Dublin Housing Prices: An Econometric Analysis

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Elish Kelly examines the Dublin housing sector at a most pertinent time. With a carefully selected range of variables she creates an interesting model from which she identifies some important policy responses.

Executive Summary

Since 1987, both new and second hand house prices have been increasing nationally. However, since 1994 there has been a sharp acceleration in house price inflation, particularly in Dublin, which has resulted in an increase in the premium of Dublin house prices over those prevailing in the country as a whole.[1] At present average new and second hand house prices in Dublin are approximately 28% -30% greater than their counterparts in the rest of the country.[2]

Three main features stand out with regards to house prices in Dublin:[3]

- Both new and second hand house prices are higher in Dublin and are increasing at a faster rate than for the country as a whole.
- In recent years, second hand house prices in Dublin have been increasing at a faster pace than new house prices.
- In Dublin, house prices have increased at a faster rate in locations nearer or within the city, in comparison to Dublin County.

So what has brought about this dramatic change in the housing market?

According to the *Bacon Report* (1998), the following economic fundamentals are underlying the strong demand for houses - rapid economic growth since 1992, accompanied by rising income levels, increasing employment and lower interest rates.[4] These are being reinforced by accelerating net immigration, and are interacting with a relatively limited supply response in the short run, which has inevitably led to a driving up of house prices.

[1] Bacon (1998)
[2] Fitzgerald (1999)
[3] Bacon (1998)
[4] Bacon (1998)

In this report I will try to identify the main forces operating in the housing market, particularly in Dublin, in order to determine what is causing house prices to increase so rapidly. My analysis will be of *New House Prices in the Dublin Region from 1980-1998*. I will have 19 (annual) observations.

I will begin my analysis by specifying my dependent variable and three independent variables. I will then estimate the model and evaluate the results of my regression. I shall then look at the forecasting power of my model. Before I conclude I will outline the policy relevance of my analysis.

Specification

Dependent Variable Y

For my Dependent Variable Y, variations in which I want to explain, I have chosen *New House Prices from 1980-1998*. Figures for 1999 will not be available until March of this year. I obtained my data from the *Annual Housing Statistics Bulletins*, which are published by the *Department of the Environment and Local Government*. In order to obtain real house prices, I adjusted my nominal figures using the *CPI Index*, with 1989 as the base year (1989 = 100). The approach used to calculate house prices is based entirely on lending agency activity; therefore there might be some downward bias in the figures as no information is gathered with respect to house prices for which no lending has been approved by the main institutions.

First Independent Variable X_1

The X–Variables can be seen as the factors that are causing house prices to rise. I have chosen house completions in Dublin as my first independent variable.[5] The level of house completions in Dublin has been declining. One would assume that with the level of house completions falling and demand rising that house prices would also rise. As a result of this, I am expecting an inverse correlation between house completions and the dependent variable, house prices.

Second Independent Variable X_2
I have chosen mortgage rates to represent the recent trend in interest rates as my second independent variable. I took the average value for each year from 1980-1998.

[5] Annual Housing Statistics Bulletins, (1980-1998)

When Ireland was preparing to participate in the first round of EMU, interest rates fell. This led to lower mortgage rates, which encouraged a rapid expansion of mortgage credit. Interest rates continued to decline until the end of the period being examined. Again, I would expect an inverse relationship between mortgage rates and house prices. As mortgage rates decline, house prices would be expected to rise.

Third Independent Variable X_3

The level of employment is my third and final explanatory variable, which has been chosen as a proxy for economic growth. Since 1992, Ireland has been experiencing rapid economic growth and this has been accompanied by a rise in the employment level. My data is for the country as a whole, therefore I am assuming that with employment increasing nationally, it has also been increasing in Dublin. This may be reinforced by the fact that the majority of Ireland's economic activity is concentrated in Dublin, which would indicate that the majority of employment is also centred there for these reasons. I am expecting a high positive correlation between the employment level and house prices.

Omitted Variables

It is recognised from the outset that no econometric model can capture all the factors that are at work in a sophisticated market like housing. One of the main reasons for this is the limitation on the availability of statistical data, which constrains the scope of the econometric analysis. As a result of this I have had to omit the following independent variables - net immigration, investment demand, the level of residentially zoned land and the length of the planning process. However a stochastic term is included, which will capture the effects of the independent variables impacting on "Y" which are not explained by X_1, X_2 or X_3.

Line Of Best Fit

There are many econometric models available that can be used to estimate the population parameters from statistics. In this analysis I will use the *Ordinary Least Squares Model*, as it is a simple but effective way for calculating the population parameters. From the estimates I obtain I will construct a line of best fit based on the following multiple regression model:

$$Y_i = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + m$$

Where:
Y_i = Variation in observed explanatory variable.

b_o = Intercept Coefficient.
b_1, b_2 *and* b_3 = Explained Variation.
m = Unexplained Variable.

The OLS Model will yield a relationship between the variables by estimating the size and the sign of β_0, β_1, β_2 and β_3.

The Regression and Evaluation

Using the Econometrics computer package " *Microfit*", my line of best fit was as follows:

$$Y_i = -147155.3 - 3.6207X_1 + 1935.4X_2 + 168.3052X_3$$

Independent Variable	*Coefficient*	*T – statistic*	*Probability*
Constant M	–147155.3	–4.9576	[.000]
X_1	–3.6207	–1.1144	[.283]
X_2	1935.4	1.7750	[.096]
X_3	168.3052	7.6435	[.000]

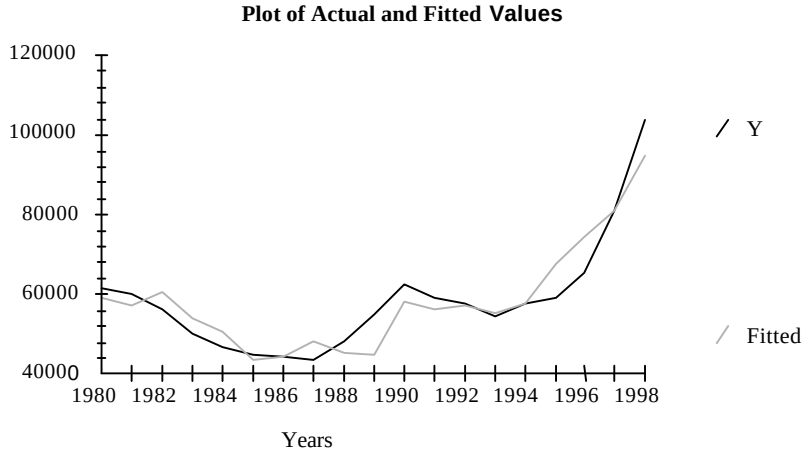
R^2 = .86989

Correlation Co-efficient

The Correlation Co-efficient, R^2, is a measure of the relationship between Y_i, X_1, X_2, and X_3. It takes on values of between 1, for a perfect fit, and 0, which indicates that there is no relationship between the dependent and independent variables.[6] In this analysis, I found the correlation between the variables to be quite high at 87% (R^2 = .86989).

An adjusted R^2, *R-bar-squared*, is a less biased measure than R^2 and in this analysis it was equal to 84% (R-bar-squared = .84386), again a very high figure. This high correlation can be seen quite clearly in the following graph:

[6] In this model there are three Explanatory Variables, so the coefficient of Multiple Determination is used.



X_1, X_2 and X_3

On seeing the high correlation of all the variables it would appear as if the model has very high explanatory powers. However, it is important to evaluate what the individual explanatory powers of X_1, X_2 and X_3 on Y are, in case multicollinearity was undermining the high R^2 value. I will return to the issue of multicollinearity in a moment.

Y Regressed on X_1

Independent Variable	*Coefficient*	*T-statistic*	*Probability*
Constant M	72850.1	4.5466	[.000]
X_1	–3.9127	–. 91750	[.372]

R^2 = .047181

Y Regressed on X_2

Independent Variable	*Coefficient*	*T-statistic*	*Probability*
Constant M	86452.5	7.3855	[.000]
X_2	–2399.5	–2.4668	[.025]

R^2 = .26359

Y Regressed on X_3

Independent Variable	*Coefficient*	*T-statistic*	*Probability*
Constant M	–100001.8	–5.9072	[.000]
X_3	135.8257	9.3899	[.000]

R^2 = .83836

These individual results indicate that my independent variable X_3, the level of employment, is having a more significant effect on my Y variable, house prices, than the other two independent variables, house completions and mortgage rates.

Possible Multicollinearity

Multicollinearity is always a possibility in multiple regressions. It refers to the existence of more than one exact linear relationship among some or all of the explanatory variables of a regression model.

The standard check for multicollinearity is to regress X_1 on X_2 and X_3, and X_2 on X_3. In this analysis multicollinearity is a possibility as the sign of my X_2 variable changed from the multiple to the single regression.

When I regressed X_1 on X_2, I found R^2 to be 0.63274. This is quite high for the two variables. My R^2 value for X_1 regressed on X_3 was 0.092794, which indicates a very low collinearity between these two variables. For X_2 regressed on X_3, R^2 turned out to be 0.45776, which again indicates a moderate degree of collinearity between X_2 and X_3.

From these results I can conclude that the high R^2 value from X_1 regressed on X_2, coupled with the changing sign, indicates significant multicollinearity between these two variables.

Although my OLS Estimators are still *BLUE*,[7] the existence of multicollinearity between X_1 and X_2 will result in these independent variables having very large variances and covariances, which makes precise estimation more difficult.

[7] Best Linear Unbiased Estimators.

Predictions Vs Results

My predictions for each of the three coefficients were as follows:

- An inverse relationship between house completions and house prices.
- An inverse relationship between mortgage rates and house prices.
- A large positive relationship between the employment level and house prices.

I will now evaluate how these predictions compare to the results. My line of best fit was as follows:

$$Y = -147155.2 - 3.6207X_1 + 1935.4X_2 + 168.3052X_3$$

My X_1 and X_3 variables did undoubtedly have their anticipated negative correlation and positive correlation with house prices.

However, my X_2 variable, mortgage rates, has a positive correlation in the multiple regression, which is telling us that as mortgage rates increase, house prices will increase. I was expecting an inverse relationship between mortgage rates and house prices, whereby a decrease in mortgage rates would lead to an increase in house prices. Hence this positive result contradicts economic theory.

In the simple regression analysis, mortgage rates have the negative value that I expected. One can, therefore, contribute this positive relationship between X_2 and Y to the problem of multicollinearity between the variables.

When I regress house prices on house completions and mortgage rates together, mortgage rates retain its inverse relationship with house prices. It is when I regress house prices on mortgage rates and the employment level together that the relationship changes from an inverse to a positive one. Multicollinearity exists between mortgage rates and the employment level, and is the explanation for the relationship between mortgage rates and house prices changing from an inverse to a positive one.

T-Statistic

The t-statistic measures the ratio of the parameter estimate to the standard error - *"an estimate of a parameter is statistically significant if the t-statistic associated with it causes us to reject, at a particular significance level, the Hypothesis test"*.[8]

[8] Kelliher (1995)

In the multiple regression case, neither X_1 or X_2 are statistically significant at the 5% or 10% significance level, therefore we cannot reject the null hypothesis that $\beta_1 = 0$ and $\beta_2 = 0$.

In the simple regression case, X_1 is again not statistically significant at the 5% or 10% level, but X_2 statistically significant at both of these levels.

In relation to X_3, it is statistically significant in both the multiple regression and the simple regression case, at the 5% and 10% levels and even at the 1% level.

The aforementioned multicollinearity is the main reason for X_1 and X_2 not being statistically significant. One of the main signals of multicollinearity is a high R^2 value, insignificant t-values and a significant F-value, which I will look at next.

F-Statistic

The F-test is a measure of the overall significance of the estimated regression model. It indicates whether all the variables in the equation together are significant. It is also a test of the significance of R^2.

The F-statistic for the multiple regression was 33.4276, with zero probability. Therefore it is statistically significant at the 10%, 5% and even the 1% significance level.

This result indicates that house completions, mortgage rates and the employment level as explanatory variables for house prices are together statistically significant. Therefore we can reject any hypothesis that this model has no explanatory power, i.e. that $\beta_1 = 0$, $\beta_2 = 0$ and $\beta_3 = 0$.

Durbin – Watson

The Durbin-Watson tests for serial correlation. It measures whether each observation is statistically dependent on the previous term.
In this model, the Durbin-Watson figure is 1.0617. As I have 19 observations and 3 variables, the critical values for the model are:

$$dl = 0.967 \text{ and } du = 1.6685$$

If my D-W statistic were greater than 1.685 then there would be no evidence of serial correlation. If it were below the lower critical figure of 0.967, then there would be definite serial correlation of the disturbance terms. However since my result lies between the lower and upper limit, there is inconclusive evidence regarding the presence or absence of serial correlation. Although I would have preferred no serial correlation, this is not an unusual occurrence in time series data.

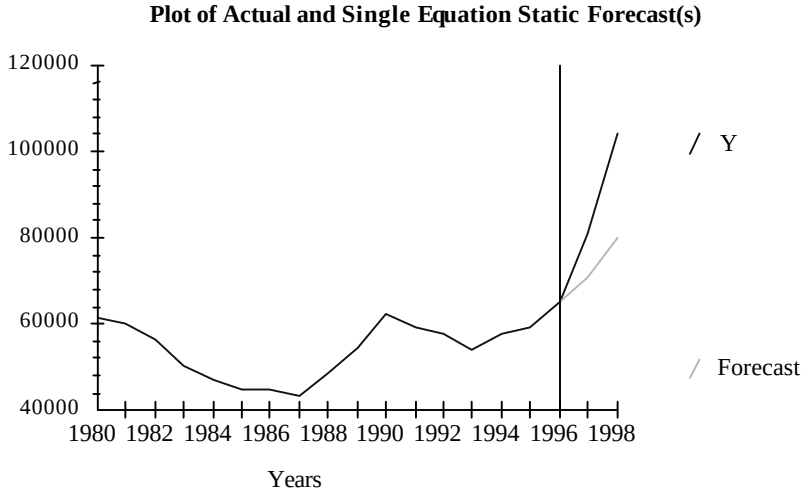
Forecasting Power of the Model

A desirable quality of any econometrics model is good forecasting capabilities. To determine my model's ability to do this I ran the regression from 1980 to 1996 and got it to predict the figures for the two omitted years. *Microfit* gave the following predictions:

Observation	*Actual*	*Prediction*	*Error*
1997	80901.0	70552.7	10348.3
1998	103994.0	79869.6	24124.4

Unfortunately, as can be seen from the table, the values my model forecast for 1997 and 1998 were considerably off the actual values. However, when one takes a closer look at this time period, 1996 was a turning point for Ireland as it begun to experience net immigration for the first time since the 1970's. This has magnified the demand for housing in Ireland, especially in the Dublin region, as it the core region for economic activity. In addition to this, almost half of the immigrants coming back into Ireland are concentrated in the household formation age category of 25-44 years.[9] This, I believe, is the reason for the sizeable difference between what my model projected and the actual results.

[9] Sherry Fitzgerald (2000)



Conclusion

On the basis of the analysis above, conclusions have been reached and also possible policy responses identified.

Policy Responses

- Monetary policy is no longer a tool that the government has control over. They are therefore unable to raise interest rates, which would lead to higher mortgage rates, to dampen the demand for houses.
- The government has the power to develop and implement policies that will spread economic activity more evenly around the country, which is required in order to solve the imbalance between demand and supply in the housing market, as population and employment will also be more evenly distributed and not all concentrated in Dublin. This policy response should help elevate the demand for housing in Dublin and hence slow down house price inflation.
- On the supply side of the market, the government has the ability to increase housing supply by allowing an increase in housing density. Greater densities

need to be accompanied by adequate social and public infrastructure; otherwise other social problems will arise.

- The length of the planning applications and appeals process is slowing down house completions. An Bord Pleanála needs to be given power by the government to recruit additional staff. This would help reduce the backlog of appeals and hence speed up the supply of housing by allowing the constructors undertake new housing developments.

In this report I have endeavoured to identify the main forces that are driving up house prices in the Dublin housing market. In doing this I evaluated how the level of house completions, mortgage rates and the employment level are impacting on house prices. I can conclude by firmly stating that there is a definite correlation between the explanatory variables and the dependent variable – approximately 95%.

Whilst house completions and the employment level did have their anticipated correlations with house prices, mortgage rates did not, as it had a positive correlation with house prices instead of an inverse one. On further investigation I discovered that the reason for this was due to multicollinearity between mortgage rates and the employment level, as mortgage rates did have its anticipated inverse relationship with house prices in the simple regression. Unfortunately, multicollinearity is always a possibility in multiple regression, especially when the sample size is not very large.

In spite of this, I still believe that my model has sound explanatory variables, as they have helped explain why house prices have risen so rapidly in the last few years. This is indicated by the T-test and F-test in the regression and by the policy responses the government is beginning to implement.

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