Survey 2000-01*. Available online at: http://www.statistics.gov.uk/statbase/Product.asp?vlnk=361&More=N (accessed: December 2006)

Office for National Statistics (2005a) *Chapter 2: Population, Region in Figures, South West, Winter 2004/05*. Available online at:

http://www.statistics.gov.uk/downloads/theme_compendia/region_in_figures_winter04/South_West.pdf (accessed: 01/09/2008)

Office for National Statistics (2005b) *Chapter 3: Economy, Region in Figures, South West, Winter 2004/05*. Available online at: http://www.statistics.gov.uk/downloads/theme_compendia/region_in_figures_winter04/South_West.pdf (accessed: 01/09/2008)

Office for National Statistics (2006) *United Kingdom Economic Accounts: Income, Product and Spending Per Head: IHXV Households Gross Disposable Income Per Head*. Available online at: http://www.statistics.gov.uk/StatBase/TSDTimezone.asp?vlnk=ukea&Pos=&ColRank=1&Rank=-1 (accessed: 21/07/2008)

Office for National Statistics (2008a) *Annual Survey of Hours and Earnings (Nomis Dataset)*. Available online at: https://www.nomisweb.co.uk/Default.asp (accessed: 10/09/2008)

Office for National Statistics (2008b) *Chapter 3: Population and Migration, Regional Trends 40*. Available online at: http://www.statistics.gov.uk/downloads/theme_compendia/Regional_Trends_40/RT40_Chapters_3_to_13.pdf (accessed: 04/08/2008)

Office for National Statistics (2008c) *Chapter 6: Housing, Regional Trends 40*. Available online at: http://www.statistics.gov.uk/downloads/theme_compendia/Regional_Trends_40/RT40_Chapters_3_to_13.pdf (accessed: 04/08/2008)

Office for National Statistics (2008d) *Claimant Count (Variable: BCJE)*. Available online at: http://www.statistics.gov.uk/StatBase/tsdataset.asp?vlnk=430&Pos=&ColRank=1&Rank=-1 (accessed: 17/07/2008)

Office for National Statistics (2008e) *Household Composition - Census 1981, 1991 and 2001 (Nomis Dataset)*. Available online at: https://www.nomisweb.co.uk/Default.asp (accessed: 02/08/2008)

Office for National Statistics (2008f) *Household Expenditure on Housing (Variables: Adfs and Adfy), Household Final Consumption Expenditure, Economic Trends Annual Supplement, .* Available online at: http://www.statistics.gov.uk/StatBase/TSDSeries1.asp

Office for National Statistics (2008g) *Household Saving Ratio (Variable: NRJS), Households Disposable Income and Consumption, Economic Trends Annual Supplement*. Available online at: http://www.statistics.gov.uk/StatBase/TSDSeries1.asp (accessed: 27/07/2008)

Office for National Statistics (2008h) Income and Wealth, *Social Trends 38*. HMSO.

Office for National Statistics (2008i) *National Accounts: GDP: Expenditure at Current Market Prices (Dataset: NATPC1)*. Available online at: http://www.statistics.gov.uk/statbase/tsdataset.asp?vlnk=208&More=Y (accessed: 21/07/2008)

Office for National Statistics (2008j) *Regional Snapshot Archive*. Available online at: http://www.statistics.gov.uk/statbase/Product.asp?vlnk=15066 (accessed: 08/09/2008)

Office for National Statistics (2008k) *Retail Prices Index: Annual Index Numbers of Retail Prices 1948-2008, Data Set Rpi1a*. Available online at: http://www.statistics.gov.uk/StatBase/tsdataset.asp?vlnk=7172&More=N&All=Y (accessed: 10/07/2008)

Office for National Statistics (2008l) *Social Trends 38, Table 5_20: Composition of the Net Wealth of the Household Sector, UK*. Available online at: http://www.statistics.gov.uk/downloads/theme_social/Social_Trends38/05_20.xls (accessed: 02/08/2008)

Office of the Deputy Prime Minister (2003) *Sustainable Communities: Building for the Future*, ODPM, London

Office of the Deputy Prime Minister (2005a) *Housing in England, 2003/04*, ODPM, London

Office of the Deputy Prime Minister (2005b) *A Sustainability Impact Study of Additional Housing Scenarios in England*, ODPM, London

Office of the Deputy Prime Minister (2005c) *Sustainable Communities: Homes for All*, ODPM, London

OFM State of Washington (2008) *The 2002 Washington Input-Output Model*. Available online at: http://www.ofm.wa.gov/economy/io/2002/default.asp

Ortalo-Magne F. and Rady S. (2002) *Homeownership, Low Household Mobility, Volatile Housing Prices, High Income Dispersion*, CESIFO Working Paper No. 823.

Ortalo-Magné F. and Rady S. (2004) Housing Transactions and Macroeconomic Fluctuations: A Case Study of England and Wales, *Journal of Housing Economics*, **13**(4), pp 287-303.

Ortalo-Magné F. and Rady S. (2006) Housing Market Dynamics: On the Contribution of Income Shocks and Credit Constraints, *Review of Economic Studies*, **73**(2), pp 459-485.

Oswald A. (1996) *A Conjecture on the Explanation for High Unemployment in the Industrialized Nations: Part I*, University of Warwick Economic Research Papers.

Oxley M. (2004) *Economics, Planning and Housing*, Palgrave Macmillan, Basingstoke.

Oxley M. (2006) Housing Economics and Housing Policy: A European Perspective, *Housing in an expanding Europe: theory, policy and participation and implementation*, Ljubljana, Slovenia.

Palm R. (1976) *Urban Social Geography from the Perspective of the Real Estate Salesman*, Center for Real Estate and Urban Economics Research Report No. 38, University of California, Berkeley.

Palmquist R. B. (1984) Estimating the Demand for the Characteristics of Housing, *Review of Economics and Statistics*, **66**(3), pp 394-404.

Paltsev S. (2004) *Moving from Static to Dynamic General Equilibrium Economic Models (Notes for a Beginner in Mpsge)*, Joint Program on the Science and Policy of Global Change, Massachusetts Institute of Technology, Cambridge, MA.

Paris C., Gray P. and Muir J. (2003) Devolving Housing Policy and Practice in Northern Ireland 1998–2002, *Housing Studies*, **18**(2), pp 159-175.

Parr J. B., Hewings G. J. D., Sohn J. and Nazara S. (2002) Agglomeration and Trade: Some Additional Perspectives, *Regional studies*, **36**(6), pp 675-684.

Partridge M. D. and Rickman D. S. (1998) Regional Computable General Equilibrium Modeling: A Survey and Critical Appraisal, *International Regional Science Review*, **21**(3), pp 205-248.

Peek J. and Wilcox J. A. (1991) The Measurement and Determinants of Single-Family House Prices, *Real Estate Economics*, **19**(3), pp 353-382.

Pereira A. M. and Shoven J. B. (1992) Survey of Dynamic Computational General Equilibrium: Models for Tax Policy Evaluation, *Journal of Policy Modeling*, **10**(3), pp 401-426.

Pesenti P. (2008) *The Global Economy Model: Theoretical Framework*, IMF Staff Papers, International Monetary Fund, New York.

Piazzesi M., Schneider M. and Tuzel S. (2007) Housing, Consumption and Asset Pricing, *Journal of Financial Economics*, **83**(3), pp 531-569.

Piggott J. R. and Whalley J. (1985) *Applied General Equilibrium Analysis of UK Tax Policy*, Cambridge University Press, Cambridge.

Pissarides C. A. and McMaster I. (1990) Regional Migration, Wages and Migration: Empirical Evidence and Implication for Policy, *Oxford Economic Papers*, pp 812-831.

Pleskovic B. and Treviño G. (1985) *The Use of a Social Accounting Matrix Framework for Public Sector Analysis: The Case Study of Mexico*, International Center for Public Enterprises in Developing Countries, Ljubljana.

Polinsky A. M. and Ellwood D. T. (1979) An Empirical Reconciliation of Micro and Grouped Estimates of the Demand for Housing, *Review of Economics and Statistics*, **61**(2), pp 199-205.

Potepan M. J. (1994) Intermetropolitan Migration and Housing Prices: Simultaneously Determined, *Journal of Housing Economics*, **3**(2), pp 77–91.

Poterba J. (1992) Taxation and Housing: Old Questions, New Answers, *American Economic Review*, **82**(2), pp 237–242.

Pozdena R. J. (1988) *The Modern Economics of Housing : A Guide to Theory and Policy for Finance and Real Estate Professionals*, Quorum, New York ; London.

Pozdena R. J. (1990) Do Interest Rates Still Affect Housing?, *Federal Reserve Bank of San Francisco Economic Review*, **3**, pp 3-14.

Priemus H. and Dieleman F. (1999) Social Housing Finance in the European Union: Developments and Prospects, *Urban Studies*, 36, pp 623-632.

Pryce G. (1999) Construction Elasticities and Land Availability: A Two-Stage Least-Squares Model of Housing Supply Using the Variable Elasticity Approach, *Urban Studies*, 36(13), pp 2283.

Psaltopoulos D., Thomson K. J., Efstratoglou S., Kola J. and Daouli A. (2004) Regional Social Accounting Matrices for Structural Policy Analysis in Lagging Eu, *European Review of Agricultural Economics*, 31(2), pp 149 - 178.

Pyatt G. and Jeffery I. (1985) *Social Accounting Matrices: A Basis for Planning*, World Bank, Washington DC.

Pyatt G. and Thorbecke E. (1976) *Planning Techniques for a Better Future*, International Labour Office, Geneva.

Quigley J. M. (2002) *Transactions Costs and Housing Markets*, Working Paper W02-005, University of California, Berkeley.

Rapkin C. and Grigsby W. G. (1960) *Residential Renewal in the Urban Core*, University of Pennsylvania Press, Philadelphia.

Rapkin C., Winnick L. and Blank D. M. (1953) *Housing Market Analysis Washington*, US Housing and Home Finance Agency, Washington.

Rattso J. (1982) Different Macroclosures of the Original Johansen Model and Their Impact on Policy Evaluation, *Journal of Policy Modeling*, 4(1), pp 85-97.

Renkow M. and Hoover D. (2000) Commuting, Migration, and Rural-Urban Population Dynamics, *Journal of Regional Science*, 40(2), pp 261-287.

Rey S. J. (2000) Integrated Regional Econometric+ Input-Output Modeling: Issues and Opportunities, *Papers in Regional Science*, 79(3), pp 271-292.

Rickman D. S. (1992) Estimating the Impacts of Regional Business Assistance Programs: Alternative Closures in a Computable General Equilibrium Model, *Papers in Regional Science*, 71(4), pp 421-435.

Robert Jr G. (1976) Econometric Policy Evaluation: A Critique, *Journal of Monetary Economics*, pp 16-46.

Robilliard A. S., Bourguignon F. and Robinson S. (2001) *Crisis and Income Distribution: A Micro-Macro Model for Indonesia*, MIMEO, The World Bank International Food Policy Research Institute, Washington DC.

Robilliard A. S. and Robinson S. (2003) Reconciling Household Surveys and National Accounts Data Using a Cross Entropy Estimation Method, *Review of Income and Wealth*, 49(3), pp 395-406.

Robinson S., Cattaneo A. and El-Said M. (2001) Updating and Estimating a Social Accounting Matrix Using Cross Entropy Methods, *Economic Systems Research*, 13(1), pp 47-64.

Robinson S. and El-Said M. (2000) *Gams Code for Estimating a Social Accounting Matrix (Sam) Using Cross Entropy (Ce) Methods*, Trade and Macroeconomics Division Discussion Paper, International Food Policy Research Institute, Washington DC.

Robinson S., Kilkenny M. and Hanson K. (1990) *The Usda/Ers Computable General Equilibrium (CGE) Model of the United States*, US Dept. of Agriculture, Economic Research Service, Agriculture and Rural Economy Division.

Robson M. T. (2003) Housing Markets and Regional Unemployment Flows in Great Britain, *The Manchester School*, 71(2), pp 132-155.

Rosen H. S. and Rosen K. T. (1980) Federal Taxes and Homeownership: Evidence from Time Series, *Journal of Political Economy*, 88(1), pp 59-75.

Rosen K. and Smith L. (1983) The Price Adjustment Process for Rental Housing and the Natural Vacancy Rate, *American Economic Reiew*, 73(4), pp 779-786.

Rosen K. T. and Smith L. B. (1986) The Resale Housing Market, *Real Estate Economics*, 14(4), pp 510-524.

Rosen S. (1974) Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition, *Journal of Political Economy*, 82(1), pp 34-55.

Rosenthal L. (1989) Income and Price Elasticities of Demand for Owner-Occupied Housing in the UK: Evidence from Pooled Cross-Sectional and Time-Series Data, *Applied Economics*, 21(6), pp 761-775.

Rosenthal L. (2003) The Value of Secondary School Quality, *Oxford Bulletin of Economics and Statistics*, 65(3), pp 329-355.

Rossi P. and Weber E. (1996) The Social Benefits of Homeownership: Empirical Evidence from National Surveys, *Housing Policy Debate*, 7, pp 1-35.

Round J. (2003) Constructing Sams for Development Policy Analysis: Lessons Learned and Challenges Ahead, *Economic Systems Research*, 15(2), pp 161-183.

Round J. I. (1991) A Sam for Europe: Problems and Perspectives, *Economic Systems Research*, 3(3), pp 249-268.

Rouwendal J. (1999) Spatial Job Search and Commuting Distances, *Regional Science and Urban Economics*, 29(4), pp 491-517.

Rust J. (1997) *Dealing with the Complexity of Economic Calculations* Workshop on Fundamental Limits to Knowledge in Economics, Santa Fe Institute, Santa Fe.

Rutherford T. (1998a) *Economic Equilibrium Modeling with Gams: An Introduction to Gams/Mcp and Gams/Mpsge*, University of Colorado, Colorado.

Rutherford T. F. (1998b) *Economic Equilibrium Modeling with Gams: An Introduction to Gams, Mcp and Gams/Mpsge*, University of Colorado.

Saunders P. and Siminski P. (2005) Home Ownership and Inequality: Imputed Rent and Income Distribution in Australia, *Economic Papers*, 24(4), pp 346-367.

Scarf H. (1967) The Approximation of Fixed Points of a Continuous Mapping, *SIAM Journal of Applied Mathematics*, 15(5), pp 328-343.

Scarf H. E. (1981a) Production Sets with Indivisibilities, Part I: Generalities, *Econometrica*, 49(1), pp 1-32.

Scarf H. E. (1981b) Production Sets with Indivisibilities, Part Ii: The Case of Two Activities, *Econometrica*, 49(2), pp 395-423.

Scarf H. E. and Hansen T. (1973) *The Computation of Economic Equilibria*, Yale University Press, New Haven, USA.

Schaffer W. A. (1999) *Regional Impact Models*, Regional Research Institute.

Schnare A. B. and Struyk R. J. (1976) Segmentation in Urban Housing Markets, *Journal of Urban Economics*, 3(2), pp 146-166.

Schneider M. H. and Zenios S. A. (1990) A Comparative Study of Algorithms for Matrix Balancing, *Operations Research*, 38(3), pp 439-455.

Schwab R. M. (1982) Inflation Expectations and the Demand for Housing, *American Economic Review*, 72(1), pp 143-153.

Schwarm W. and Cutler H. (2003) Building Small City and Town Sams and CGE Models, *Review of Urban & Regional Development Studies*, 15(2), pp 132-147.

Sen A. K. (1963) Neo-Classical and Neo-Keynesian Theories of Distribution, *The Economic Record*, 39(85), pp 53-64.

Sen H. (1996) *Social Accounting Matrix (Sam) and Its Implication for Macroeconomic Planning*, Unpublished Assessed Article, Development Project Planning Centre, Bradford University, Bradford.

Sentance A. (1998) UK Macroeconomic Policy and Economic Performance, in Buxton T., Chapman P. G. and Temple P. (Eds) *Britain's Economic Performance*. Routledge, London.

Shannon C. E. (1948) A Mathematical Theory of Communication, *Bell Systems Technical Journal*, 27(3), pp 379–423.

Shaw C. (2007) *Fifty Years of United Kingdom National Population Projections: How Accurate Have They Been?*, Population Trends, Office for National Statistics.

Sheppard S. (1997) *Hedonic Analysis of Housing Markets. Department of Economics*, Oberlin College: Mimeo.

Shibusawa H., Miyata Y. and Chen Z. (1999) An Analysis of Energy Problem in China: An Interregional General Equilibrium Model, *39th European Congress of the Regional Science Assocation*, Dublin.

Shiller R. J. (2007) *Understanding Recent Trends in House Prices and Home Ownership*, NBER Working Paper.

Shoven J. B. and Whalley J. (1984) Applied General-Equilibrium Models of Taxation and International Trade: An Introduction and Survey, *Journal of Economic Literature*, 22(3), pp 1007-1051.

Shoven J. B. and Whalley J. (1992) *Applying General Equilibrium*, Cambridge University Press, Cambridge.

Shucksmith M. (1991) Still No Homes for Locals? Affordable Housing and Planning Controls in Rural Areas, in Champion T. and Watkins C. (Eds) *People in the Countryside. Studies of Social Change in Rural Britain.*, pp. 53-66. Paul Chapman Publishing Ltd, London.

Silos P. (2007) Housing Tenure and Wealth Distribution in Life-Cycle Economies, *The BE Journal of Macroeconomics*, 7(1), pp 27-54.

Slocombe L. (2003) Integration in the Regions: Cross-Sectoral Housing Policy Co-Ordination at Regional Level, *Housing Studies*, 18(2), pp 235-248.

Smith J. (2005) There Is No Housing Bubble, *Business Economics*, 40(2), pp 29-35.

Smith L. B., Rosen K. T. and Fallis G. (1988) Recent Developments in Economic Models of Housing Markets, *Journal of Economic Literature*, 26(1), pp 29-64.

Smith L. B., Rosen K. T., Markandya A. and Ullmo P.-A. (1984) The Demand for Housing, Household Headship Rates, and Household Formation: An International Analysis*, *Urban Studies*, 21(4), pp 407 - 414.

Smith M. H. and Smith G. N. (2007) Homeownership in an Uncertain World with Substantial Transaction Costs, *Journal of Regional Science*, 47(5), pp 881-896.

Smith V. K. and Huang J. C. (1993) Hedonic Models and Air Pollution: Twenty-Five Years and Counting, *Environmental and Resource Economics*, 3(4), pp 381-394.

South West Economy Centre (2003) *South West Regional Accounts and Econ| I Software: User Guide*, University of Plymouth, Plymouth.

South West Housing Body (2005) *South West Regional Housing Strategy 2005-16*, South West Regional Assembly,,

South West Regional Assembly (2008) *Annual Monitoring and Implementation Report 2006/07*, South West Regional Assembly, Taunton, Somerset.

South West Regional Development Agency (2007) *The State of the Region Report 2007*, SWRDA,http://www.swo.org.uk/observatory/links-1/state/state-of-the-south-w.shtm

Stafford D. C. (1978) *The Economics of Housing Policy*, Croom Helm Ltd, London.

Stephens M. (1996) Institutional Responses to the UK Housing Market Recession, *Urban Studies*, 33(2), pp 337-352.

Stephens M., Whitehead C. and Munro M. (2005) *Evaluation of Individual Housing Policies and Technical Report, Evaluation of English Housing Policy 1975-2000*, TSO, London

Stone L. O. (1971) On the Correlation between Metropolitan Area in-and out-Migration by Occupation, *Journal of the American Statistical Association*, 66(336), pp 693-700.

Stone M. E. (2006) What Is Housing Affordability? The Case for the Residual Income Approach, *Housing Policy Debate*, 17(1), pp 151-184.

Stone R. (1961) *Input-Output and National Accounts*, Organisation for European Economic Co-operation, Paris.

Stone R. and Brown A. (1962) *A Computable Model of Economic Growth*, Chapman and Hall, London.

Stover M. E. (1986) The Price Elasticity of the Supply of Single-Family Detached Urban Housing, *Journal of Urban Economics*, 20(3), pp 331-340.

Straszheim M. R. (1973) Estimation of the Demand for Urban Housing Services from Household Interview Data, *Review of Economics and Statistics*, 55(1), pp 1-8.

Sultana S. (2002) Job/Housing Imbalance and Commuting Time in the Atlanta Metropolitan Area: Exploration of Causes of Longer Commuting Time, *Urban Geography*, 23(8), pp 728-749.

Swan T. W. (1960) *Of Golden Ages and Production Functions*, Penguin Books, Harmondsworth

Sweeney J. L. (1974) Quality, Commodity Hierarchies, and Housing Markets, *Econometrica*, 42(1), pp 147-67.

Tarlow B. S. (2004) *Asset Pricing Implications of Housing in General Equilibrium*, Columbia University, New York.

Tewdwr-Jones M., Gallent N. and Mace A. (2002) *Second Homes and Holiday Homes and the Land Use Planning System*, Welsh Assembly, Cardiff.

Tewdwr-Jones M. and Williams R. H. (2001) *The European Dimension of British Planning*, Routledge.

Theil H. (1967) *Economics and Information Theory*, Rand McNally, Chicago.

Thissen M. (1998) *A Classification of Empirical CGE Modelling*, SOM Research Report 99C01, University of Groningen, Groningen, The Netherlands.

Thissen M. and Loefgren H. (1998) A New Approach to Sam Updating with an Application to Egypt, *Environment and Planning A*, 30, pp 1991-2004.

Thomas A. (1993) The Influence of Wages and House Prices on British Interregional Migration Decisions, *Applied Economics*, 25(9), pp 1261-1268.

Thorbecke E. (2000) The Use of Social Accounting Matrices in Modelling, *26th General Conference of The International Association for Research in Income and Wealth,*, Cracow, Poland.

Titman S. (1982) The Effects of Anticipated Inflation on Housing Market Equilibrium, *Journal of Finance*, 37(3), pp 827–842.

Titman S. (1985) Urban Land Prices, *American Economic Review*, 75, pp 505-514.

Tiwari P. (2004) A Policy Mechanism for Housing Construction Activity to Achieve Social and Environmental Goals: A Case for India, *International Transactions in Operational Research*, 11(6), pp 645-665.

Toh M. H. (1998) The Ras Approach in Updating Input–Output Matrices: An Instrumental Variable Interpretation and Analysis of Structural Change, *Economic Systems Research*, 10(1), pp 63-78.

Topel R. and Rosen S. (1988) Housing Investment in the United States, *Journal of Political Economy*, 96(4), pp 718-740.

Treyz G. I. (1993) *Regional Economic Modeling: A Systematic Approach to Economic Forecasting and Policy Analysis*, Kluwer Academic.

Tsatsaronis K. and Zhu H. (2004) What Drives Housing Price Dynamics: Cross-Country Evidence, *BIS Quarterly Review*, pp 65-78.

Tsenkova S. (2008) *Provision of Affordable Housing in Europe, North America and Central Asia: Policies and Practices*, Cities, Policy and Planning Lab Research Series, Calgary.

Tversky A. and Kahneman D. (1974) Judgment under Uncertainty: Heuristics and Biases, *Science*, 185(4157), pp 1124-1131.

United Nations Statistics Division (1993) *The Use of Income Account: Household Final Consumption Expenditure*. Available online at: http://millenniumindicators.un.org/unsd/sna1993/toclev8.asp?L1=9&L2=4 (accessed: 08/06/2009).

US Federal Reserve (2006) *Research Staff and Resources*. Available online at: http://www.federalreserve.gov/research/default.htm (accessed: August).

Vargas E. E., Schreiner D. F., Tembo G. and Marcouiller D. W. (2001) Computable General Equilibrium Modeling for Regional Analysis, in Loveridge S. (Ed) *The Web Book of Regional Science* Regional Research Institute, West Virginia University, Morgantown, WV.

Vlieghe G. (2001) *Corporate Liquidations in the United Kingdom*, Bank of England Financial Stability Review, Bank of England, London.

Vostanis P. and Cumella S. (1999) *Homeless Children: Problems and Needs*, Jessica Kingsley Publishers.

Vukina T., Roka F. and Carter T. (1995) Economic Impact of Poultry Industry: The Case Study of North Carolina, *The Journal of Applied Poultry Research*, 4(3), pp 319 - 331.

Waddell P. (1996) Accessibility and Residential Location: The Interaction of Workplace, Residential Mobility, Tenure, and Location Choices, *Lincoln Land Institute TRED Conference*, Cambridge, MA.

Wallace A. (2004) *Understanding Local Housing Markets? The Need for a Complimentary Institutional Approach*, Working Paper, University of York.

Wallace A., Bevan M., Croucher K., Jackson K., O'Malley L. and Orton V. (2005) *The Impact of Empty, Second and Holiday Homes on the Sustainability of Rural Communities: A Systematic Literature Review*, Centre for Housing Policy, University of York, York.

Wang F. (2001) Explaining Intraurban Variations of Commuting by Job Proximity and Workers' Characteristics, *Environment and Planning B*, 28(2), pp 169-182.

Waters E., Holland D. W. and Weber B. A. (1997) Economic Impacts of a Property Tax Limitation: A Computable General Equilibrium Analysis of Oregon's Measure 5, *Land Economics*, 73(1), pp 72-89.

Weinberg D. H., Friedman J. and Mayo S. K. (1981) Intraurban Residential Mobility: The Role of Transactions Costs, Market Imperfections, and Household Disequilibrium, *Journal of Urban Economics*, 9(3), pp 332-348.

West G. R. (1994) Queensland State Impact and Projection Model: The Household Sector, *Economic Systems Research*, 6(4), pp 363-383.

West G. R. (1995) Comparison of Input–Output, Input–Output Econometric and Computable General Equilibrium Impact Models at the Regional Level, *Economic Systems Research*, 7(2), pp 209-227.

Whalley J. and Jones R. (1989) A Canadian Regional General Equilibrium Model and Some Applications, *Journal of Urban Economics*, 25, pp 368-404.

White M. J. (1988) Urban Commuting Journeys Are Not" Wasteful", *Journal of Political Economy*, 96(5), pp 1097.

Whitehead C. (1999) Urban Housing Markets: Theory and Policy, in Mills E. S. and Cheshire P. (Eds) *Handbook of Regional and Urban Economics*. Elsevier Science, Oxford.

Whitehead C. M. E. (1974) *The UK Housing Market: An Econometric Model*, Lexington Books, Lexington M.A.

Whitehead C. M. E. (1991) From Need to Affordability: An Analysis of UK Housing Objectives, *Urban Studies*, 28(6), pp 871-887.

Whitley J. D. (1994) *A Course in Macroeconomic Modelling and Forecasting*, Harvester Wheatsheaf.

Wilcox S. and Homes S. (1999) *The Vexed Question of Affordability*, Scottish Homes, Edinburgh.

Wilkinson R. K. (1973) The Income Elasticity of Demand for Housing, *Oxford Economic Papers*, 25(3), pp 361-77.

Wood R. (2003) The Informational Content of Regional House Prices: Could They Be Used to Improve National Price Forecasts?, *Bank of England Quarterly Bulletin*, 43, pp 304–314.