Modelling Irish House Prices:
A Review and Some New Results*

Anthony Murphy
Nuffield College, Oxford OX1 1NF, UK

December 2005

1. Introduction

Ireland's booming housing market has attracted and continues to attract a considerable amount of attention, both domestically and internationally. Irish house prices are extremely high by historic and international standards, both in absolute terms and relative to incomes. Table 1 shows that the strength and duration of the house price boom is unique. Many other countries and regions have experienced large house price booms. However, at least in the 1980's and early 1990's, most of these booms have ended in a house price bust (IMF 2001, 2003). To date, there is no sign of a house bust in Ireland. In fact, it is only in the past year that Irish house price inflation has moderated to below 7% per annum.[1]

— Table 1 About Here ---

There is widespread agreement on the reasons for the boom in Irish house prices in the

* This paper is partly based on a report on Housing and National Competitiveness (Murphy, 2004) prepared for the National Competitiveness Council in Ireland.

[1] Based on the ESRI/Permanent TSB house price data for July 2005.

1990's. For example, Bacon et. al. (1998) explain the boom in terms of rising demand - due to rising incomes, falling interest rates and a bulge in the key house buying age group, inter alia - and a sluggish supply response - partly associated with planning restrictions and a shortage of zoned and serviced land. This explanation is consistent with the standard, textbook model of the housing market.

There is considerably less agreement about the reasons for the continued strength of house prices since 2000 and the outlook for house prices in the next few years, given the remarkable expansion in the number of new houses being built. In particular, there is no consensus about the impact of fundamental and other, non-fundamental influences on house prices. This issue is important for policy. If house prices are above fundamentals, then we are likely to see some form of correction / return to fundamentals in any case, without any new policy initiatives.[2] Some sort of model of the Irish housing market is required to address this issue and to guide policy.

The outline of the rest of this paper is as follows. Recent house price and other trends are discussed in Section 2. I outline the standard textbook model of the housing market in the Section 3 and show how it is applied in practice. Using this is framework I critically review recent house price models for Ireland (Section 4) while some new model results are presented in Section 5. Finally, some brief conclusions are set out in Section 6.

---

[2] A lot of misguided and inconsistent policies - as well as some good, supply side policies - were tried out in the late 1990's. These included numerous changes in stamp duty rates (including different rates for first time buyers, investors and others); the proposed withdrawal of mortgage interest relief for landlords; time limits on planning permissions. These policies tended to fuel demand and/or reduce supply.

The extremely generous tax treatment of housing did not help. If the Irish tax system moved away from taxing housing flows to taxing the housing stock and if unnecessary tax reliefs were eliminated, house prices would undoubtably be lower. Housing policy in Ireland is not tenure neutral and over emphases home ownership

2. Recent Trends in New House Completions, House Prices and Private Sector Rents

Table 1 shows that the supply of new houses has risen sharply both nationally, and in the Greater Dublin Area, as infrastructure has come on stream, more land has been zoned and serviced, policy changed to allow considerably higher densities and more resources devoted to planning. House completions appear to have peaked in 2004 when almost 77 thousand new homes were built.[3] This compares well with an estimated long run requirement of 45 to 50 thousand houses per annum, of which a third or so are required in Dublin (Fitzgerald et. al., 2003; McCarty et. al., 2003).[4] This also compares well with the 190 thousand or so houses completed in 2003/4 in the UK, a country with a population of almost 60 million whereas Ireland has a population of just 4 million.

— Figures 1(a and b) and Table 2 About Here ---

The rise in the number of new house completions has been achieved by a combination of successful supply side policies which increased the supply of zoned and serviced land. These policies involved large investments in infrastructure, allowing higher densities, some re-zoning and the employment of more planners inter alia. Of course, given the initial infrastructure deficits and the substantial time lags between servicing land and new houses being completed, the boom in Irish house prices in the late 1990's was almost inevitable given the (largely unanticipated) strength of pent-up demand.

---

[3] The new house completion data, which are based on electricity supply connections, may overstate the number of new house completions (McCarty et.al., 2003). In addition many of these new house are holiday and/or second homes and do not contribute to effective housing supply (Fitzgerald et. al. 2003; McCarty et. al. 2003 and NESC, 2004). Fitzgerald (2005) suggest that over 19% of the habitable 2002 housing stock consisted of vacant or second homes, up from 17% in 1991.

[4] The long run requirement is based on the convergence of the Irish headship rate to the UK or average EU headship rate in the next decade or so.

— Table 3 About Here ---

The housing land availability data in Table 3 suggest that sufficient zoned and serviced land is available nationally, as well as in Dublin and the rest of the Greater Dublin Area (Meath, Kildare and Wicklow).[5] For example, the amount of zoned and serviced housing land in June 2004 stood at 12.5 thousand hectares. This land would, under reasonable density assumptions, accommodate almost 370 thousand housing units, or almost 27% of the permanent housing stock in 2004. This is a more than adequate supply, given the current high levels of completions and the likely requirement for 45 to 50 thousand new homes in the next decade or so. The increase in the supply of zoned and serviced land in Dublin is particularly impressive, although there is some suspicion that speculative land hoarding is occurring (Casey, 2003, Goodbody, 2003, Murphy, 2004).

— Tables 4 and 5 About Here ---

The data in Tables 4 and 5 show that the capacity of the planning system has increased and that the incidence of planning delays has fallen even though the planning system in Ireland has become more become more complex, with more layers and competing objectives. In many ways, the Irish system appears to resemble the UK system. However, in practice, the Irish system is far more flexible and responsive to market forces.

— Figure 2 and Table 6 About Here ---

Turning to house prices, it is rather surprisingly that annual house price inflation is still so high, given the remarkable increases in new housing supply. The data in Figure 2

[5] The evidence is that Dublin house prices lead national house prices (Osborne, 2003; Stephenson, 2003a). .

and Table 6 show that house prices have risen in nominal and real terms and also relative to incomes.

Lower interest rates (Figure 3) and a rise in the key house buying population cohort (Figure 4) are clearly important factors buoying up house prices. Government tax policy in the late 1990's almost as often raised demand as reduced it, thus contributed to the rise in house prices (Murphy, 1998; Murphy and Brereton, 2001; Berry et. al., 2001; Ball / RICS, 2004 and IMF, 2004b). Financial liberalization and speculative frenzy are also likely contributory factors to the rise in house prices

— Figures 3 to 5 About Here ---

By way of contrast, in the past few years private sector rents have fallen in real and nominal terms. Rents have also fallen relative to house prices. See Figure 5. In the medium to long run, these disparate trends cannot continue.

3. The Standard Textbook Model of the Housing Market

The standard or textbook model of the housing market is extremely useful when explaining Irish house prices.[6] In the standard model, the demand for housing services has both consumption and investment components so the relevant price of housing is the user cost of housing. This implies that explanations of house prices that concentrate solely on house price to income ratios, measures of affordability or demographics are inadequate.

In the standard model, the supply of housing services is assumed to be proportional to the housing stock, which is largely fixed in the short run. This means that house prices

[6] This textbook model of the housing market is set out and employed in a wide range of papers including Buckley and Ermisch (1982), Mankiw and Weil (1989), Meen (1990, 1996 and 2000), Muellbauer and Murphy (1997), Muth (1989) and Poterba (1984, 1991). Irish applications include Irvine (1984) and Murphy (1998).

(measured relative to income, for example) tend to overshoot their long run values in a boom, even in the absence of any speculation or frenzy. The model also implies that fiscal incentives to home buyers will mainly be capitalized in higher house prices in the short run, a lesson repeatedly ignored by Irish policy makers in the late 1990's.

The textbook model is also useful when reviewing estimated house price equations for Ireland, since the international literature provides one with widely accepted, strong priors for the size of various elasticities such as the price and income elasticities of the demand for housing services and these may be used to evaluate models of Irish house prices.[7]

The standard, textbook model of the housing market consists of three equations - a demand equation which, given the housing stock, real incomes, interest rates etc. largely determines house prices in the short run; a supply equation which determines the supply of new houses (new house completions) in the short run; an equation showing how the stock of houses changes over time as new houses are completed. The house price equation is derived from the demand for housing services by inverting and rearranging the demand equation, so that the dependent variable is house prices as opposed to the quantity of housing services / housing stock. This is the most common form of estimated house price equation in the international literature.[8]

A simplified version of the textbook model of house prices that most researchers use is as

---

[7] For example, Meen (1996) and Meen and Andrews (1998) survey the UK and US literature and present central estimates of the key elasticities. There are no good reasons to believe that the elasticities of demand for housing in Ireland are very different from those in the UK or US.

[8] Reduced form and ad hoc equations are less common. If the housing stock and new house completions equations are substituted into the demand equation, a reduced form house price equation may be obtained and estimated. The housing stock and construction costs along with the other variables that drive demand and supply appear as explanatory variables in reduced form equations. Ad hoc equations, which have no theoretical foundations, are generally hard to interpret.

follows. The demand for housing services, which is assumed proportional to the housing stock hs, may be specified as:

$$(1) \qquad hs/pop = y^{\alpha} r_h^{-\beta} d$$

where pop is population, y is real income, r_h is the real rental price and d represents other factors, such as demography, which shift the demand for housing curve. The α and β coefficients are the income and price elasticities of the demand for housing services. The international literature suggests that the income elasticity α is about ½ to 1 in cross section data and about 1¼ in time series data, and, that the price elasticity β is between ½ and ¾. (Meen,1996; Meen and Andrews,1998).

In Ireland and the UK, at least, the rental r_h is difficult to measure since the private rented sector is small and may not be representative of the overall housing stock. However, in equilibrium, the rental r_h equals the real user cost of housing uc_h which, in principle, may be calculated. Hence, r_h may be replaced by a suitable expression for the user cost. In the simplest case, the user cost may be defined as:

$$(2) \qquad uc_h = ph.(r^a + m + t_h - \dot{p}h^e/ph) \equiv ph.v_h$$

where ph = real price of houses; r^a = tax adjusted real interest rate; m = rate of expenditure on maintenance and repair etc.; t_h = net rate of tax on housing; $\dot{p}h^e/ph$ = expected rate of appreciation of real house prices and v_h is the user cost of housing expressed as a proportion of the price of the house. In practice, the main drivers of the user cost are the mortgage rate and the rate of inflation of house prices. See Irvine (1984), Muellbauer and Murphy (1997) and Barham (2004) inter alia, for more details of how to calculate the other components of the user cost of housing.[9]

[9] In the Irish case, the complications include transaction costs including stamp duty, gearing and the opportunity cost of funds, new house grants, mortgage subsidies, varying marginal tax rates and limits on mortgage interest tax relief.

The inverted demand curve, obtained by substituting (2) into (1) is then:

(3) $$ph = y^{\alpha/\beta}(hs/pop)^{-\beta} v_h^{-1} d^{1/\beta}$$

House prices are positively related to real incomes y, negatively related to the per capita housing stock h/pop and the percentage user cost of capital v_h and positively related to other variables that increase the demand for housing. A priori, the coefficients on income and the per capita housing stock are greater than one and possibly as high as 2 or 2½.

The simplest log-linear version of this equation may be written as:

(4) $$\ln p_{ht} = \beta_0 + \beta_1 \ln y_t - \beta_2 \ln(hs_t/pop_t) - \beta_3 v_{ht} + \beta_4 \ln d_t + u_t$$

where $v_t = r_t^a + m_t + t_{ht} - (\ln ph_t^e - \ln ph_{t-1})$ is the user cost rate. Equations similar to (4) may also be derived from an explicit multi-period utility maximization problem. Income y is then a measure of permanent income or some combination of physical and financial wealth and current and future real income.

Estimated versions of this equation, which condition on the housing stock hs, tend to be more complicated. Many of the modelling choices, such as the choice of proxies or selection of lag lengths, are largely data determined. Estimated versions of (4) are invariably dynamic - they include lagged house prices and lagged explanatory variables on the right hand side of (4) and may include an error correction term. They often include proxies for credit / mortgage rationing.

The unobserved ph_t^e variable in the user cost variable has to be proxied in some fashion. It may be replaced by ph_t which is then instrumented or expected capital gains ($\ln ph_t^e - \ln ph_{t-1}$) may be proxied by lagged capital gains or the fitted value from a simple regression on predetermined variables. Very often, the interest rate and capital gains components in the user cost variable appear in the equation separately, with a larger coefficient on the

interest rate term. See Meen (2002) for example.

The model of house prices is completed by adding an equation for the supply of new house completions hc and the evolution of the stock of housing h:

$$\ln hc_t = \gamma_0 + \gamma_1 \ln ph_t^e - \gamma_2 \ln cc_t + v_t \quad (5)$$

$$hs_t = (1-\delta)hs_{t-1} + hc_t \quad (6)$$

where cc represent construction costs and δ may be interpreted as the housing stock "depreciation rate". Equation (5) says that new house completions depend positively on (expected) house prices and negatively on construction costs. Equation (6) is almost an identity.[10]

Estimated versions of (5) are obviously dynamic. In principle, construction costs include materials costs, earnings, land prices and the cost of capital. In practice, land prices are rarely included in econometric housing supply equations. A potential omitted variable is a measure of planning restrictions. Surprisingly, construction costs are very often insignificant (Murphy, 1998, DiPasquale, 1999). The available UK evidence suggests that, although house prices are a cyclical markup on costs, land prices and house prices move together over time and that land prices are move volatile than house prices over the cycle (Evans 2004).

Murphy (1998) finds that new housing supply in Ireland is quite elastic. However, his estimates suggest that the price elasticity of new housing supply in Dublin is only half the national figure. Studies for the UK produce very low estimates of the price elasticities of

[10] Equation (5) may, of course, be substituted into (6) to yield, along with (4), an two equation system explaining house prices and the housing stock. See Poterba (1984), for example, who assumes that individuals have rational expectations.

new housing supply, especially in the South East. US studies suggest that new housing supply is highly elastic, although lower estimates are obtained for urban areas on the East and West coasts where planning constraints bite. See Meen (1996), DiPasquale (2001) and Malpezzi and MacLennan (2001) inter alia.

4. A Review of Some House Price Models

In this Section I critically review some estimated house price models for Ireland starting with my own work.[11] Murphy (1998) estimates a version of the textbook model using annual data from 1974 to 1997. The estimated inverted demand and new supply equations for Ireland are, omitting the constant terms, as follows:

$$\ln ph_s \propto 0.32\ \Delta\ln y + 1.39 \ln y_{-1} - 1.47 \ln (hs/pop)_{-1} - 0.35\ uc + 0.04 * pop_{2534}$$

$$\ln hc \propto 0.77 \ln hc_{-1} + 0.76\ \Delta\ln ph_n + 0.39 \ln ph_{n,-1}$$

where ph_n and ph_s = real new and second hand house prices, y = real income, hs = housing stock, pop = population, uc = user cost proxied by r - $\Delta\ln ph_n$ (instumented), r = nominal mortgage rate, pop_{2534} = population percentage aged 25 to 34 and hc = new house completions. Equations for Dublin are also estimated.

The econometric results suggest that most of the rises in Irish and Dublin house prices up to 1977 could be explained by "fundamentals". The key driving factors are rising per capita incomes (which incorporates the effect of rising employment rates), lower interest rates and a growing proportion of the population in the key house buying age group.[12]

---

[11] Surprisingly, no economist appears to have examined the Irish housing market from the early 1980's to the late 1990's.

[12] In the US the effect of demography on house prices has been controversial. See Mankiw and Weil (1989), Poterba (1991) and Green and Hendershott (1996). The demographic variable used in Chapter 2 is the change in, and not the level of, the

Housing supply responds with a long lag, consistent with the time delays in the planning process set out. Housing supply is far less elastic in Dublin than elsewhere, probably reflecting infrastructure deficits and the operation of the planning / zoning system.

The results are broadly consistent with prior expectations and the results for other countries, particularly the UK. The income elasticity of house prices is at the lower end of the range identified by Meen (1996) and Meen and Andrews (1998). The interest rate effect, part of the user cost term, is also low. No consistent building cost effect could be found for the new supply equation, which is unfortunate given the large coefficient on lagged house completions

Kenny (1999) uses a cointegrating regression (vector error correction model) approach to model quarterly data from 1975 Q1 to 1997 Q1. The end of his data period precedes the recent boom in house prices. He identifies two long run equilibrium relationships which capture housing demand and supply:

$$\ln ph \propto \ln y - \ln (hs/pop) - 0.084\, r$$

$$\ln ph \propto \ln ccl + 0.340\, r$$

where y is now real aggregate GNP, ccl is a composite measure of building costs including land. Unfortunately, there are no comprehensive housing land price data in Ireland so the land price data are derived from the house price data (on the basis of guess-estimates). Kenny explicitly excludes demographic variables from the model, suggesting that the use of aggregate, as opposed to per capita, GNP captures the relevant demographic effects.

The first equation may be interpreted as an approximate inverted demand equation.

---

proportion of the working age population aged 20 to 39.

However the imposed unit elasticities on income and the per capita housing stock are not consistent with the values found in the international literature. The second equation is a markup pricing equation. It is not really a supply equation since it does not explain new house completions, which are not included in Kenny's model. Some calculations suggest that current house prices are far higher than the long run or fundamental values implied by Kenny's inverted demand equation.

Harmon and Hogan (2003) estimate general, dynamic inverted demand and new house completions equation. The inverted demand equation explains house prices in terms of the housing stock, real incomes, mortgage interest rates and demographics. Unfortunately, the housing stock (quantity) variable is statistically insignificant in their demand equation so it is difficult to interpret it as a inverted demand equation. This result illustrates the importance of pinning down the long run solution of the Irish house price equation.

Their supply equation is standard. Harmon and Hogan find some evidence of instability in the demand and supply equations. Both the supply and demand elasticities appear to be falling in the mid to late 1990's. However, it is very difficult to reproduce their estimated equations.

Murphy and Brereton (2001) update the estimated inverted demand and new house completions equations in Murphy (1998) using an extra three years data for 1997 to 1999. They also used the equations estimated over the period 1974 to 1996, when house prices were close to fundamental values, to forecast house prices and new house completions in the period 1997 to 1999. They suggest that the forecast errors should capture frenzy type, speculative deviations from fundamentals, policy intervention effects and financial liberalization effects.

Murphy and Brereton (2001) conclude that the estimated house price / inverted demand equation in Murphy (1998) is somewhat unstable in the period 1997 to 1999. Although

the equation holds up qualitatively, demand is a good deal higher than predicted. If speculative frenzy is the main reason why the demand equation under predicts, house prices could be 20% or so higher than fundamentals.

The new house completions / supply equation is reasonably stable over time. The housing supply elasticities are somewhat lower than in Murphy (1998). Overall, the forecasting results suggest that the government action to curb housing demand and increase housing supply had not yet taken effect by 1999.

In an annex to their 2003 report on Ireland, the International Monetary Fund (IMF, 2003) ask whether or not fundamentals can explain the growth in Irish house prices. They look at house price to income and house price to rent ratios. They estimate what they term a "reduced form", error correction model using income y, mortgage interest rates r and share of the population aged 25 to 34, pop_{2534}, to explain house prices. Unfortunately, this equation is difficult to interpret. It is not a reduced form equation since it does not include the housing stock. As Meen (2002) notes, this biases the estimated income elasticity downwards. Using annual data from 1977 to 2002, their long-run equilibrium relationship or cointegrating vector for house prices is:

$$\ln ph \propto 0.92 \ln y - 0.02 r + 5.40\ pop_{2534}$$

The income elasticity is very low as predicted.

Based on the models results, the IMF suggest that actual house prices in 2002 were 16½% above their long run equilibrium values, but only 3% above the fitted value allowing for short run dynamics. However, if the model is estimated for the period 1976 to 1999, the implied deviation of house prices from their long run equilibrium value is over 50%. (This result is clearly wrong and stems from their incorrect model for house prices.) Accordingly, the IMF suggest that "no one can know the equilibrium value of an asset with any degree of certainty" and that

> "In the case of Irish house prices, the empirical evidence suggests, that as long as the change in demand behaviour that seemed to have occurred in the late 1990's is permanent, the sustained rise is quite consistent with strong fundamentals" (IMF, 2003, p. 29).

This conclusion is not very informative since permanent rises in demand means that fundamentals are strong.

Stephenson (2003b), inter alia, estimates two different housing demand equations for the period 1978 to 2001. One equation (Model I) is an inverted demand equation. This equation is similar to the demand equations in Murphy (1998) and Murphy and Brereton (2001). Stephenson adds employment and consumer confidence to the list of explanatory variables and uses population rather the proportion of the population aged 26-34 as his demographic variable. The other equation (Model II) is an ad hoc equation, since the housing stock is incorrectly signed and insignificant. Chow tests suggest that both equations are somewhat unstable.

To see whether fundamentals explain house prices over the period 1996 to 2001, Stephenson (2003b) generates the one period ahead forecast errors from a series of rolling regressions. He initially estimates a regression for the period 1978 to 1995, then he estimates a regression for 1979 to 1996 and so on. Stephenson suggests that the one period ahead forecasts represent fundamentals or long run equilibrium values and, therefore, the forecast errors are capturing deviations from fundamentals due to speculation, frenzy etc. In the case of Model II, but not Model I, the one period ahead forecast errors are small which, according to Stephenson, suggests that house prices in the period 1996 to 2001 were close to fundamentals.

However, there is no necessary correspondence between the predictions of a rolling regression and fundamental values. Moreover, it is very difficult to interpret an ad hoc model (Model II) in terms of fundamental and other factors. Finally, when house prices are booming, a model with a lagged dependent variable (Model II) will almost always

forecast better than a model without one (Model I).

In a series of papers, Roche (1999, 2001 and 2003) examines the likelihood of a crash in Irish and Dublin house prices. A similar approach is used in all three papers so we focus on the most recent one. Roche (2003) estimates a regime switching model of house prices. Special cases of this model are a fads model and a partial collapsing (speculative) bubble model.[13] Regime switching models can be difficult to estimate since the models are highly non-linear. Ideally, one should estimate the models using long runs of data. Roche (2003) uses quarterly data from 1979 Q1 to 2003 Q1

The regime switching model is estimated in two stage. In the first stage, the non-fundamental component of house prices is estimated. In the second stage, the actual regime switching model is estimated using last period's estimated non-fundamental prices as the only explanatory variable explaining the change in house prices this period. This means that the regime switching model results are crucially dependent on the model used to estimate the fundamental and non-fundamental components of house prices. If the first stage, estimated, non-fundamental component of house prices is small, then the chances of finding a fad or speculative bubble in the second stage are low.

Roche (2003) estimates a "reduced form" model for new house prices. House prices are regressed on a trend, supply side factors (building costs and land costs) and demand side factors (net immigration, the average mortgage, the user cost and per capita disposable income). The net immigration and average mortgage variables capture demographic and financial liberalization effects.

---

[13] In both the fads and collapsing bubbles models, houses prices may systematically differ from fundamentals over a number of years. In the fads model, the non-fundamental component of house prices is mean reverting. However, in the collapsing bubbles market, there is a period when the non-fundamental or speculative component of house prices grows along with the probability of a collapse in this component.

The model is an ad-hoc one rather than a reduced form model since land costs, the average mortgage and user costs are all endogenous variables. Residential land prices, house prices and the average mortgage loan are clearly driven by much the same factors. For example, the average new house price and average mortgage loan are cointegrated at the annual frequency. In addition, the land price data are very poor[14].

At a theoretical level, there are problems with using the model to estimate the non-fundamental component in Irish house prices. Suppose house prices are over valued and rising because of a speculative bubble. This will generate rising land prices, rising average mortgage loans and lower user costs. Therefore, the chances of picking up this speculative bubble by regressing house prices on land prices, the average mortgage loan and user costs are very slim.

In view of this, it is not surprising that Roche's estimated house price equation fits the data well. For example, the difference between the (higher) actual and (lower) estimated house prices in 2002 is only 4.6%. Roche (2003) suggests that this 4.6% figure is an appropriate measure of the over-valuation of Irish house prices in 2002. However, Roche's choice of explanatory variables in the house price equation will invariably suggest that house prices are close to their fundamental values, even if they are not.

In Section 2 of it's Financial Stability Report 2004, the Central Bank and Financial Services Authority of Ireland (CBFSAI, 2004) examine the contribution of fundamental and non fundamental influences on Irish house prices. Inter alia, they looked at the house price to rents ratio and the discounted house price to rents ratio. The former ratio suggests that house prices are overvalued by about 63%. This an excessive figure. In an efficient market, house prices are approximately equal to the discounted present

[14]As noted above, the land price data, which come from the Construction Industry Review and Outlook prepared for the Department of Environment, Heritage and Local Government, are guess-estimates based on the published house price data.

value of net rents Since interest rates are much lower now than in the past, the ratio of house prices to rents should be higher now. After the change in interest rates is taken account of, the discounted house price to rent ratio suggest that house prices are overvalued by about 30%.

At this point, the CBFSAI appear to backtrack from this finding. They suggest that:

> "... [T]he real interest rate that is relevant here is not the economy-wide interest rate but rather the own rate of interest in the housing market. This is the nominal mortgage rate less the expected house price inflation rate. In Ireland house price inflation has been well in excess of overall inflation over the past 10 years. Since this is almost certainly the case for their respective expected values, it follows that the own real rate of interest for the housing market has been much lower than the (already very low) real interest rate of interest for the overall economy."

This "bootstrap" type argument is flawed. With uncertainty, it is true that the appropriate discount rate is a risk adjusted interest rate. However the risk adjusted rate is higher rather than lower than the risk free interest rate.[15]

The CBFSAI then consider a range of supply and demand factors that influence fundamental house prices. The analysis is based largely on McQuinn (2004a, 2004b). . McQuinn (2004b) uses a cointegrating regression approach and quarterly data from 1980 Q1 to 2002 Q4 to estimate long run new housing supply (completions) and inverted demand (house price) equations. In addition to the housing stock, he includes income, the rental/user cost or real interest rate, net migration and the average mortgage loan in his inverted demand equation. He follows Roche (2003) in using net migration as his demographic variable and the average mortgage loan as a proxy for financial liberalization.

---

[15] Since house prices, rents and consumption are positively correlated, the risk adjustment to house prices is likely to be negative. Thus, the price of a house should be lower than the discounted present value of the net rentals using the risk free real interest rate. See Cochrane (2000, p.15-16).

The inclusion of the average mortgage loan as an explanatory variable creates problems, as discussed already when reviewing Roche (2003). Firstly, the average mortgage loan is not independent of house prices. Secondly, the results of estimating the housing demand equation including the average mortgage loan as an explanatory variable is extremely unlikely to tell you whether or not house prices are overvalued relative to fundamentals. Thirdly, the estimated demand elasticities of house prices with respect to income and the housing stock (approximately -½ and ¼) are orders of magnitude lower than the consensus estimates in the international literature.[16] As a result, it is not obvious that the estimated house prices equations in McQuinn (2004b) represent inverted demand equations and their interpretation is unclear. Any decomposition of house prices into fundamental and non-fundamental components based on these equations is also likely to be unclear.

Comparing, the actual and fitted values of the house price equation, McQuinn (2004b) suggests that house prices were overvalued in 1998 and 1999 but were close to their fundamental values in 2001 and 2002. The overvaluation in the late 1990's appears to be of the order of 10% to 20% depending on the model used. However, in view of the problems with the demand equations, one should be cautious about accepting these conclusions.

5. Some New Results

In this Section I present some new estimates of the inverted demand and new house completions equations in the standard, textbook model using annual data from 1974 to 2004. The new estimates are based on more data (e.g. five more years than Murphy and Brereton, 2001), more general specifications (e.g. error correction formulation) and a more comprehensive check on the chosen specification using PcGets (Hendry and

[16] The results in Tables 1 or 3 and Table 4 of McQuinn (2004b) are also surprisingly different. A priori, they should be similar.

Krolzig, 2001).

Annual data from 1974 to 2004 were used to estimate the model. 1974 was chosen as the start year because the house price data I use were collected on a different basis before then. Before considering the estimation results, a number of data issues must be mentioned since they limit the analysis. First, the house price data used are not mix adjusted since mix-adjusted figures are only available from 1996 Q1. Fortunately, the mix-adjusted Permanent TSB / ESRI house price indices and the simple average Department of Environment, Heritage and Local Government house price data used here display similar trends. Second, there are no official annual housing stock figures so the housing stock is estimated using Census, Labour Force Survey/Quarterly National Household Survey and house completions data. Third, official quarterly national accounts are only available from 1997 Q1 and the published data do not include the personal sector. Fourth, the official annual personal disposable income data have two discontinuities in 1985 and 1990 which had to be spliced. Fifth, no estimates of the effects of financial liberalization along the lines of Fernandez-Corugedo and Muellbauer (2004) are available.[17] There are a number of reasons for this including the fact that there are no time series data on personal wealth or loan to value ratios for first time buyers.

— Table 7 About Here —

Now consider the estimated inverted demand equations in Table 7. The dependent variable is the rate of growth of real, second hand house prices, $\Delta \ln(ph_s/pc)$. The equations are formulated as error correction models using:

$$1.75 * \ln y_{-1} - 2 * \ln hs_{-1} - 0.3 * uc_{-1} - 1.2 * rbmr - 0.1 * pop_{2534} - ph_{s,-1}$$

[17] Kelly and Everett (2004) discuss the effects of the financial liberalization in Ireland. However, they do not present a timetable of financial liberalization or attempt to quantify its effects.

as the error correction term. This I(0) term includes the usual suspects - real per capita income, the per capita housing stock, the user cost of housing, the share of the population aged 25 to 34 and the real mortgage interest rate[18]. All of the variables are lagged apart from pop_{2534}, the key house buying population cohort. Murphy (1998) was the first to identify the important role played by this variable. Other demographic variables were tried, including Δ ln pop which includes net migration, but pop_{2534} was always preferred.

The parameter values in the error correction term are partly based on a preliminary or first step OLS regression of $\ln ph_s$ on ln y, ln hs, uc, rbmr and pop_{2534} using data for 1974 to 1994, before the recent boom in house prices. The terms in income and the housing stock could be re-formulated in terms of income per house but the data always suggest a lower coefficient on income than the housing stock. The real interest rate effect in the preliminary regression is poorly determined but the restriction that the coefficient on the real interest rate is three times the coefficient on the user cost is acceptable. This ratio is the same order of magnitude as in Meen's UK house price equations (for example, see Table 2 in Miles (2003)).

The rest of the model is pretty simple. The growth in current and lagged real income have almost a one for one effect on the growth in house prices. The two step 0/1 dummies in 1997 and 2003 pick up the combined effects of financial liberalization, policy interventions since 1998 and speculative frenzy effects.[19] Without a good

---

[18] The user cost uc is equal to 0.05 + rates + 0.80 * (1 - t) * bmr + 0.20 * dr - Δ ln ph_s where rates is the property tax rate (abolished in 1977) ; bmr and dr are the mortgage and deposit interest rates; t is an estimate of the marginal rate of tax relief on mortgage interest (Irvine, 1984 and own calculations using data on the cost of reliefs from Revenue Commissioners). The user cost is based on an 80% loan to value ratio since there are no time series on loan to value ratios for first time buyers.

[19] For example, foreign banks only entered the Irish retail mortgage market in 1998 and mortgage interest rates fell immediately. Their entry was widely anticipated and increased competition among the existing mortgage lenders. Lending criteria were relaxed and a range of new products were introduced in the early 2000's. This is why

measure of financial liberalization, one cannot disentangle these effects. The effect of these step dummies is to raise house prices by about 15% in the short run and over 35% in the long-run, which seems too large to be the effect of financial liberalization only. I speculate that a third or more of this 35% effect represents a deviation of house prices from fundamentals, which will be corrected over time.

— Figure 6 About Here ---

The equations appear to be reasonable. They fit quite well (see Figure 6) - apart from the aftermath of the first oil price shock in 1975 - and are fairly stable over time. I used PcGets (Hendry and Krolzig, 2002) to check the specification. I searched for but could not find statistically significant, correctly signed short run interest rate effects, lagged house price inflation or trend effects.

— Table 8 About Here —

The new house completion results in Table 8 differ from those in Murphy (1998) and Murphy and Brereton (2001) since the negative effects of building costs (wages and materials) on supply can now be pinned down. The national and Dublin long run equations are:

(Ireland) $\ln hc \propto 2.11 \ln(ph/bc)$

---

the Central Bank and Financial Services Authority of Ireland 's 2004 Financial Stability Report (CBFSAI, 2004) devotes so much attention to the housing market.

The publication of the three "Bacon" reports (Bacon et. al., 1998, Bacon and McCabe, 1999 and 2000) on the housing market was accompanied by a unprecedented range of demand and supply side government measures. Instead of reducing demand and increasing supply, the evidence suggests that many of the measures drove up house prices in the short run and contributed to the speculative frenzy.

(Dublin) $\ln hc_{DUB} \propto 1.26 \ln(ph_{DUB}/bc)$

which seem plausible. The supply of new house houses is quite elastic nationally but only about half as responsive in Dublin. The estimated speeds of adjustment are similar and suggest that new housing supply responds with a long lag. A priori one might have expected to find a lower speed of adjustment in Dublin. The restriction that new house price and buildings costs have the same absolute effect is acceptable. The equations appear to be stable although the standard errors and adjusted R^2 are far lower than for the inverted demand equations in the previous Table. The estimated time dummies for 1998 to 2004 are jointly insignificant suggesting that the successful supply side policies have not changed the long run relationship between price and output.

— Table 9 About Here ---

Some results for the major cities and the rest of Ireland are presented in Table 9. The equations appear to be stable although the fit is not great. More importantly, the results are consistent with the previous ones and with one's priors. The supply elasticities in Cork and Limerick appear to higher than in Dublin but lower than elsewhere; the speed of adjustment in the rest of the country appears to be higher than in Dublin and the major cities.

6. Summary

The standard or textbook model of the housing market is a useful framework when reviewing studies of the Irish housing market which seek to explain the boom in Irish house prices. A great deal of effort has been devoted to modeling Irish house prices but the results are, I believe, rather mixed. For example, many models are not consistent with international research findings.

There is widespread agreement on the reasons for the boom in Irish house prices in the

mid to late 1990's. There is less agreement about the reasons for the continued strength of house prices since 2000 and the outlook for house prices in the next few years. In the absence of good measures of financial liberalization, it is difficult to quantify the deviation of Irish house prices from fundamentals.

7. References

Bacon, P. and MacCabe, F. (1999), *The Housing Market: An Economic Review and Assessment*, Government of Ireland Publications, Stationery Office, Dublin.

Bacon, P. and MacCabe, F. (2000), *The Housing Market in Ireland: An Economic Evaluation of Trends and Prospects*, Government of Ireland Publications, Stationery Office, Dublin.

Bacon, P., MacCabe, F. and Murphy, A. (1998), *An Economic Assessment of Recent House Price Developments*, Government of Ireland Publications, Stationery Office, Dublin.

Ball, M, and Royal Institute of Chartered Surveyors (2004), *European Housing Review 2004*, Royal Institute of Charted Surveyors, London.

Barham, G. (2004), "The Effects of Taxation Policy on the Cost of Capital in Housing – A Historical Profile (1976 to 2003)", in Central Bank and Financial Services Authority of Ireland (2004), *Financial Stability Report 2004*, Dublin.

Berry, J., McGreal, S., Stevenson, S. and Young, J. (2001), "Government Intervention and Impact on the Housing Market in Greater Dublin", *Housing Studies*, 16(6), 755-769.

Buckley, R. and Ermisch, J. (1982). “Government Policy and House Prices in the United Kingdom: An Econometric Analysis”, *Oxford Bulletin of Economics and Statistics*, 47, 273-304.

Casey, J. (2003), “The Land Question”, Building Industry Bulletin, July, Jerome Casey & Co., Dublin.

Central Bank and Financial Services Authority of Ireland (2004), *Financial Stability Report 2004*, Dublin.

DiPasquale, D. (1999), “What Don’t we Know About Housing Supply?”, *Journal of Real Estate Finance and Economics*, 18, 9-25.

DKM Economic Consultants (2004), *Review of the Construction Industry 2003 and Outlook 2004-2006*, DKM and Department of Environment, Heritage and Local Government, Dublin.

Economist, The (2004). “Global House Prices: The Sun Also Sets”, 9 September.

Evans, A. W. (2004), *Economics and Land Use Planning*, Blackwell Publishing, Oxford.

Fernandez-Corugedo, E. and Muellbauer, J. (2004), “Consumer Credit Conditions in the UK”, forthcoming, Bank of England working paper.

Fitzgerald, J., McCarthy, C., Morgenroth, E. and O’Connell, P. (Eds) (2003), *The Mid-Tem Evaluation of the National Development Plan and Community Support Framework for Ireland, 2000 to 2006*, Economic and Social Research Institute, Dublin.

Fitzgerald, J. (2005), “the Irish Housing Stock: Growth in Number of Vacant Dwellings”, *Quarterly Economic Commentary,* Spring, 42-63, Economic and Social Research Institute, Dublin.

Goodbody Economic Consultants (2003), *Rationale For And Impact of a Use It Or Lose It Scheme*, Dublin.

Harmon, C. and Hogan V. (2000), “Econometric Analysis of the Housing Market and projections of Future Deamnd” in Bacon, P. and MacCabe, F., *The Housing Market in Ireland: An Economic Evaluation of Trends and Prospects*, Government of Ireland Publications, Stationery Office, Dublin.

Hendry, D.F. and Krolzig, H.-M. (2001). *Automatic Econometric Model Selection using PcGets*, Timberlake Consultants Press, London.

International Monetary Fund (2003), *Ireland*, staff country report 03/242, IMF, Washington.

International Monetary Fund (2004), “The Global House Price Boom”, *World Economic Outlook*, September, IMF, Washington.

Irvine, I. (1984), *A Study of New House Prices in Ireland in the Seventies*, General Research Series, 118, Economic and Social Research Institute, Dublin.

Kelly, J. and Everett, M. (2004), “Financial Liberalism and Economic Growth in Ireland”, *Quarterly Bulletin*, Autumn, 91-112, Central Bank and Financial Services Authority of Ireland, Dublin

Kenny, G. (1999). “Modelling the Demand and Supply Sides of the Housing Market: Evidence from Ireland”, *Economic Modelling*, 16, 389-409.

Malpezzi, S. and MacLennan, D. (2001), “The Price Elasticity of Supply of New Residential Construction in the United States and the United Kingdom”, *Journal of Housing Economics*, 10, 278-306.

Mankiw, G. and Weil, D. (1989). “The Baby Boom, the Baby Bust and the Housing Market”, *Regional Science and Urban Economics*, 19, 325-46.

McCarthy, C., Hughes, A. and Woelger, E. (2003), *Where Have All the Houses Gone?*, Davy Stockbrokers, Dublin.

McQuinn. K. (2004a), “A Model of the Irish Housing Sector”, Research Paper 1/RT/04, Central Bank and Financial Services Authority of Ireland, Dublin.

McQuinn, K. (2004b), “The Irish Housing Market: Fundamental and Non-Fundamental Influences”, in Central Bank and Financial Services Authority of Ireland, *Financial Stability Report 2004*, Dublin.

Meen, G. (1990). “The Removal of Mortgage Market Constraints and the Implications for Econometric Modelling of UK House Price”, *Oxford Bulletin of Economics and Statistics*, 52, 1-23.

Meen, G. (1996). “Ten Propositions in UK Housing Macroeconomics: An Overview of the 1980s and Early 1990s”, *Urban Studies*, 33, 425-44.

Meen, G. (2000). “Time-Series Models of Housing: A Transatlantic Divide?”, *Journal of Housing Economics*, 11, 1-23.

Meen, G. and Andrew, M. (1998), *Modeling Regional House Prices: A Review of the Literature*, report prepared for Department of the Environment, Transport and the

Regions, Centre for Spatial and Real Estate Economics, University of Reading.

Miles, D. (2003), *The UK Mortgage Market: Taking a Longer Term View, Interim Report,* HMSO and HM Treasury, London.

Muellbauer, J. and Murphy, A. (1997), "Booms and Busts in the UK Housing Market", *Economic Journal*, 107, 1720-46.

Murphy, A (1998), "Econometric Modelling of the Irish Housing Market" in Bacon, P., MacCabe, F. and Murphy, A. (1998), *An Economic Assessment of Recent House Price Developments*, Government of Ireland Publications, Stationery Office, Dublin.

Murphy, A. and Brereton, F. (2001), "Modeling Irish House Prices: A Review", paper presented at Irish Economic Association annual conference.

Murphy, A. (2004), Housing and National Competitiveness, report prepared for National Competitiveness Council, mimeo.

Muth, R.F. (1989), "Theoretical Issues in Housing Market Research", in Muth, R.F. and Goodman, J.C., *The Economics of the Housing Market*, Harwood Academic Publishers, Chur.

Osborne, J. (2003), "Exploring the Booms and Busts in the Irish Housing Market", MA thesis, Dept. of Economics, University College Dublin.

Poterba, J.M. (1984). "Tax Subsidies to Owner-Occupied Housing: An Asset Market Approach", *Quarterly Journal of Economics*, 99, 729-52.

Poterba, J.M. (1991). "House Price Dynamics: the Role of Tax Policy and Demography", *Brookings Papers on Economic Activity*, 2, 143-203.

Roche, M. (1999). “Irish House Prices: Will The Roof Cave In?”, *Economic and Social Review*, 30, 343-62.

Roche, M. (2001), “The Rise in House Prices in Dublin: Fad or Just Fundamentals?”, *Economic Modelling*, 18, 281-295.

Roche, M. (2003), “Will There be a Crash in Irish House Prices?”, *Quarterly Economic Commentary*, , Winter, 57-72, Economic and Social Research Institute, Dublin.

Stephenson, S. (2003a), “House Price Diffusion and Inter-Regional and Cross Border House Price Dynamics”, Centre for Real Estate Research working paper 2003-07, Graduate School of Business, University College Dublin.

Stephenson, S. (2003b), “Economics, Demography and Fiscal Influences on Housing Market Dynamics”, Centre for Real Estate Research working paper 2003-08, Graduate School of Business, University College Dublin.

Stephenson, S. (2003), “Economics, Demography and Fiscal Influences on Housing Market Dynamics”, Centre for Real Estate Research working paper 2003-08, Graduate School of Business, University College Dublin.

Figure 3.1 (a): National and Dublin New House Completions

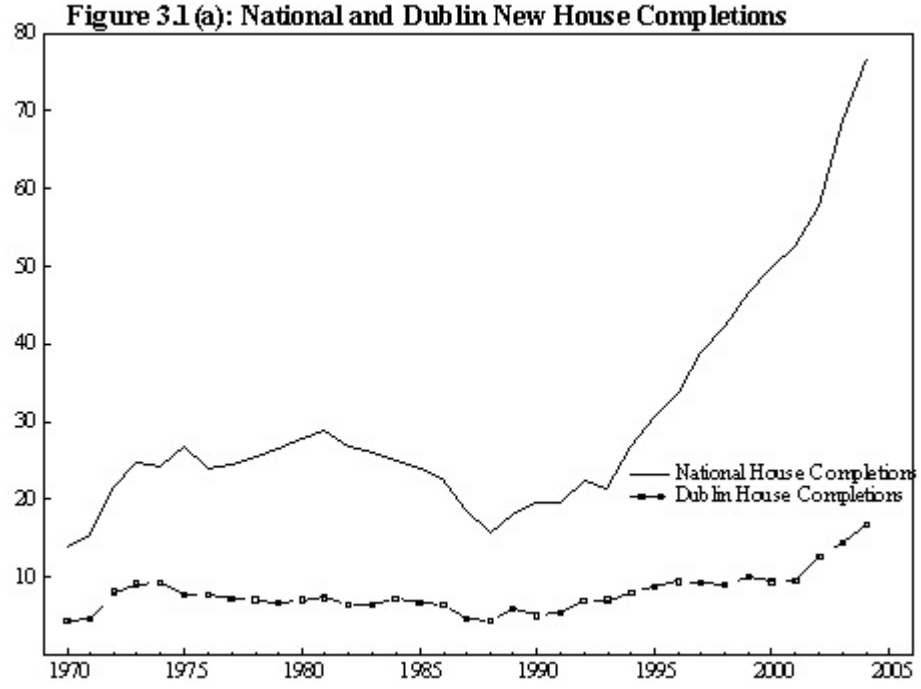

Figure 3.1b: Log House Completions

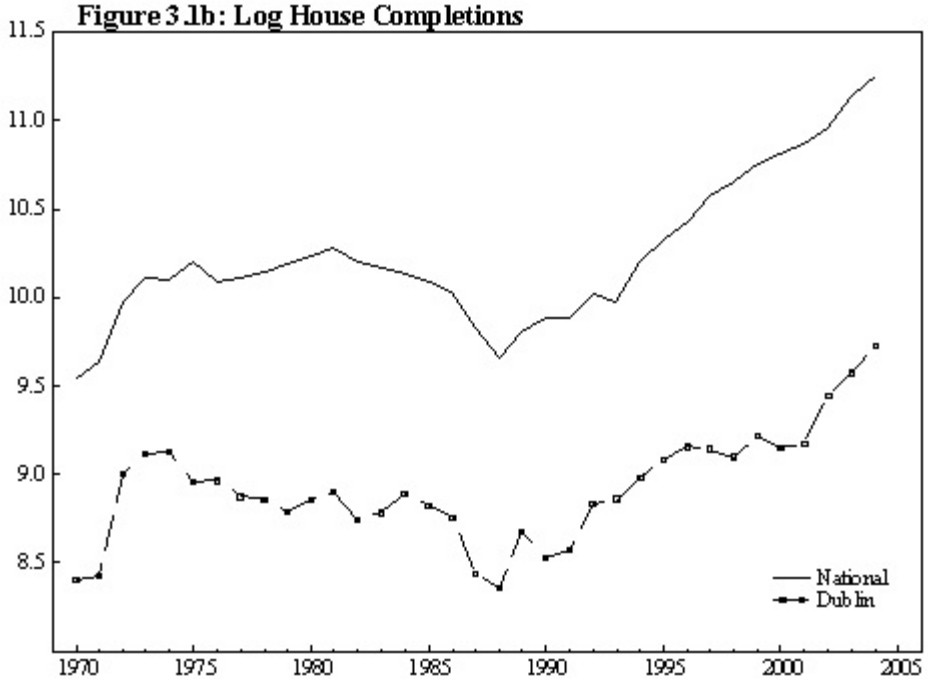

Figure 3.2: ΔLog Real House Prices and Per Capita Income

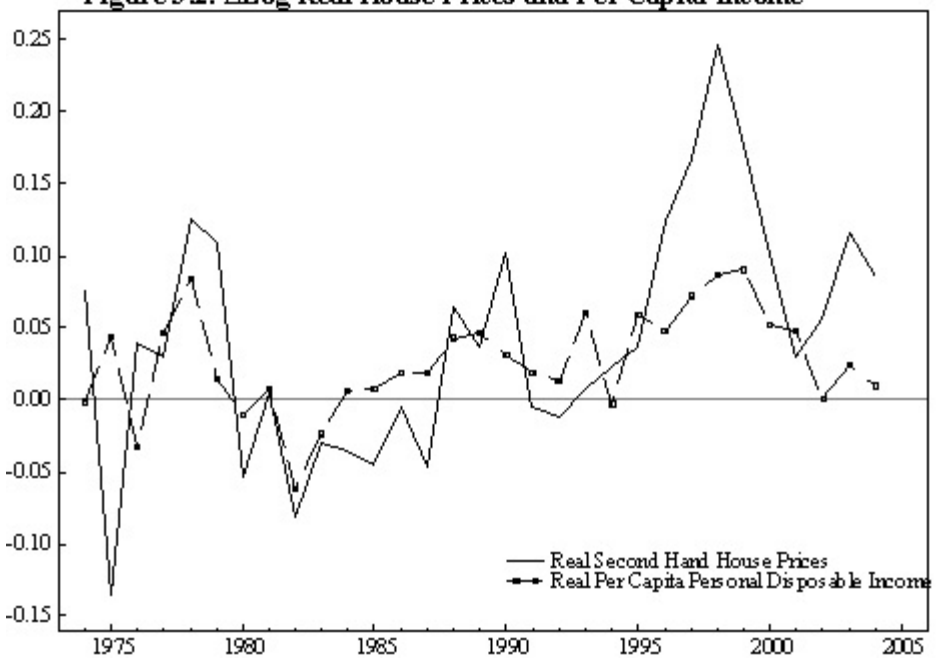

Figure 3: Nominal and Real Mortgage Interest Rate and User Cost of Housing

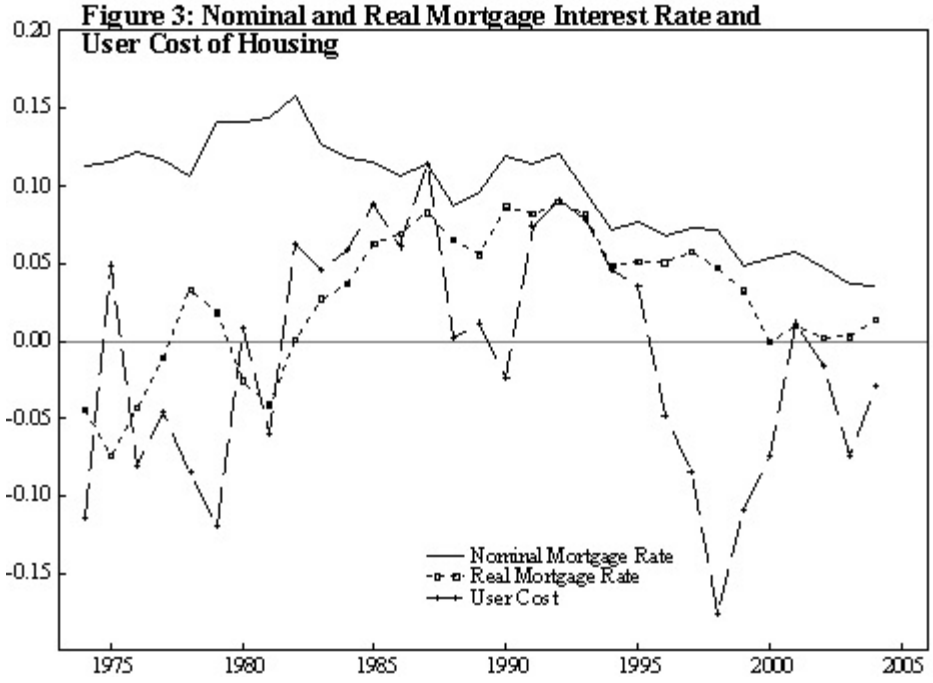

Figure 3.4: Population Share Aged 25 to 34

Figure 3.5: ΔLog House Prices and Private Sector Rents

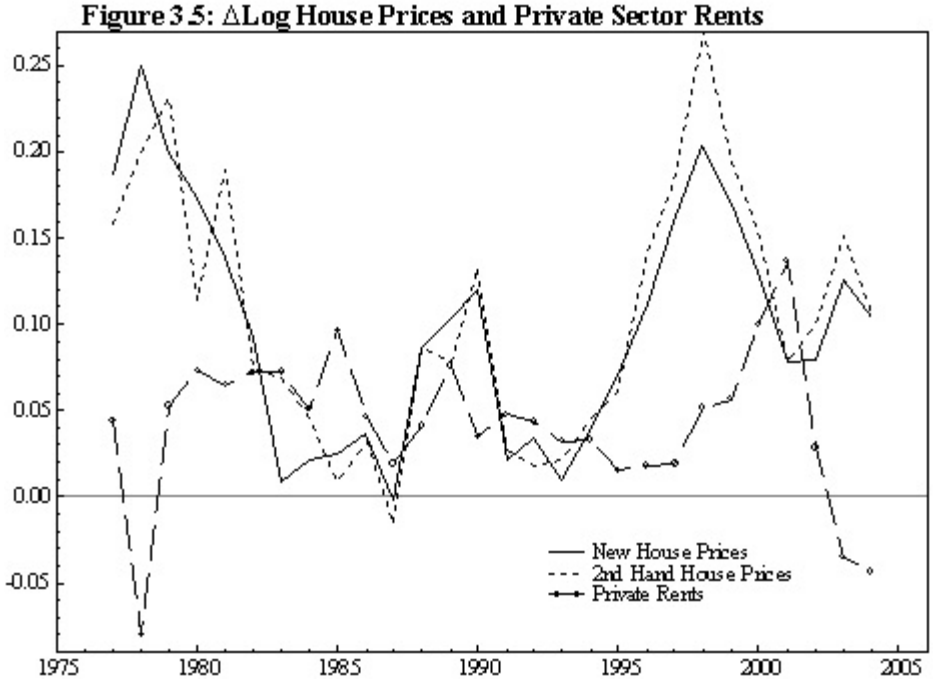

Figure 3.6: ΔLog House Prices - OLS Regression 1974-2004

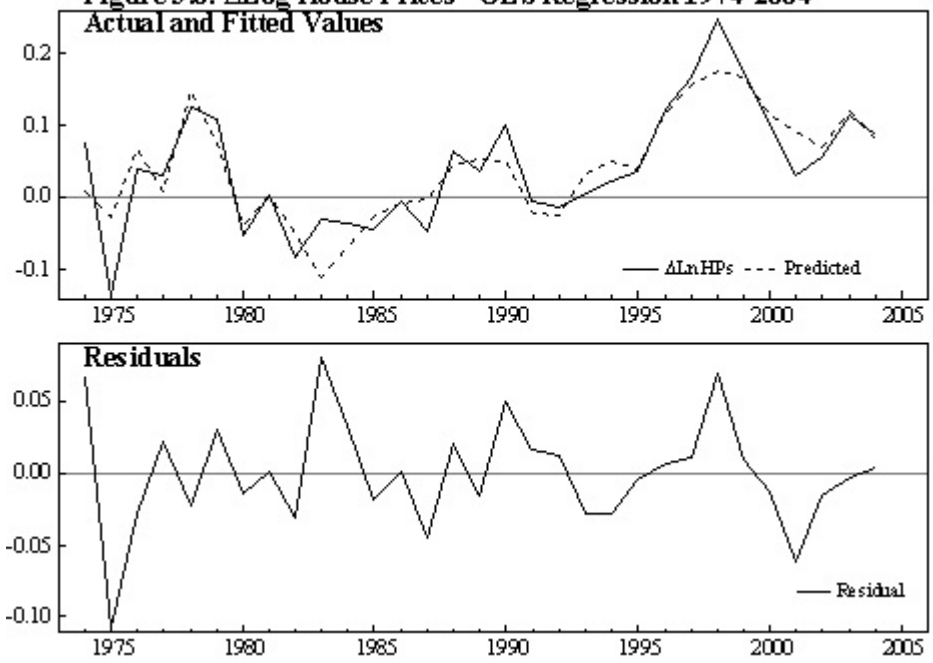

Table 1

International House Price Inflation

The Economist's House Price Indices

	Year to 2004 Q2	1997 to 2004		Year to 2004 Q2	1997 to 2004
Spain	17.2	168	Hong Kong	28.7	-55
France	14.5	68	South Africa	25.5	168
United Kingdom	13.8	132	New Zealand	22.1	51
Ireland	11.1	181	Australia	10.9	110
Italy	10.8	62	China	10.4	na
Sweden	10	77	United States	9.4	57
Belgium	8.2	50	Canada	7.3	42
Denmark	5	44	Singapore	-0.8	na
Netherlands	3.9	74	Japan	-6.4	-24
Switzerland	2.1	11			
Germany	-1.7	-3			

Source: The Economist (2004), "The Sun Also Sets", 9th September.

Table 2

New House Completions

Year	Dublin	Rest of Greater Dublin	Ireland
1996	9446	4222	33725
1997	9325	4560	38842
1998	8957	5266	42349
1999	10035	5193	46512
2000	9405	6153	49812
2001	9605	6893	52606
2002	12623	8052	57695
2003	14399	8458	68819
2004	16810	9105	76954

Source: Department of Environment, Heritage and Local Government (DoEHLG) Housing Statistics Bulletin.

Note: the rest of the Greater Dublin Area consists of counties Kildare, Meath and Wicklow.

Table 3

Zoned and Serviced Land - No. of Potential Housing Units

	Dublin	Rest of Greater Dublin	Cork	Galway	Limerick	Waterford	Ireland
Jan 1998	38907	-	-	-	-	-	-
Dec 1999	41461	27740	37332	15376	20907	4760	-
June 2000	67017	28742	36669	16391	18664	4436	-
June 2001	91390	30072	-	16706	14104	7300	-
June 2002	96700	26661	37358	15996	19420	15083	327784
June 2003	118187	20910	35128	13962	13962	6558	368705
June 2004	112193	22435	32471	27710	10245	6684	366724
2004 House Completions	16810	9105	8276	4941	3106	2371	76954

Source: Bacon et. al. (1998), Bacon and McCabe(2000) and DoEHLG Housing Statistics Bulletin

Notes: (a) The Rest of the Greater Dublin area consists of Kildare, Meath and Wicklow. (b) Zoned and serviced land consists of zoned land of ½ hectare or more in size that "has the necessary water, sewerage, transport and other services required to bring the land into development and sufficient for planning permission to be granted and construction to commence" (DoEHLG Housing Statistics Bulletin).

Table 4

Appeals to An Bord Pleanala (National Planning Appeals Board)

Year	Planning Authority Decisions and Appeals			No. of An Bord Pleanala Decisions	Decision of Planning Authority		
	No. of Planning Decisions	No. of Appeals	Appeal Rate		Reversed	Varied	Confirmed
1996	46015	3319	7.2%	2540	23%	38%	41%
1997	50427	3845	7.6%	2902	23%	34%	42%
1998	58634	4533	7.7%	3154	22%	37%	41%
1999	69869	4706	6.7%	3697	25%	33%	42%
2000	77320	5306	6.9%	3801	27%	31%	42%
2001	71890	5219	7.3%	3829	29%	30%	40%
2002	60378	4324	7.2%	4276	33%	34%	34%
2003	64456	4643	7.2%	4716	30%	36%	34%
2004	74192	5132	6.9%	5145	na	na	na

Source: DoEHLG Planning Statistics 2002.

Table 5

Performance of An Bord Pleanala (National Planning Appeals Board)

Year	No. of Cases Disposed of	Average No. of Weeks Taken to Dispose of Cases	Cases Determined Within 18 Week / 4 Month Period	Outstanding Cases at Year End
1996	3237	15	93%	1085
1997	3563	16	85%	1387
1998	4057	18	63%	1878
1999	4623	21	47%	1945
2000	4833	21	47%	2431
2001	5105	25	29%	2753
2002	5892	23	36%	1425
2003	4815	16	74%	1353

Source: Annual Report of An Bord Pleanala 2003

Note: The An Bord Pleanala and DoEHLG Planning Statistics are not directly comparable.

Table 6

New and Second Hand House Prices in Euros

Year	Dublin		Ireland	
	New	Second Hand	New	Second Hand
1996	97058 +12.0%	104431 +17.4%	87202 +11.0%	85629 +15.2%
1997	122036 +25.7%	131258 +25.7%	102222 +17.2%	102712 +20.0%
1998	160699 +31.7%	176420 +34.4%	125302 +22.6%	134529 +31.0%
1999	193526 +20.4%	210610 +19.4%	148521 +18.5%	163316 +21.4%
2000	221724 +14.6%	247039 +17.3%	169191 +13.9%	190550 +16.7%
2001	243095 +9.6%	267939 +8.5%	182863 +8.1%	206117 +8.2%
2002	256109 +6.6%	297424 +11.0%	198087 +8.3%	227799 +10.5%
2003	291646 +13.9%	355451 +19.5%	224567 +13.4%	264898 +16.2%
2004	322628 +10.6%	389791 +9.7%	249191 +11.0%	294667 +11.2%
Ave Inflation 1996-2004				
Nominal House Prices	16.2%	17.9%	14.0%	16.7%
Real House Prices	13.2%	15.2%	10.7%	13.0%
Real Per Capita PDI			7.7%	
Real Per Household PDI			7.2%	

Source: DoEHLG Housing Statistic Bulletins and CSO

Note: The house price data are not mix-adjusted. PDI is personal disposable income.

Table 7

A Model of Second Hand House Prices

Inverted Demand Equation

Dependent Variable = $\Delta \ln (HP_S / PC)$ = Change in Log Real Second Hand House Prices

OLS and IV Estimates, 1974 or 1980 to 2004 (31 or 25 Observations)

		OLS 1974-2004	**IV 1974-2004**	**OLS 1980-2004**
Constant		-2.159 (3.41)	-2.158 (3.40)	-1.983 (2.66)
Change in Current and Lagged Real Income	$\Delta \ln Y + \Delta \ln Y_{-1}$	0.955 (5.76)	0.991 (5.06)	0.914 (5.48)
Error Correction Term in Real Income Per House, User Cost and Demography	$1.75 * \ln Y_{-1} - 2* \ln HS_{-1}$ $- 0.3 * UC_{-1} - 1.2 * RBMR_{-1}$ $- 0.1 * POP2534 - HP_{s,-1}$	0.442 (3.37)	0.441 (3.37)	0.406 (2.63)
0/1 Step Dummies	1997 Onwards	0.044 (1.80)	0.041 (2.18)	0.047 (1.94)
	2003 Onwards	0.094 (2.38)	0.098 (2.39)	0.088 (2.39)
Equation Standard Error		0.043	0.043	0.038
Adjusted R Squared		0.726	0.726	0.781
Heteroscedasticity LM Test - P Value		0.99	-	0.16
ARCH(1) LM Test - P Value		0.25	-	0.93
AR(1)/MA(1) LM Test - P Value		0.26	-	0.46
Chow F Test (1990 Sample Split) - P Value		0.73	-	-
Normality Test - P Value		0.46	-	0.64
RESET Test - P Value		0.04	-	0.03

Notes: Absolute t values in parentheses. Y = PDI / (POP*PC) = real per capita personal disposable income (PDI), POP = population, PC = consumer price index, HS = housing stock, UC = user cost of housing (see footnote 18 in the text for details), RBMR = real building society mortgage rate. Sources: DoEHLG and CSO. The sum $\Delta \ln Y + \Delta \ln Y_{-1}$ is instrumented by $\Delta \ln Y_{-1}$ and the fitted value of $\Delta \ln Y$ from an OLS regression with $\Delta \ln Y_{-1}$, the growth in world trade (source: UN Monthly Bulletin of Statistics), the change in nominal interest rates and an outlier dummy for 1994 as explanatory variables. The standard error of this instrumenting equation is 0.028 and the adjusted R^2 is 0.38.

Table 8

National and Dublin New House Completions Equations

Dependent Variable = Change in Log National or Dublin House Completions (Δ ln HC)

OLS Estimates, 1974 to 2004 (31 Observations)

		National		Dublin	
Constant		-0.402 (1.52)	-0.819 (1.84)	-0.559 (0.27)	0.091 (0.11)
Lagged House Completions	$\Delta \ln(HC)_{-1}$	0.203 (0.83)	-	0.071 (0.31)	-
	$\ln(HC)_{-1}$	-0.237 (1.20)	-0.223 (1.94)	-0.318 (2.06)	-0.195 (1.64)
Real New House Price Inflation	$\Delta \ln(HP_N/PC)$	0.385 (0.49)	-	0.811 (0.75)	-
	$\Delta \ln(HP_N/PC)_{-1}$	-0.128 (0.21)	-	-0.634 (1.32)	-
Ratio of New House Prices to Building Costs	$\ln(HP_N/BC)$	0.433 (0.53)	0.471 (2.88)	-0.276 (0.26)	0.246 (2.53)
	$\ln(HP_N/BC)_{-1}$	-0.004 (0.01)	-	0.784 (0.69)	-
Time Dummies / Forecast Errors + Underprediction - Overprediction	1998	-0.047 (0.36)	-	-0.092 (0.51)	-
	1999	-0.049 (0.31)	-	-0.007 (0.04)	-
	2000	-0.049 (0.31)	-	-0.234 (1.06)	-
	2001	-0.008 (0.05)	-	-0.241 (0.90)	-
	2002	0.030 (0.19)	-	0.049 (0.21)	-
	2003	0.065 (0.38)	-	-0.082 (0.34)	-
	2004	0.003 (0.02)	-	0.001 (0.00)	-
Equation Standard Error		0.11	0.08	0.13	0.12
Adjusted R Squared		0	0.25	0	0.13

Table 2 (Continued)

Heteroscedastcity LM Test - P Value	0.21	0.07	0.6	0.72
ARCH(1) LM Test - P Value	0.27	0.09	0.17	0.57
AR(1)/MA(1) LM Test - P Value	0.03	0.16	0.95	0.68
Chow F Test (1990 Sample Split)	0.97	0.02	0.97	0.36
Chow F Test (2001 Sample Split)	-	0.93	-	0.29
Normality Test - P Value	0.13	0.66	0.79	0.86
RESET Test - P Value	0.12	0.09	0.32	0.96

Notes: Absolute t values in parentheses. HC = house completions; PH_N = new house prices; BC = building costs; PC = consumer price index. Sources: DoEHLG and CSO.

Table 9

New House Completions Equations for Main Cities Outside Dublin and for the Rest of Ireland

Dependent Variable = Change in Log House Completions (Δ ln HC)

OLS Estimates, 1974 to 2004 (31 Observations)

		Cork	Galway	Limerick	Waterford	Rest of County
Constant		-1.029	-1.964	-1.186	-2.209	-1.811
		(1.74)	(2.32)	(1.18)	(2.39)	(3.13)
Lagged House Completions	$\ln(HC)_{-1}$	-0.381	-0.310	-0.244	-0.316	-0.415
		(2.89)	(2.52)	(1.67)	(2.21)	(3.03)
Ratio of New House Prices to Building Costs	$\ln(HP_N/BC)$	0.627	0.648	0.449	0.662	0.882
		(3.43)	(2.99)	(1.90)	(2.78)	(3.61)
Equation Standard Error		0.13	0.15	0.05	0.17	0.11
Adjusted R Squared		0.25	0.18	0.17	0.22	0.29
Chow Test (1997 Break) - P Value		0.97	0.65	0.69	0.6	0.96

Notes: See notes to Table 8. HP_N and HC vary by area. BC is a national building cost measure. The Rest of Ireland excludes Dublin, Cork, Galway, Limerick and Waterford.