

A DESCRIPTIVE ANALYSIS OF THE IRISH HOUSING MARKET

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1.
Introduction

The rapid increase in house prices in the latter half of the 1990s focused public, media and policy attention on the Irish housing market, particularly as the rate of house price rise was increasingly viewed as unsustainable. Measures of the increase in house prices show the annual rate of national change in the latter years of the 1990s at over 20 per cent per annum and Roche (1999, 2001) found evidence of a bubble in national and Dublin house prices. These rates of increase have resulted in three separate reports to deal with the issue as well as the government policy responses and analysis by external agencies. Furthermore, there has been a rapid expansion in the number of annual house completions. The increase in the value of houses has also resulted in a dramatic increase in household wealth.

The OECD (1999) identified the shortage of housing as an important bottleneck in the economy and the boom in the housing sector as a symptom of excess demand in the economy. Indeed, alleviating the housing constraint is noted as one of the necessary policies for prolonging the “high growth era”. The subsequent survey, published in 2001, was more positive and suggested that supply-side measures were starting to have an effect. However, demographic factors were expected to ensure that housing demand remains high, which coupled with growth in disposable income, means that the “pressures to acquire houses will continue for some time yet.”

It is worthwhile analysing the market so that we may better understand its importance within the economy as well as to gain some insights into the factors driving this market. Section 2 sets out some of the characteristics of the Irish housing market in comparison to some other economies. The upward trend in house prices has been identified as the

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result of rising demand for owner-occupied housing and a relatively inelastic supply of serviced land. The factors driving demand and supply structure are examined in Sections 3 and 4. The growth in house prices is presented in Section 5. Section 6 outlines some of the work that has been done to model Irish house prices. Section 7 details the housing market in the *Medium-Term Review* and Section 8 summarises and concludes.

2. Some Characteristics of the Irish Housing Market

Ireland has the highest proportion of owner-occupiers in the EU, 83 per cent in 1995, up from 74 per cent at the beginning of the 1980s. This is the highest owner-occupier rate in the EU-15, although Greece and Spain also have rates above 80 per cent in contrast to Germany with the lowest rate of owner-occupation at 42 per cent. The proportion of owner-occupiers has risen throughout the EU since the beginning of the 1980s. Figures for 1981/82 show the EU average at 54 per cent, which by 1995 had risen to 60 per cent. The high owner-occupier rates in Ireland are, in part at least, a reflection of the fiscal incentives in place encouraging home ownership.

Between 1977 and 2000 real house prices in Ireland rose by an annual average of 4.7 per cent. This is the highest annual growth rate when compared to a number of other European countries for which data is available and reflects very strong growth in the late 1970s and between 1996 and 2000. The annual average growth rate over the entire period was 3 per cent for Spain, 2.7 per cent in the Netherlands and 2.5 per cent in the UK. Real house prices actually contracted in Germany, by an annual average of 0.1 per cent over the period.

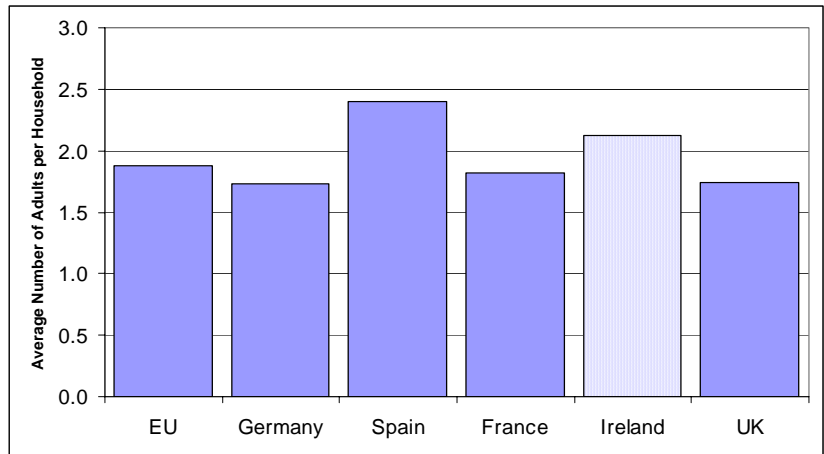
Table 1: Annual Average Percentage Change in Real House Prices

Period	UK %	Spain %	Germany %	Ireland %
1976-1980	2.0	0.4	2.2	6.7
1981-1985	0.5	-3.0	-2.1	-5.7
1986-1990	8.9	17.1	1.2	3.8
1991-1995	-4.0	-1.7	1.5	1.0
1995-2000	7.1	3.4	-4.4	14.0

Sources: Ring Deutscher Makler; National Data, supplied by Bank of International Settlements.

In keeping with the trend across Europe, the average number of adults per household in Ireland has fallen since the start of the 1980s, from 3.6 to 2.1 in 1999, although this is still higher than many other EU countries. This compares with an average number of persons per household of 3.1 in Spain, 3 in Portugal, 2.3 in the UK, 2.2 in Germany and 2.1 in Finland (see Figure 1).

Figure 1: Average Number of Adults per Household, 1999



The housing market is driven by a number of factors,¹ which include: Overall economic growth, which is resulting in rising incomes and employment growth.

Demographic factors, such as the proportion of the population in the household forming age groups and net inflows of people into the country. Cultural changes in terms of family patterns and behaviour.

Affordability is obviously very important. This determines whether young adults set up independent households or remain at home, and it can affect immigration flows.

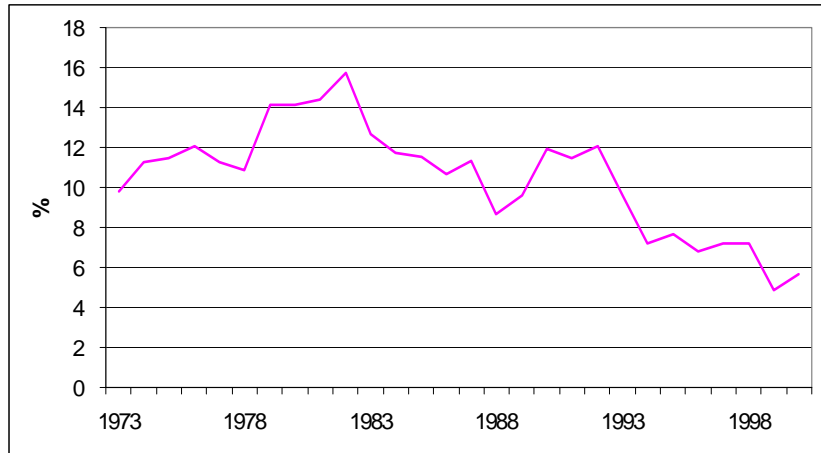
Rising standards of living have also increased the demand for second dwellings i.e. holiday homes.

The cost of borrowing, as measured by the fixed and variable mortgage rate.

The latter half of the 1990s and the first year of the current decade was an exceptional period for the Irish economy. Between 1995 and 2000, real GNP growth averaged 8.7 per cent. Employment grew rapidly, by an annual average of 4.9 per cent. Having peaked at an annual average of nearly 17 per cent in 1993 the unemployment rate fell to below 4 per cent in 2000. The state of the public finances improved and the government enjoyed a number of years of growing surplus. A series of stimulatory budgets contributed to a substantial increase in aggregate disposable income. Between 1995 and 2000, after-tax non-agricultural wages rose by an annual average of 5.5 per cent. Interest rates, a key determinant for the housing market, declined as the Irish economy moved towards membership of EMU. This regime shift – entry to EMU – which resulted in a reduction in domestic interest rates due to convergence with euro rates, has had an impact on the Irish housing market. Interest rates are now expected to be lower and less volatile in the future (see Figure 2).

¹ For other analyses of the Irish housing market, see Bacon, McCabe, Murphy (1998); O'Connell and Quinn (1999) and Duffy *et alia* (2001).

Figure 2: Representative Mortgage Rate



3. The Demand for Owner-occupied Housing

The literature on the housing markets identifies a number of factors as contributing to the demand for housing (Muth and Goodman, 1989, DiPasquale and Wheaton, 1996, among others). In an Irish context, Bacon, MacCabe and Murphy (1998) reported the key drivers of the housing market to be economic growth, demography, cost of finance, and the speed of the supply response, with the supply response in Dublin estimated at half the rest of the country.

In the context of the Irish housing market demographic pressures have been one of the key factors. Analysis of the 1996 Census shows that headship rates (proportion of each age group who are heads of households) increases substantially in the 25-39 year age group. The number in these age bands rose from 727,000 in 1990 to 821,000 in 1999, an increase of nearly 13 per cent. The headship rate of just under 15 per cent in the 20-24 year age group nearly doubles to 29.3 per cent in the 25-29 year age group. The headship rate in the 30-34 year age group increases to 42.4 per cent, while the rate in the 35-39 year age group was 48.2 per cent. Data from the UK Census shows that Irish headship rates are lower than those in the UK. If Irish headship rates were to rise towards UK levels this would represent an increase in this source of demand for dwellings. This demand for dwellings will split between demand for renting or purchasing depending on the rate of owner-occupation.

Economic and employment growth in the latter half of the 1990s attracted emigrants and foreign nationals to Ireland. Since 1996 the net flow has been a positive inflow into the country, reaching 25,500 in 2001. The *Medium-Term Review: 2001-2007* estimates that the inflow of returning emigrants and foreign nationals has contributed an average of nearly 6,000 units to housing demand between 1996 and 2001.

Figure 3: Irish and UK Headship Rates, 1996

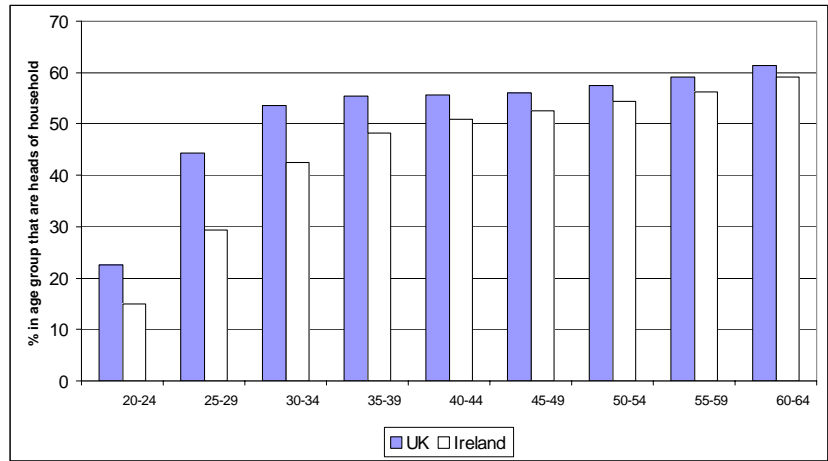
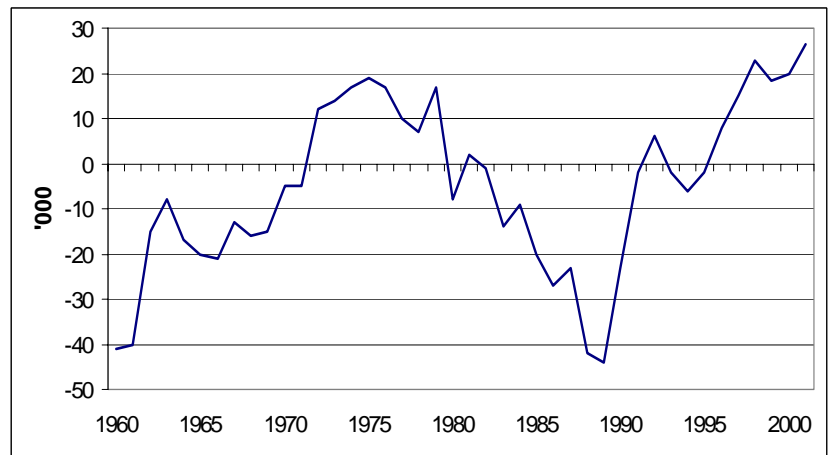
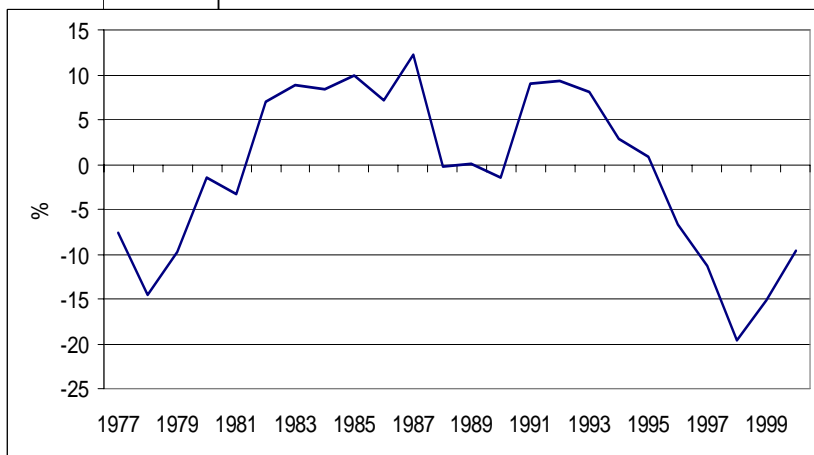


Figure 4: Net Migration



The rate of return, or the user cost of housing provides a measure of the cost of owning a house and aims to take account of capital appreciation. More elaborate measures take account of tax, indebtedness and expectations. In Figure 5, in keeping with the methodology of Bacon, MacCabe and Murphy (1998), this is calculated by the mortgage interest rate minus the change in house prices. The figure below shows that the user cost of housing has fallen since 1992. This fall in the user cost helps explain why demand for dwellings continued to rise even at a time of rapid price growth. Houses, although highly priced, were relatively cheap to live in because of low real interest rates and expected capital gains.

Figure 6



is therefore given in section 6.

4. The Supply of Housing in Ireland

The increase in housing demand has stimulated an increase in new house building. By 1998 the number of house completions, at 42,349, was over double the amount in 1990. The total number of house completions rose to 49,812 in 2000, and increased further in 2001 to over 52,000. Private house completions, at 47,727, account for 90.7 per cent of total completions in 2001. This represents a very strong level of housing completions. Despite the difference in population, figures show that completions in Ireland rose to nearly 12 per cent of completions in Germany in 2000. This compares to 6.1 per cent in 1990. Figure 6 shows the volume of private house completions as a percentage of the total housing stock. The 2000 figure of 3.4 per cent is the highest figure for the period shown commencing in 1971. The ratio declined during the 1980s, reflecting the fall in real house prices. However, the recent rapid increases in house prices are reflected in a sharp upturn in the number of private house completions. Estimates from the ESRI macro-model suggest that there has also been a substantial increase in the number of second or replacement dwellings in the latter part of the 1990s, reaching around 12,000 units in 1999.

There has also been a strong expansion in investment in housing. As a share of GNP investment in housing peaked at 7.3 per cent in 1979 (IR£558 million) and declined to a low of 4.3 per cent in 1988, (IR£858 million). Since 1996 its share of GNP has been over 6 per cent. In 2000, investment in housing reached IR£6.3 billion (€8 bn) and increased as a share of GNP to 9.3 per cent.

Figure 6: Private House Completions as a % of Total Housing Stock

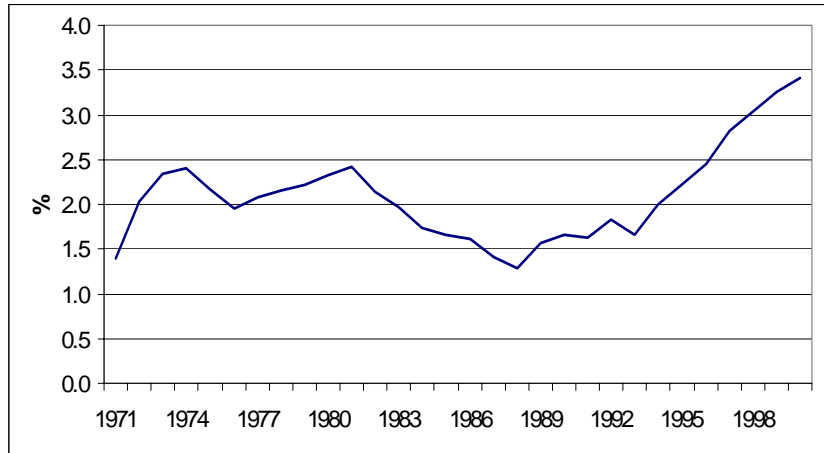
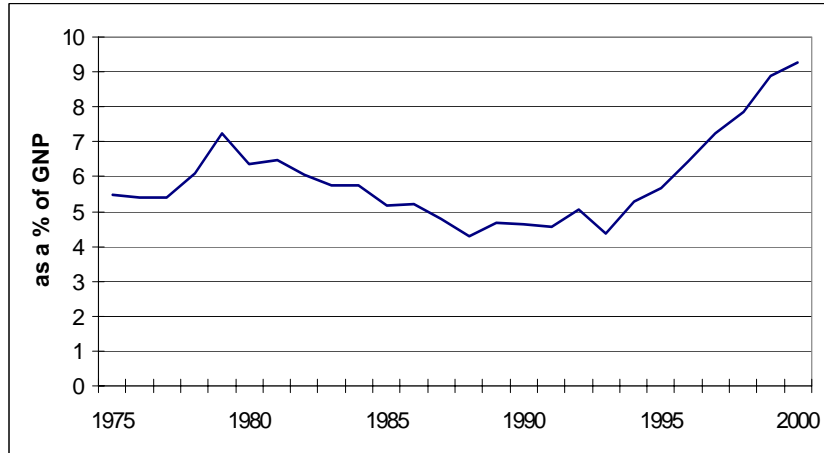


Figure 7: Gross Physical Capital Formation: Dwellings



The housing component of the ESRI *HERMES* macro-model includes an equation, derived from Murphy (1998), to estimate the number of house completions, essentially the supply of new houses, see Appendix 1. The results from this equation show that short-run changes in house prices have a significant effect in boosting housing completions. In the long run completions are particularly influenced by real new house prices and the mark-up of house prices over costs. This mark-up or profitability measure indicates that if house prices increase relative to the cost of building then profitability rises and this increases the rate of house completions. Interestingly, the results from the house completions equation indicates that, given the increase in house prices that has occurred, over 60,000 dwellings a year should be constructed. As outlined in the *Medium-Term Review* a possible explanation for this discrepancy is that the equation does not take account of changes in the real cost of building, such as the price of land, the rise in construction labour costs, and the rise in builders' profits. A contributing factor could be that the model does not capture the impact of government intervention in the housing market through changes to planning regulations etc. Kenny (1998)

5. Trends in Irish House Prices

finds that the supply of houses in the period 1994 to 1997 was below the level consistent with the prevailing level of house prices, income and interest rates. In addition, during the same time period house prices were at an historical high relative to the cost base of the average construction firm. One of the conclusions drawn by Kenny is that “given the short-run fixity of supply, it is reasonable to expect that house prices will overshoot their equilibrium level and then subsequently decline somewhat. Some degree of price volatility is, therefore, a natural feature of the housing market.”

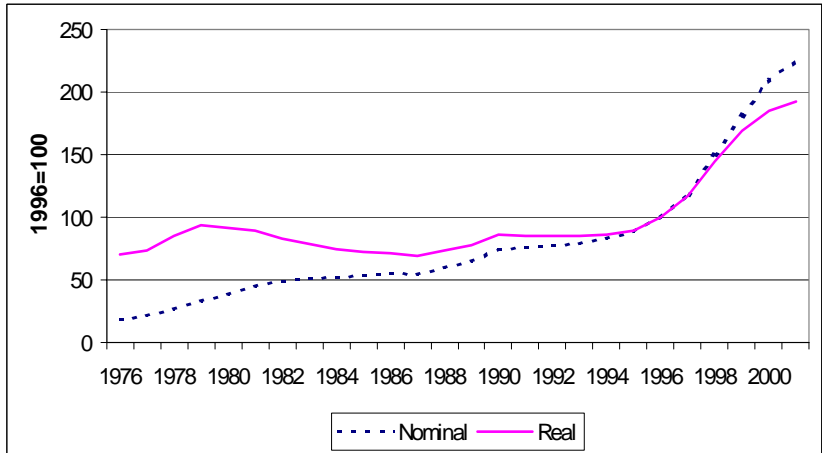
The rate of house price increases in the latter half of the 1990s was one of the main factors underpinning the upsurge in both domestic and external focus on the housing market. Trends in Irish house prices also provide a context for many of the developments that occurred between 1996 and 2000. Nationally average house prices reached IR£141,659 (€179,870) in 2000, and increased further to an average of IR£153,173 (€194,490) in 2001, compared with an average of IR£59,975 (€76,153) in 1995.² Since the mid-1970s the trend in nominal house prices has been steadily upward, apart from a brief period between 1985 and 1987 when prices remained broadly stable.

Adjusted for inflation, house prices have risen by 177 per cent between 1976 and 2000. As is evident from Figure 8, house prices in real terms declined in certain periods, most notably between 1980 and 1987, and to a lesser extent between 1991 and 1993. The growth in real house prices in the latter half of the 1970s was followed by a cumulative decline of 26 per cent. This was followed by a small boom in house prices in the late 1980s (1988-90) with an increase of 16.6 per cent. This boom was short lived and followed by a period of marginal decline, a fall of 1.2 per cent between 1990 and 1993. The current boom has seen prices rise by 97 per cent since 1994, a virtual doubling of house prices in real terms.

In contrast to the rise in house prices, between 1976 and 1999, the consumer price index, excluding mortgage interest, rose by an annual average of 6.6 per cent. This annual average would include the high inflation period of the late 1970s. Annual average consumer price inflation over the 1990s was just 2.4 per cent.

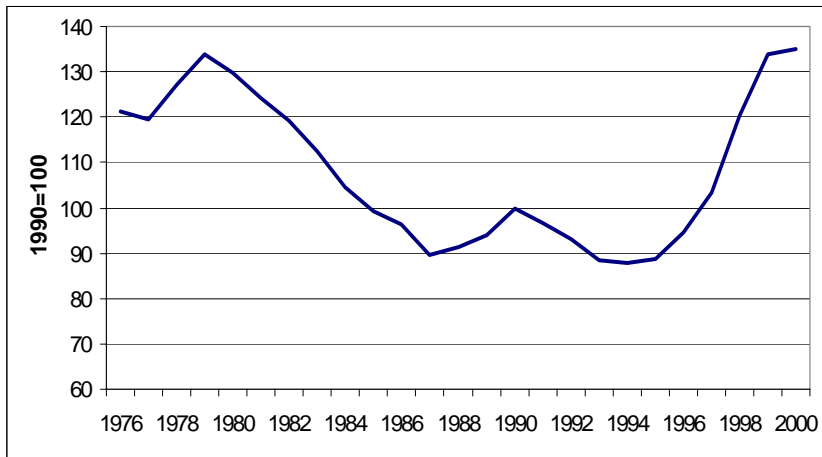
² This is based on the Department of the Environment average house price series. While there are difficulties using an average price this is the longest series available for the Irish market. The permanent tsb mix adjusted index is only available from 1996.

Figure 8: Trends in Nominal and Real House Prices



The recent rise in Irish house prices has been much faster than income growth. Figure 9 shows the ratio of house prices to personal disposable income. As is evident this ratio peaked in 1979 before declining steadily until 1987. Following a short-lived increase until 1990 the ratio declined until 1995 before increasing sharply. The ratio for 1999 is at the level last seen in 1974. The figure for 2000 indicates a sharp moderation in the growth of this ratio.

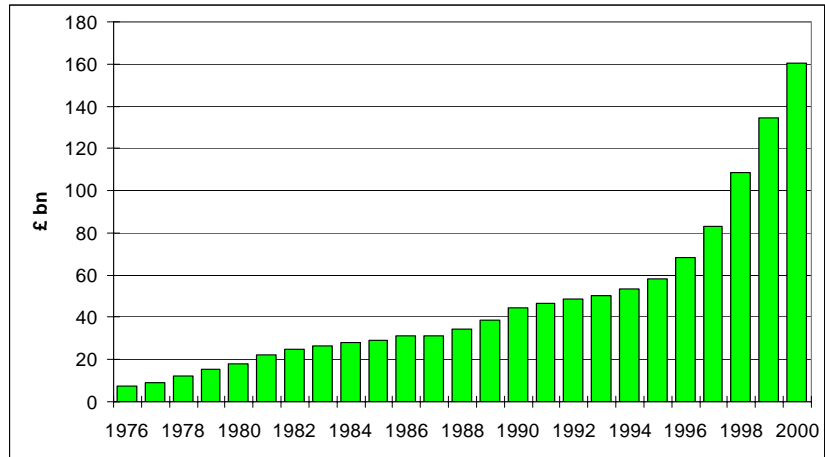
Figure 9: Ratio of House Prices to Personal Disposable Income



The rapid rise in prices has resulted in a substantial increase in aggregate household wealth. Case, Quigley and Shiller (2001), provide a useful framework for the estimation of aggregate housing wealth. In an analysis of fourteen countries, including Ireland, they find “strong evidence that variations in housing market wealth have important effects on consumption.” The IMF *World Economic Outlook* (2002), across a range of economies, finds a much stronger relationship between consumption and housing wealth than between consumption and equity wealth. Using estimates of the housing stock, home ownership rates interpolated between benchmark years and the Department of the Environment’s

average house price series (mix-adjusted indices are only available since 1996), the aggregate value of owner-occupied housing has risen from IR£7.5 billion in 1976, equivalent to 127 per cent of GNP, to IR£160 billion (€203bn) in 2000, 184 per cent of GNP. It is this kind of increase in wealth as a result of rising house prices that led *The Economist* magazine³ to argue that the housing market internationally had “sheltered the whole world economy from deep recession.”

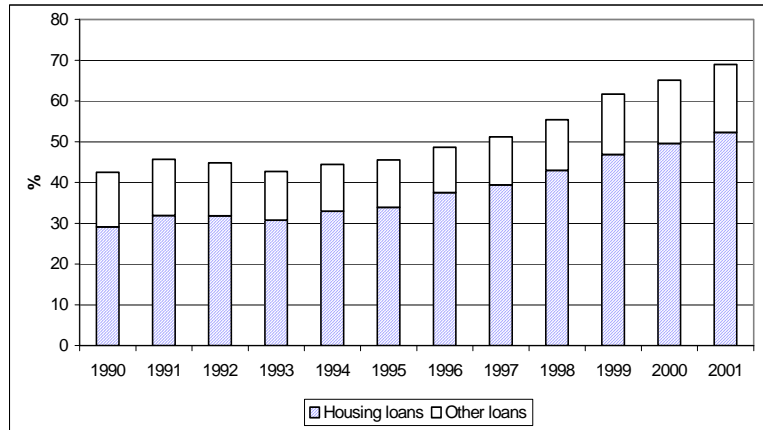
Figure 10: Nominal Owner-occupied Housing Wealth



While Figure 10 shows that there has been a substantial increase in housing wealth there is also evidence of higher borrowing for housing purposes, mortgage, bridging, and other housing finance. Overall, the ratio of personal debt to personal disposable income increased from 43 per cent in 1990 to 69 per cent in 2001. Much of this increase has happened in recent years. Between 1990 and 1997 the ratio of personal debt increased by 9 percentage points. In the period between 1998 and 2001 the ratio increased by 13.6 percentage points. The vast majority of this increase has been in borrowings for housing purposes. House mortgage finance and other housing finance amounted to just over 29 per cent of personal disposable income in 1990. By 2001 this had risen to 52 per cent. In contrast, other personal debt (finance for investment and other advances) has risen from 13.4 per cent of personal disposable income in 1990 to 16.7 per cent in 2001.

³ *The Economist* March 30th – April 5th, 2002. The article does make the point that strong house price increases can, in the longer run, have some negative impacts on an economy.

Figure 11: Personal Sector Debt, as a % of Personal Disposable Income



**6.
Modelling Irish
House Prices⁴**

The recent *Medium-Term Review* included an analysis of the outlook for the housing market. The forecasts in the *MTR* are based on the ESRI *HERMES* macro-model. This has been developed to include a model of the housing market. The housing model is based on work done by Anthony Murphy, initially for the first Bacon report.⁵ In the original Murphy model house prices are determined by real disposable income, the per capita housing stock, a proxy for the user cost of housing and the percentage of the population aged 25-34 years. These variables were all found to be statistically significant and use of this model in the Bacon, MacCabe and Murphy, (1998) report explained 89 per cent of the variation in house prices over the period 1974 to 1996. The results indicate that a 1 per cent increase in personal disposable income should result in a 1.45 per cent rise in house prices.

The ability to predict house prices between 1997 and 1999 is examined by Murphy and Brereton (2001). The authors conclude that the house price equation has been rather unstable over that period and under-predicts demand. Two possible explanations are put forward: misspecification, or speculative frenzy. Furthermore, “if speculative frenzy is the primary reason why the demand equation under-predicts, house prices are 20 per cent or so higher than warranted by fundamentals.”

The ESRI macro-model includes an equation for new house prices,⁶ see Appendix 1, based on the change in per capita income, the level of per capita income, per capita housing stock, the user cost of housing, and the percentage of the population in the main household formation age group 25 to 34 years.

The coefficient for the change in income measures the responsiveness of new house prices to income volatility and suggests quite a rapid pass through of short-run changes in income. Per capita real income is also highly significant with an elasticity greater than one. Thus

⁴ This section draws heavily on separate work by John Fitz Gerald, ESRI, and Anthony Murphy, UCD.

⁵ See A. Murphy (1998), and A. Murphy, and F. Brereton (2001).

⁶ The ESRI macro-model also includes an equation for second-hand house prices, given in Appendix 1.

rising standards of living have a strong effect in increasing the demand for housing, leading to a more than proportionate increase in new house prices. The housing stock per capita variable can be considered as capturing a “scarcity” effect – given a rapid growth in the population, as witnessed in the 1990s, and the inevitably slower growth in the stock of houses, the consequent housing scarcity quickly puts upward pressure on house prices. In addition to this scarcity effect, changing demographics which increase the proportion of the population in the house-buying age group will put upward pressure on house price. The estimated results suggest that the per capita housing stock and the percentage population in the household formation age group have a greater impact than in the model contained in the Bacon, MacCabe and Murphy report (1998). The model also includes a measure of expectations of house price changes in the user cost variable, based on the average change in house prices in the previous three periods. Further research on modelling the housing market using forward-looking price expectations is desirable.

7.
**The Housing
Market in the
Medium-Term
Review**

In recent years the ESRI’s *Medium-Term Review (MTR)* has included a section dealing with the housing market to provide a forecast of the sources of demand for housing in the future. The various forces driving the Irish housing market indicate that the economy will, on average, require at least 40,000 completions each year on average until at least 2010.

Pure demographic factors (the changing numbers in their late twenties and early thirties), excluding the effects of migration would require 16,600 dwellings a year. The rise in headship is estimated to have added 12,400 a year to housing demand between 1996 and 2001 and 11,400 between 2001 and 2006. Since 1996 demand for housing has also been boosted by a net inflow of returning emigrants and immigrants, attracted by employment opportunities in the Irish economy. In the period between 1996 and 2001 this factor is estimated to have added nearly 5,900 dwellings a year to housing demand. The importance of migration is forecast to continue over the next decade. On the basis of the levels of migration assumed in the Benchmark Forecast (a net inflow averaging 13,500 between 2000-10), there will be a need for between 5,200 and 6,100 dwellings a year over the next decade to accommodate these new households. However, the rise in house prices, the scarcity of available housing and high rental levels could work to deter immigration and in the short-term these figures may well represent an upper bound for housing demand driven by migration.

Table 2: *Medium-Term Review* Benchmark Forecast: Decomposition of Housing Demand, Thousands, Annual Averages

	1996-2001	2001-2006	2006-2011	2011-2016
	'000	'000	'000	'000
Migration	5.9	5.2	6.1	3.7
Change in headship	12.4	11.4	11.9	4.6
Population Growth	15.4	18.0	16.9	15.0
Second Dwellings	11.0	14.3	7.1	9.0
Total	44.6	48.9	35.3	42.0

Sources: D. Duffy, J. Fitz Gerald, J. Hore, I. Kearney and C. MacCoille (2001) *Medium-Term Review: 2001-2007*.

The category of second dwellings includes replacement homes and second dwellings. Between 1996 and 2001 it is estimated that second dwellings accounted for 11,000 dwellings a year. Following government intervention, Bacon and MacCabe (2000) examined developments in the housing market. Although there had been some moderation in house price inflation, stronger than anticipated economic growth and low mortgage interest rates continued to underpin demand. Furthermore the aggregate increase in house prices was found to mask higher inflation facing first time buyers. While there had been response on the supply side, the report suggested that some of this focused on building holiday homes, diverting resources away from the residential market.

The Irish market between 1995 and 2000 was characterised by rapid price increases, high levels of demand and insufficient supply. Despite record levels of house building during the late 1990s the housing market continued to be driven by excess demand. In terms of impact on the wider economy, the increase in household wealth could provide part of the explanation for the strong increases in personal consumption in recent years.

Although not dealt with in this article another factor that has had an influence on the housing market in recent years has been government policy. In response to the Bacon reports government intervention focused on altering stamp duty and fiscal measures. Some of these measures were revoked in Budget 2002. Evidence suggests that revoking these policies has stimulated demand in the housing market.

As part of the IMF Article 4 review of the Irish economy in 2000, one of the selected issues was Ireland's property boom. The paper shows that many of the fundamentals underpinning the Irish housing market seem set to remain strong. Furthermore, while international experience of property booms suggest that the recent rapid house price inflation will end in prices falling, the IMF find that "it would be wrong to conclude based on this that a price collapse in Ireland is inevitable".

Furthermore, despite concerns about the exposure of the economy to the housing market, data quoted in the OECD *Economic Survey Ireland*, 2001, shows that the level of outstanding residential mortgages is much lower than the level in other European countries. Of course, while this may limit exposure to a property market shock, it does not mean that the economy would be unaffected by a sharp downturn in house prices.

The market was boosted by the expectation of and the fall in interest rates associated with EMU membership, growth in disposable income and growth in the number of young adults in the household formation age groups. At the same time as the economy grew strongly, employment prospects were good and there was a net inflow of people into the country.

The recent *Medium-Term Review* Benchmark or Slowdown forecast suggests that there will be an on-going demand for over 40,000 units a year until the end of the current decade. Kenny (1998) and Duffy *et al.* (2001) point to the fact that house prices in real terms can be expected to show a small fall in the longer term as supply and demand conditions equate. Some adjustment in the housing market appears to be happening at present. The rapid increase in house prices during the late 1990s, which

was partly due to rapid demand growth, has resulted in some aspiring home owners being unable to enter the market. Until this demand has been satisfied then it is likely that house prices will increase, albeit at more moderate rates than experienced in the late 1990s.

REFERENCES

- BACON, P., F. MacCABE, A. MURPHY, 1998. *An Economic Assessment of Recent House Price Developments*, Dublin: The Stationery Office, April.
- BACON, P., and F. MacCABE, 1999. *The Housing Market: An Economic Review and Assessment*, Dublin: The Stationery Office, March.
- BACON, P., and F. MacCABE, 2000. *The Housing Market in Ireland: An Economic Evaluation of Trends and Prospects*, Dublin: The Stationery Office, June.
- CASE, K.E., J.M. QUIGLEY, R.J. SHILLER, 2001. "Comparing Wealth Effects: The Stock Market Versus The Housing Market", NBER Working Paper 8606, November.
- CUTLER, J, 1995. "The Housing Market and the Economy", Bank of England *Quarterly Bulletin*, August.
- DiPASQUALE, D, and W.C. WHEATON, 1996. *Urban Economics and Real Estate Markets*, New Jersey: Prentice Hall.
- DUFFY, D, J. FITZ GERALD, J. HORE, I. KEARNEY, C. MacCOILLE, 2001. *Medium-Term Review: 2001-2007*, No. 8, Dublin: The Economic and Social Research Institute.
- ECONOMIST, 2002. "The Houses that Saved the World", March 30th – April 5th.
- INTERNATIONAL MONETARY FUND, 2000. *Ireland Report – Selected Issues*.
- INTERNATIONAL MONETARY FUND, 2002. "Is Wealth Increasingly Driving Consumption?" *World Economic Outlook*, April.
- KENNY, G., 1998. "The Housing Market and the Macroeconomy: Evidence from Ireland", Central Bank of Ireland Technical Paper 1/RT/98, March.
- MURPHY, A., 1998. "Econometric Modelling of the Irish Housing Market" in Bacon, McCabe and Murphy, *An Economic Assessment of Recent House Price Developments*, Dublin: Stationery Office, April.
- MURPHY, A., and F. BRERETON, 2001. "Modelling Irish House Prices: A Review", paper presented at the Irish Economic Association Annual Conference, April.
- MUTH, R.F. and A.C. GOODMAN, 1989. *The Economics of Housing Markets*, Switzerland: Harvard Academic Publishers.
- O'CONNELL, T., and T. QUINN, 1999. "Recent Property Price Developments: An Assessment, Central Bank *Quarterly Bulletin*, Autumn.
- OECD, 1999. *Ireland Economic Survey*, Paris: OECD.
- OECD, 2001. *Ireland Economic Survey*, Paris: OECD.
- ROCHE, M. 1999. "Irish House Prices: Will the Roof Cave In"? *The Economic and Social Review*, Vol. 30, No. 4, October.
- ROCHE, M. 2001. "The Rise in House Prices in Dublin: bubble, fad or just fundamentals", *Economic Modelling*, Vol. 18, pp. 281-295.

ESRI Macro Model Equation for House Completions

$$\begin{aligned}
 (\text{HCOMP}) = & -6.8 + 0.42(\text{dPHNEW}) + 0.66((\text{HCOMP})_{-1}) + \\
 & (-3.0) \quad (1.41) \quad (5.99) \\
 & 0.48((\text{PHNEW})_{-1}) + 0.26 (\text{PHNEWB}) \\
 & (2.66) \quad (2.82)
 \end{aligned}$$

where: HCOMP is the number of annual house completions in log terms, PHNEW is the price of new houses deflated by the consumer price index in log terms, dPHNEW is the change in the price of new houses deflated by the consumer price index in log terms, and PHNEWB is the price of new houses deflated the long run cost of production in the building industry in log terms.

In the ESRI macro-model the equation for new house prices is specified as follows:

$$\begin{aligned}
 \text{PHNEW} = & 2.10 + 0.88 (\text{dYPOP}) + 1.23 (\text{YPOP})_{-1} - 2.48(\text{HSTKPOP}) \\
 & (3.17) \quad (5.14) \quad (7.54) \quad (-7.88) \\
 & -0.43 (\text{R}) + 3.79(\text{POP_AGE}) \\
 & (-3.95) \quad (1.47)
 \end{aligned}$$

where PHNEW is the price of new houses deflated by the consumer price index in log terms, dYPOP is the change in real personal disposable income per capita in log terms, YPOP is real personal disposable income per capita in log terms, HSTKPOP is the stock of houses divided by the total population, R is the user cost of housing based on the mortgage rate less the average change in house prices over the previous three time periods, and POP_AGE is the population aged 25 to 34 years as a proportion of the working age population.

The ESRI model also includes a similar equation for second-hand house prices:

$$\begin{aligned}
 \text{PHOLD} = & 10.04 + 0.27 (\text{dYPOP}) + 0.91 (\text{YPOP})_{-1} - 0.70(\text{HSTKPOP}) \\
 & (5.26) \quad (1.19) \quad (4.78) \quad (-1.57) \\
 & -0.39 (\text{R}) - 10.28(\text{P2534}) \\
 & (13.01) \quad (-1.04)
 \end{aligned}$$

where PHOLD is the price of second-hand houses deflated by the consumer price index in log terms, dYPOP is the change in real personal disposable income per capita in log terms, YPOP is real personal disposable income per capita in log terms, HSTKPOP is the stock of houses divided by the total population, R is the user cost of housing based on the mortgage rate and the change in second-hand house prices, P2534 is the population aged 25 to 34 years as a proportion of the total population.

In general the estimated coefficients and implied elasticities for second-hand house prices are significantly lower than in the model determining new house prices. Only the real disposable income variable and the real interest rate are statistically significant, while the income volatility and demographic change variables are not. Notably the elasticity with respect to real disposable income is less than one. These results

suggest that second-hand house prices are driven by changing living standards, with demographic changes and short-run income volatility having a much reduced effect.

Note: coefficients are specified as elasticities i.e. they give the percentage change in house prices associated with a 1 per cent change in the variable. T-statistics are given in brackets.