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The growth of house prices in Australian capital cities: What can economic fundamentals explain?*

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Abstract

The paper examines the role of economic activity, population growth, mortgage rates and inflation as key drivers of the real growth rates of house prices in Australian capital cities over the past 15 years. The empirical evidence suggests that these economic variables do explain a sizeable percentage of house price growth rates. In particular the level of mortgage interest rates is found to be an important influence in all eight cities. The effects of the other economic variables are less consistent across the capital cities; however one interesting finding is evidence of a positive spillover effect from the Sydney housing market onto house prices in a number of other capital cities (Abelson, 1994 and Bewley, Dvornak and Livera, 2004).

JEL Classification: C5; C22; C23; G12; R31

Keywords: Australian house prices, interest rates, autoregressive distributed lag, mean group estimator

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1. Introduction

The recent behaviour of property prices in Australia has been the subject of considerable interest and debate. At least part of this interest has been motivated by the rapid growth in house and apartment prices in cities such as Sydney and Brisbane from 1996-2003. This has led some commentators to ask whether parts of the Australian housing market have been affected by speculative bubbles[1]. While the issue of speculative bubbles is an important one, it is also the case that there are considerable econometric difficulties with testing for the presence of bubbles (Flood and Hodrick, 1990). Consequently this paper focuses on examining the degree to which the behaviour of Australian house prices can be explained by economic fundamentals. If economic factors can provide a good explanation for house prices this would tend to limit the likely role of speculative bubbles as an important feature of Australian property markets.

There is a small but growing literature on modelling the time series behaviour of house prices in Australia (Abelson, 1994; Bourassa and Hendershott, 1995; Bewley, Dvornak and Livera, 2004; Bodman and Crosby, 2004; Abelson, Joyeux, Milunovich and Chung, 2005 and Oster, 2005). In general these studies have somewhat varied focuses and employ different methods for modelling house prices. The recent papers by Abelson, Joyeux, Milunovich and Chung (2005) and Oster (2005) develop models for the aggregate level of house prices in Australia. The apparent presence of stochastic trends in the time series data leads these authors to use cointegation techniques and to estimate error correction models. In contrast Abelson (1994), Bourassa and Hendershott (1995) Bewley, Dvornak and Livera (2004) and Bodman and Crosby (2004) model dis-aggregated data on house prices for the state and territory capital cities. Furthermore these authors typically model the growth rate (rather than the level) of house prices, thus avoiding some of the problems associated with non-stationary data. This paper follows the approach of these latter three studies and seeks to model the growth rates of house prices in Australia's capital cities.

Time series data on Australian property prices are available from two sources, the Australian Bureau of Statistics (ABS) and the Real Estate Institute of Australia (REIA).

[1] According to the Economist (2003), "Australia's housing market could be as much a victim of irrational exuberance as America's stock-market has been."

Both institutions publish quarterly data on established house prices in the capital cities of the six states and two territories; the REIA reports a median house price and the ABS reports a house price index[2]. Qualitatively both series tend to show a similar pattern for the growth rates of house prices and in this paper the analysis is based on the ABS data[3]. Because the ABS data are provided as an index they do not indicate anything about the differences in the absolute levels of house prices across Australian cities. Nevertheless the indices do provide information about the relative growth rates of house prices and it is the growth rate of house prices that is the dependent variable for this study.

Ideally it would be desirable to have a model for the level of house prices and not just their growth rate. However given the non-stationary nature of house prices, in practice this would require the identification of cointegrating relationships for all eight cities. This is likely to be a relatively difficult task and for that reason this paper works with growth rates[4].

In principle the time series data for the eight capitals can be used to form a panel data set for Australian house prices[5]. However the nature of the panel is somewhat unusual in that it consists of large T (73 time series observations) and small N (8 cross-section units). Pesaran and Smith (1995) develop a model for large T and large N data sets which they call a dynamic heterogeneous panel. Despite the modest size of N in this case, Pesaran and Smith's framework appears to be more appropriate than traditional dynamic panel models. The essence of Pesaran and Smith's approach involves estimating individual time series models for each of the eight cities and then using a mean group estimator, *i.e.* averaging across the coefficients across the eight groups, to estimate the mean effects.

This remainder of this paper has the following structure. Section 2 contains a discussion of the methodologies of previous Australian studies. In Section 3 the econometric model for house price growth used in this paper is described. Section 4 contains a description

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[2] For most cities the REIA data begin in 1980 whereas the ABS data only begin in 1986.

[3] Abelson and Chung (2005) discuss the relative merits of various measures of Australian house prices. They note that the ABS series attempts to be a constant quality index by holding house size and location constant over time.

[4] While Abelson, Joyeux, Milunovich and Chung (2005) and Oster (2005) work with the level of house prices, their task is made somewhat easier by using aggregate Australian data.

[5] Bourassa and Hendershott (1995) treat their data as a pooled time series cross-section rather than a true panel, thus ignoring any issues of state-specific effects.

and preliminary analysis of the data. Section 5 presents the main empirical findings and Section 6 concludes.

2. Previous Australian Studies

In order to motivate the empirical model for house prices that is developed in this paper it is useful to briefly discuss the models that have been used in previous empirical studies.

Bourassa and Hendershott (1995) and Bodman and Crosby (2004) use a similar model for house prices, a key element of which is to allow for the possibility of speculative bubbles in the Australian data[6]. A stylized version of their model is given by,

$$hpg_t^* = \mu + \beta x_t \tag{1}$$

where *hpg** is the growth rate of equilibrium house prices and *x* is the economic fundamental. The actual growth rate of house prices is given by

$$hpg_t = hgp_t^* + \theta_t \tag{2}$$

where the term θ is given by

$$\theta_t = \alpha hgp_{t-1} + \gamma(P_{t-1}^* / P_{t-1} - 1) + v_t \ . \tag{3}$$

The inclusion of the lagged growth rate of house prices allows for persistence of dynamics in the growth rates, while the second term is the lagged difference between the equilibrium and actual house price *levels.* This second term acts like an error correction mechanism so that if the actual level of house prices exceeds the equilibrium level this will act to dampen the actual growth rate of house prices (and vise versa). Bodman and Crosby refer to this term as a "bubble buster." Combining the three equations gives

$$hpg_t = \mu + \beta x + \alpha hgp_{t-1} + \gamma(P_{t-1}^* / P_{t-1} - 1) + v_t \ . \tag{4}$$

In practice the difficulty with estimating (4) is that the variable measuring equilibrium house prices levels P_{t-1}^* cannot be constructed without estimates of the population parameters μ and β from (1). However conditional on these estimates, P_{t-1}^* can be calculated by the recursive formula

$$P_{t-1}^* = P_{t-2}^*(1 + hpg_{t-1}) \tag{5}$$

[6] Bourassa and Hendershott acknowledge that their bubble term may also act as a proxy for omitted fundamentals.

and some initial starting value for P^*. The strategy used by both Bourassa and Hendershott and Bodman and Crosby is to initially estimate (4) without the disequilibrium term to obtain estimates of μ and β. These are then used in equation (5) to compute an initial series for P*. This can now be included in (4) and a new set of estimates of μ and β obtained. The authors then iterate between equations (4) and (5) until their estimates stabilize.

In their empirical analysis Bourassa and Hendershott use annual data for the period 1979-93 (T=14) on the growth rate of real house prices in the five state capital cities plus Canberra (N=6). The authors pool the data for the six cities and estimate the resulting model by ordinary least squares. No further attempt is made to exploit the panel nature of their data. The explanatory variables that are hypothesised to drive the growth of house prices are: real wage growth; growth in employment; growth in real construction costs; the after-tax real interest rate and population growth due to immigration.

In implementing the above model Bodman and Crosby use quarterly data and estimate individual models for each of the five state capital cities. Like Bourassa and Hendershott they allow for the real interest rate and real constructions costs as potential explanatory variables. However Bodman and Crosby also include the following additional variables: real rents; real Australian GDP per capita and a demographic variable (either population growth at the state level or fraction of the population aged 60-64).

Bewley, Dvornak and Livera (2004) also seek to model the quarterly growth rate of real house prices in the state and territory capital cities. However these authors estimate a non-structural VAR model for house prices. In effect their model is used to examine whether lagged growth rates of house prices in some cities can help forecast (Granger-cause) future growth rates in other cities. The authors present some evidence that changes in house prices in Sydney help to predict changes in other Australian cities.

In contrast to the above papers, the studies by Abelson, Joyeux, Milunovich and Chung (2005) and Oster (2005) develop models for the level of house prices as well as the growth rate. Both studies employ a cointegrating-error correction framework. A stylised version of Abelson, Joyeux, Milunovich and Chung's model is given by a double-log long run model for house prices

$$\log P_t = \delta_0 + \delta_1 \log x_t + u_t \tag{6}$$

and an asymmetric ECM for the growth rate of house prices,

$$\Delta \log P_t = \theta_0 + \alpha_1 I_{t-1}[\log P_{t-1} - \delta_1 \log x_{t-1}] + \alpha_2 (1 - I_{t-1})[\log P_{t-1} - \delta_1 \log x_{t-1}] + e_t \qquad (7)$$

where

$I_t = 1$ if $\log P_t - \log P_{t-4} > 0.02$

$I_t = 0$ otherwise.

The indicator function I_t signals whether or not the housing market is in a boom, which is determined by real price growth in the previous year exceeding 2 percent. The idea is to allow different speeds of adjustment to equilibrium in boom periods and non-boom periods.

Abelson *et. al.* estimate their model using aggregate quarterly data for the period 1970:1 to 2003:1. In their equilibrium model, given by equation (6), seven explanatory variables are allowed to affect the log-level of real house prices. These variables are the following – the real mortgage interest rate; the real value of share prices; real per-capita household disposable income; the exchange rate; the unemployment rate, the consumer price index and the per-capita stock of housing.

Oster (2005) also uses a double-log model for the long run level of Australian house prices, but estimates a standard symmetric form of the error correction model. One important difference with Oster's study is that he uses the nominal rather than the real level of house prices as the dependent variable. His model is estimated on aggregate quarterly data from 1983:1 to 2005:1. For the long run model the explanatory variables are - the Australian population; nominal household disposable income; and the real 90 day bank bill rate. However the error correction model includes some additional exogenous variables *viz,* unemployment, share prices and housing starts.

The above studies suggest a relatively large number of potential explanatory variables for house prices in Australian cities. However most of the variables can be motivated by the role they play in influencing the demand and supply curves for housing. In fact Abelson *et. al*. explicitly motivate their model in terms of a simple disequilibrium supply and demand model for houses. Their long run model for house prices includes a number of exogenous variables that influence demand for houses (eg. income and interest rates)

as well as the quantity of housing stock. In effect their model is an inverse demand curve for housing.

One difficulty with estimating a demand curve, even a long run demand curve, is that it opens up questions of identification. Such problems can be avoided by explicitly working with a reduced-form model for house prices. Since it does not seem unreasonable to treat many of the economic variables that are thought to affect house prices as exogenous, estimating a reduced-form model seems a reasonable strategy. Furthermore estimation of a reduced-form model yields direct estimates of the short and long run effects of the exogenous variables on the growth of house prices.

3. An Econometric Model for the Growth Rate of House Prices

The empirical model developed in this paper is for the growth rate of house prices in the Australian state and territory capital cities. Unlike Abelson *et. al.* and Oster no attempt is made to develop a model for the level of house prices. One benefit of this approach is that the growth rate of house prices is likely to be a better behaved time series than the price level, in particular since growth rates are more likely to be stationary than price levels. Bodman and Crosby and Abelson *et. al.* both present evidence that house prices (or log house prices) are I(1) in levels, but that growth rates are I(0).

In the absence of any tight theoretical framework, judgement is required about a number of aspects of any empirical model. To model the real growth rate of house prices (*hpg)* I use the following autoregressive distributed lag (ADL) model,

$$hpg_t = \mu + \sum_{i=1}^{m} \alpha_i hpg_{t-i} + \sum_{i=0}^{m} \beta' \mathbf{z}_{t-i} + u_t \tag{8}$$

where $\mathbf{z}_t$ is a vector of explanatory variables. While there are a large number of potential explanatory variables that could be included in the model, this study focuses on four commonly acknowledged influences on house prices - the effects of the business cycle or economic activity, the rate of population growth, the level of mortgage interest rates and the effects of inflation. Equation (8) represents a relatively general dynamic model for house prices growth rates and is estimated for each of the state and territory capital cites.

Given the form of our data it might seem natural to pool the times series observations for the eight cities and use a panel estimator, (Bourassa and Hendershott, 1995). However it is worth considering whether or not this is a sensible strategy. The form of

our panel data is somewhat unusual relative to the structure that is typically assumed in the derivation of panel estimators. Our situation is characterised by small number of cross-section units (N=8) and a relatively large number of time series observations for each individual unit (T=74).

Pesaran and Smith (1995) develop a panel data model for large N and large T panels which they call a dynamic heterogeneous panel. It has the following form;

$$y_{it} = \lambda_i y_{i,t-1} + \beta_i' \mathbf{x}_{it} + \varepsilon_{it} \quad i = 1..N, \qquad t = 1..T \tag{9}$$

where $\lambda_i = \lambda + \eta_{1i}$ and $\beta_i = \beta + \eta_{2i}$. It is assumed that η_{1i} and η_{2i} have zero means and constant covariances. The basic idea here is that the coefficients are allowed to differ across each of the N cross sections. Pesaran and Smith's model differs from the more standard dynamic panel data model which has the following form;

$$y_{it} = \lambda y_{i,t-1} + \beta' \mathbf{x}_{it} + \omega_i + \varepsilon_{it} \quad i = 1..N, \; t = 1..T \tag{10}$$

In (10) the slope coefficients are assumed to be the same across the N cross-sections and any heterogeneity is incorporated via a fixed effect ω_i. This model is typically used in situations where T is relatively small and it is infeasible to estimate separate time series regressions.

If (9) is the data generating process, Pesaran and Smith show that standard estimators for (10) will be inconsistent. Re-writing (9) we obtain

$$y_{it} = \lambda y_{i,t-1} + \beta' \mathbf{x}_{it} + \omega_i + \nu_{it} \tag{11}$$

where $\nu_{it} = \varepsilon_{it} + \eta_{1i} y_{i,t-1} + \eta_{2i}' \mathbf{x}_{\mathrm{it}}$. Now in general $y_{i,t-1}$ and $\mathbf{x}_{it}$ will be correlated with ν_{it} so that standard pooled estimators will be inconsistent. This is true even for instrumental variables estimation as any potential instruments will almost certainly be correlated with ν_{it}.

Pesaran and Smith show that consistent estimates of the average short and long-run effects in equation (9) can be obtained by estimating separate regressions for each group and then averaging the coefficients over the groups. They call this a mean group estimator. While such an estimator is likely to work best for large N and well as large T, it is probably the best strategy available given the data. Thus in addition to reporting

long-run coefficient estimates for each city, I also report un-weighted averages across the eight cities.

4. Data

To measure the growth rate of house prices (*hpg*) for each of the eight capital cities I use the quarterly price indexes for established houses constructed by the Australian Bureau of Statistics. The full data sample available is 1986:2-2004:3. These indices measure house prices in nominal terms, so to remove the effect of inflation; the house price index for each city is divided by the city-specific consumer price index. The quarterly growth rate is calculated as the first-difference of the logarithm of this ratio multiplied by 100. Figures 1 to 8 plot the quarterly real growth rate of house prices for each city. For the purpose of comparison, the real growth rate for Sydney house prices is also shown on the graphs for the other seven cities.

A couple of features are evident from the figures. For Sydney, Melbourne and Perth the real growth rates of house prices that occurred in the late 1980s boom are considerably larger than any growth rates over the rest of the sample period. Also during the more recent period of rapid growth in house prices it is in Brisbane where the highest growth rates have occurred.

Table 1 reports the mean quarterly growth rates, standard deviations, first-order serial correlation coefficients (AR(1)) and contemporaneous correlations for the eight series. Sydney and Brisbane have experienced the highest average growth rates in real house prices over the sample period. Hobart has experienced the lowest. In terms of volatility, Melbourne has the highest and Hobart is the lowest. Growth rates of house prices are positively correlated across all eight cities, with those of Darwin the least correlated with the other capitals. All of the of the point estimates for the AR(1) coefficients are positive, with the largest (and statistically significant) coefficients for Sydney, Brisbane, Perth and Canberra.

The explanatory variables included in equation (9) are as follows. It is anticipated that the growth rate of house prices will be positively related to real income growth within a capital city. Unfortunately quarterly measures of real income are not available for the capital cities or even at the state or territory level. Therefore as potential proxies for real income growth I use the state or territory unemployment rate (*un*) and the growth rate of

state final demand (*sfdg*). Population growth (*popg*) is widely viewed to be an important driver of house prices, with high population growth rates leading to increases in house prices. Population growth rates for the capital cities are proxied by population growth rates in the relevant state or territory. Mortgage interest rates (*nrate*) are likely to influence the demand for housing and consequently the growth rate of house prices. Whether nominal or real interest rates are most important is an open question. This is one reason to include the rate of inflation (*inf*) as an additional explanatory variable. However Abelson *et. al.* also argue that inflation may have additional effects on house prices due to the tax system. Finally I also include a dummy variable for the September quarter 2000 to allow for any effects from the introduction of the goods and services tax (GST).

The definitions and summary statistics for the explanatory variables used in this study are contained in the Data Appendix.

5. Empirical Results

In order to gain some insights into what are the most important influences on the growth rate of house prices a general version of the ADL model (equation (8)) is estimated for each of the eight cities. A summary of the main results from this exercise are reported in Table 2.

To estimate equation (8) it is necessary to choose a value for m - the number of lags to include in the model. For each of the cities m is chosen to ensure that the error term in (8) is free of serial correlation up to order five, (Breusch, 1978; Godfrey, 1978). In the case of Sydney meeting this condition requires m=4, whereas for Melbourne m=2 is sufficient. The results from two other standard diagnostic tests are also reported in Table 2. Because the dependent variable is a component of the real return to housing it is likely to exhibit conditional heteroskedasticity. The results from a formal test for homoskedasticity are therefore reported in Table 2 (Breusch and Pagan, 1979; Koenker, 1981). In addition t- and F-statistics are computed using heteroskedasticity consistent variance-covariance matrices (White, 1980). Finally the RESET test is used as a general check for functional form misspecification (Ramsey, 1969).

To account for the possibility of seasonality in the growth rate of house prices, three seasonal dummies are included in the models for those cities where they were found to be

jointly significant. Finally although equation (8) includes the contemporaneous values of each regressor, in practice I do not include the contemporaneous value for inflation (*inf*). This is done to avoid potentially spurious correlations associated with the fact that the city-specific CPI is used to construct the dependent variable and to compute *inf*.

5.1 A General Model

Given the relatively large number of estimated coefficients the full set of estimates are not reported in Table 2. Instead for most regressors Table 2 reports the sum of coefficient estimates on the current and lagged values for each variable and the associated t-statistics and also the p-value associated with an F-test for the joint significance of each variable and its lags. The exceptions are for the constant term, the GST dummy and the three seasonal dummies.

The first thing to note from Table 2 is that for the majority of the capital cities the set of regressors can explain around 50 percent of the variation in growth rate of house prices. This would appear to be a quite a good fit for a variable which is essentially an asset return. Certainly it is not evident that one could obtain a similarly high level of explanatory power for a model of the growth rate of stock prices. The two cites for which the model has least explanatory power are Adelaide ($\overline{R}^2 = 0.28$) and Darwin ($\overline{R}^2 = 0.09$). It appears that the economic variables included in the model have very little ability to explain the behavior of the growth rate of house prices in Darwin.

The variable that has the most consistent effect on the growth rate of house prices across the capital cities is the nominal mortgage rate (*nrate*). Current and lagged values of *nrate* are jointly significant for all cities (except Darwin) and the sums of the coefficient estimates are negative for all cities and statistically significant in all models (except Darwin).

Inflation has a significant and positive effect on house price growth rates in four cities, Sydney, Brisbane, Perth and Canberra. In the other four capitals the effect of inflation is statistically insignificant. Population growth has a significant effect on the growth rate of house prices in all cities except Adelaide and Canberra. As might be expected the sum of the coefficients on current and lagged population growth are generally positive, with the two exceptions being Sydney and Darwin. In the case of Sydney the sum of the

coefficients is not statistically significant; suggesting that it is changes in population growth rates which are important. The results for Darwin are simply perverse.

The two variables that are used to capture the general state of economic activity are the unemployment rate (*un*) and the growth of state final demand (*sfdg*). The only cases where *sfdg* is significant is Sydney, where it has an expected positive effect on house prices and possibly Melbourne, where it is jointly significant at about the 7 percent level, but the sign of the total effect is negative. In the case of the unemployment rate the results are mixed. For Sydney there is no effect from unemployment on the growth rate of house prices. For Brisbane, Adelaide and Canberra the sum of the coefficients on *un* has the anticipated negative effect. However for Melbourne, Perth, Hobart and (possibly) Darwin the sum of the coefficients on current and lagged *un* is positive.

The remaining two stochastic variables in the models are the own lagged values of *hpg* and for the cities other than Sydney, the lagged values of the growth rate of house prices in Sydney (*hpgs*). Lags of *hpgs* appear to have some explanatory power for house prices in all other capital cities. The sum of the effect is positive in all cases except for Darwin. *Ceteris paribus*, a rise in the growth rate of house prices in Sydney will eventually lead to a rise in the growth rate in the other Australian capitals, expect for Darwin. Finally of the eight cities, only in Melbourne, Adelaide and Perth do the growth rates of house prices not seem to exhibit any significant autoregressive components. Of the other cities, Sydney, Brisbane, Canberra and Darwin exhibit positive autocorrelation, while Hobart displays negative correlation.

The growth rates of house prices in four cities - Melbourne, Hobart, Canberra and Darwin – display some evidence of seasonality. It is interesting that these cities also display the greatest seasonal climatic changes. The introduction of the GST had a negative effect on the growth rate of house prices in all cities except Sydney.

Except for Darwin, the results reported in Table 2 from estimating the general ADL model for *hpg* suggest that a limited set of economic fundamentals can explain a sizeable amount of the variation in house price growth rates in the Australian capitals. However it is also apparent from Table 2 that not all of the economic variables are statistically significant for each of the cities. This suggests that a more efficient set of estimates may

be obtained by eliminating variables with relatively large p-values and moving a more restricted specification.

5.2 A Restricted Model

Table 3 contains the final restricted models for *hpg* in each of the eight capitals. In this case the full set of coefficient estimates are reported. Since the individual coefficients can be difficult to interpret, Table 4 contains the long-run marginal effects and their associated t-statistics for relevant economic variables. The results from the diagnostic tests are also reported in Table 4. Finally the p-value for an F-test on the joint acceptability of the restrictions imposed in going from the general to the specific model is also reported.

In the case of Sydney three changes are made to the general model. The unemployment rate is dropped from the model as are the contemporaneous value for *nrate*, lags 3 and 4 of *hpg* and lags 2, 3 and 4 of *sfdg*. The adjusted R-squared indicates that economic factors can account for about 70 percent of the variation in growth rate of Sydney house prices. The diagnostic tests indicate that model is free of serial correlation and heteroskedasticity and the RESET test does not indicate any evidence of mis-specification. The long run marginal effects in Table 4 indicate that there are three main influences on the growth rate of Sydney house prices – changes in the level of economic activity as measured by the growth rate of state final demand, the level of nominal mortgage rates and the rate of inflation. While population growth is found to have a significant effect on the Sydney growth rate, the effect appears to be temporary. An increase in the population growth rate increases the growth rate of house prices for two quarters, but this effect is then approximately unwound in the subsequent two quarters. No significant long-run effect on the house price growth rate is found.

For Melbourne lagged house price growth rates and inflation are dropped from the general model. For the remaining variables the following are omitted: contemporaneous values for *nrate* and *sfdg* and lag 2 for *hpgs*. Finally it appears to be the change rather than the actual level of unemployment that influences the growth rate for Melbourne house prices, so the contemporaneous value for Δun is included in the model. The estimated effect from a change in the unemployment rate is reasonably large – a 1 percent rise in the quarterly unemployment rate reduces the growth rate of house prices by 3.6

percent. The economic factors included in the restricted model can account for about 56 percent of the variation in the growth rate of house prices in Melbourne. The diagnostic tests do not indicate any obvious problems with the model. The key long run influences on the growth rate of Melbourne house prices are indicated in Table 4. One anomalous result is that the estimated long run marginal effect from *sfdg* is negative. While it is difficult to interpret this result I have left the variable in the model due to its statistical significance.[7] One implication of the negative coefficients on *sfdg* is that it suggests that it is probably not a good proxy for income growth in Melbourne. The other long run effects are for population growth, mortgage rates and Sydney house price growth rates and these have signs that are consistent with prior expectations.

In moving to the restricted model for Brisbane, *sfdg* is omitted along with the contemporaneous value for unemployment. The fourth lag is omitted for *nrate* and *inf* while lags 2 and 3 for *hpgs* are dropped. The amount of variation in the growth rate of Brisbane house prices explained by the model is similar to that for Melbourne. While the diagnostic tests for serial correlation and heteroskedasticity are clear for Brisbane, the RESET test continues to suggest some potential mis-specification. According to the the results in Table 4, the drivers of house price growth rates in Brisbane are unemployment, population growth, mortgage rates, inflation and Sydney house price growth. All of the estimated long run marginal effects have the anticipated signs.

The restricted model for Adelaide is obtained by omitting current and lagged values for *hpg*, *sfdg*, *popg* and *inf*. The remaining variables; unemployment, mortgage rates and Sydney house price growth explain about 28 percent of the variation of the growth rate of Adelaide house prices. This is the lowest amount for any of the state capitals. None of the diagnostic tests suggest any evidence of mis-specification.

In the case of Perth current and lagged values of *hpg* and *sfdg* are deleted from the model as is lag 3 on *inf*. As in the case of Melbourne it seems to be the change in the unemployment rate that is important rather than its actual level. The contemporaneous value for Δun is included in the model. The restricted model explains about 61 percent of the variation in the growth rate of house prices in Perth. All of the estimated long-run

[7] If *sfdg* is omitted from the model the other long-run coefficients do not change in any economically important manner.

marginal effects have the anticipated signs; however the estimated long-run effect from population growth is not statistically significant. The BPK test indicates some evidence of heteroskedasticity, while the RESET test also points to possible mis-specification.

Turning to Hobart, current and lagged values of *sfdg* and *inf* can be omitted from the model as can lag 3 of *nrate* and lags 2 and 3 of *hpgs*. The change in the unemployment rate is important rather than the level with $\Delta un(-1)$ entering the model. None of the diagnostic tests indicate any problems with the model for Hobart. The restricted model explains about 43 percent of the Hobart data. All of the long-run marginal effects have the expected signs.

For Canberra *sfdg* and *hpgs* are deleted from the general model along with lags 1 to 3 of *popg*. All of the diagnostic tests are clear for Canberra. The estimated model explains about 51 percent of the variation in the Canberra data. In Canberra the main long-run drivers of house price growth are unemployment, population growth, mortgage rates and (possibly) inflation. Interestingly there is no spillover effect from Sydney to the Canberra market.

Finally the results for Darwin are reported. While none of the diagnostic tests indicate any problems with the restricted model for Darwin, it simply cannot explain much of the variation in the growth rate of house prices in Darwin. The adjusted R-squared is only about 14 percent. Clearly this is much lower than for any of the other Australian cites considered. Aside from mortgage rates and lagged *hpg* the only significant economic influences for Darwin are changes in unemployment and changes in population growth. Thus the only long-run influence on house price growth rates in Darwin is the mortgage rate and even this is only significant at the 30 percent level.

The p-values reported in the last row of Table 4 indicate that for each of the models the set of restrictions imposed are not jointly rejected.

While the results for the restricted models appear to be reasonable for most of the capital cities it is interesting to examine the fit of the models by comparing the actual and fitted values for house price growth rates. Plots of these two series are reported in Figures 9 to 16. In general the estimated models track the actual series for house price growth rates quite closely. The main exception is not surprisingly Darwin. In the case of Adelaide which has the second lowest R-bar squared the model is not able to explain

some relatively large short-run swings in growth rates in the period 1990-1993. Where the estimated models do seem to be relatively successful is in capturing the more persistent movements in growth rates typically associated with the various booms and busts in Australian housing markets. In particular the sequence of positive growth rates associated with the rapid rise in house prices in most Australian capital cities in the period 2001 to 2003 are typically predicted by the respective models. The one major exception is for Brisbane, where the exceptionally high house price growth rates round 2002-03 are not captured.

5.3 Discussion of Results

A number of potentially interesting findings emerge from the empirical results. It is evident from Table 4 that the most consistently important influence on the growth rate of house prices in the Australian capital cities is the level of mortgage rates. In Australia mortgage rates are closely linked to the stance of monetary policy through the setting of the overnight cash rate by the Reserve Bank. The results in this paper suggest that the Reserve Bank can have a quantitatively important effect on house price growth rates via monetary policy. Interestingly by far the largest estimated long-run marginal effect is for Sydney.[8] Here the results suggest that a 50 basis point rise in the mortgage rate will lower the growth rate of Sydney house prices by about 2 percent per quarter. This is quite a large effect as can be seen from the fact that the average quarterly growth rate for Sydney is only 1.28 percent. The estimated effects for the other cities of a 50 basis point rise in the mortgage rate range from about 0.25 percent for Darwin to about 1 percent for Canberra, with the most common figure lying between a half and one percent. One possible explanation for the larger marginal effect from mortgage rates in Sydney compared to the other capital cites may be the higher level of house prices in Sydney and the associated need for higher mortgages.

The other variables included in the model are less consistently important across the eight cities. Population growth is most important for the Melbourne, Brisbane and Hobart housing markets, with Melbourne having the largest long-run marginal effect. An increase in the population growth rate of 0.25 percent is estimated to raise the growth rate

[8] Some caution is required in interpreting the estimates as part of the Sydney effect will spillover into other cities (excluding Canberra and Darwin).

of house prices in Melbourne by about 3 percent. The unemployment rate has some influence on the growth rate of house prices in all cities except for Sydney. For Melbourne, Perth and Darwin the effect is only temporary as it comes via changes in unemployment rate. However for Brisbane, Adelaide and Canberra it is the level of the unemployment rate that is important, with a 1 percent rise in the unemployment rate reducing house price growth rates by about 1 percent in Brisbane and Canberra and about 0.60 percent in Adelaide.

The effect of inflation on the growth rate of house prices varies between the cities. For Melbourne, Adelaide, Hobart and Darwin there is no significant long-run effect from inflation. This implies that any effect on inflation on the growth rate of house prices in these cities must come indirectly via the effect of inflation on mortgage rates[9]. For these cities rises in inflation will lower the growth rate of house prices. In Sydney, Brisbane, Perth and Canberra there appear to be separate effects on house price growth from inflation. For Perth and Canberra the long-run coefficients on mortgage rates and inflation are roughly of equal and opposite signs, implying that for these cities it is the level of real interest rates that influences the growth rate of house prices. In contrast for Sydney and Brisbane a rise in inflation has a net positive effect on house price growth rates. For Sydney the long-run effects for the mortgage rate and inflation are -4.1 and 8.4 respectively. Thus if we write *narte* as (*rrate* + *inf*), then the net effect for inflation is 4.3. For Brisbane the equivalent figure is only 1.0, substantially smaller but still positive.

Finally there is evidence of the spillover effects noted by Bewley, Dvornak and Livera (2004) from the Sydney housing market to a number of the other capitals. Canberra and Darwin are the only cities which do not appear to be affected by the Sydney market. Based on the long-run estimates in Table 4 the strongest spillover effects from Sydney are to the Brisbane and Perth housing markets. The explanation for the predictive role for the growth rate of Sydney house prices is not clear. While there could be a true causal relationship, where changes in the returns to housing in Sydney induce buyers into (and out of) other markets and thus influence returns in other markets, it is possible that the Sydney market simply acts as a signal for markets in other capital cities.

5.4 Aggregate Effects

[9] Since I am dealing with long-run effects in the following I assume that the Fisher effect holds ex-post.

Following Pesaran and Smith (1995) economy-wide estimates can be obtained by taking an unweighted average of the coefficient estimates from the individual time series models. Given the quite diverse set of dynamic structures for each of the cities I only report the mean group or panel estimates for the long-run marginal effects. These estimates are reported in final column of Table 4. The estimated average effects all have the expected sign. The estimates indicate that higher unemployment and nominal mortgage rates act to reduce the real growth rate of Australian house prices, while higher population growth and inflation have a positive effect on real house price growth rates. At the aggregate level the approximately equal and opposite signs on the nominal mortgage rate and the inflation rate indicate that it is changes in real interest rates that affect the real growth rate of Australian house prices. Furthermore the magnitude of the effect is not small – a 1 percent rise in the real mortgage rate is estimated to reduce the real growth rate of house prices in Australian capital cities by about 1.5 percent.

6. Conclusion

This paper provides evidence that the real growth rates of house prices in most Australian capital cities are reasonably well explained by a relatively small set of economic factors. In the case of Sydney, Melbourne, Brisbane, Perth and Canberra over 50 percent of the variation house price growth rates is explained. For Hobart and Adelaide the respective figures are about 40 and 30 percent. Only for Darwin does the particular set of economic factors appear to have little explanatory power.

Across all eight capital cities the one common influence on house price growth rates is found to be the level of mortgage rates. *Ceteris paribus* a rise in mortgage rates has a negative effect in house price growth in all cites, with the largest effect occurring in the Sydney market. Given the close relationship between mortgage rates and the cash rate this finding suggests that the monetary policy can have a quantitatively important effect on the real return to housing.

The effects from the other economic variables appear to be less systematic for all of the capitals. At present it does not seem possible to find a single model or common set of economic factors that can explain growth rates in all eight capitals. This may simply be a reflection of the heterogeneity in the various housing markets.

Finally one area in which further work would appear to be useful is in constructing better measures of some of the explanatory variables. In particular most other Australian studies find a role for real income in explaining house prices – whereas this paper does not identify an important role for state final demand. One obvious explanation for this finding is that state final demand is not a good proxy for real income growth in the various capitals. Future work may lead to better measures for state and ideally city-level income.

Table 1: Summary Statistics for Real House Price Growth Rates - 1986:3 to 2004:3

	Sydney	Melbourne	Brisbane	Adelaide	Perth	Hobart	Canberra	Darwin
Mean	1.28	0.92	1.20	0.52	0.90	0.34	0.74	0.56
Std	2.89	3.24	2.69	2.62	2.56	1.99	2.49	2.85
AR(1)	0.64	0.19	0.62	0.19	0.54	0.16	0.52	0.23
	(0.13)	(0.17)	(0.09)	(0.13)	(0.13)	(0.14)	(0.09)	(0.14)
Correlations:								
Sydney	1.00							
Melbourne	0.52	1.00						
Brisbane	0.50	0.30	1.00					
Adelaide	0.29	0.19	0.49	1.00				
Perth	0.66	0.55	0.54	0.30	1.00			
Hobart	0.26	0.23	0.47	0.43	0.34	1.00		
Canberra	0.54	0.37	0.72	0.45	0.48	0.40	1.00	
Darwin	0.04	0.06	0.32	0.27	0.16	0.31	0.18	1.00

Notes: Std is the standard deviation and AR(1) is the first-order auto-correlation coefficient. Numbers in (.) are heteroskedasticity robust standard errors (White, 1980).

Table 2: General Model for Growth Rate of House Prices in State and Territory Capital Cities: 1987:3 – 2004:3 - Dependent Variable *hpg*

	Sydney	Melbourne	Brisbane	Adelaide	Perth	Hobart	Canberra	Darwin
Lags m	4	2	3	2	3	3	3	3
constant	-0.2551 (-0.132)	-9.7143 (-1.827)	4.0610 (1.535)	9.3552 (2.874)	-4.4360 (-2.048)	2.2672 (1.420)	5.6219 (2.573)	1.4248 (1.096)
gstdum	0.0051 (0.008)	-11.5528 (-14.044)	-1.3637 (-1.646)	-5.7045 (-8.457)	-3.3636 (-4.128)	-0.1713 (-0.196)	-3.9833 (5.599)	-2.7116 (-2.614)
seasdum	-	0.0116	-	-	-	0.0112	0.0014	0.0236
$\sum_{i=1}^{m} hpg_{t-i}$	0.4234 (3.273)	0.0556 (0.350)	0.3990 (2.434)	-0.2849 (-1.016)	0.2172 (1.121)	-0.9256 (-2.947)	0.3299 (1.900)	0.4122 (2.168)
Joint Sig.	0.0047	0.8882	0.0002	0.2564	0.1667	0.0113	0.0568	0.1710
$\sum_{i=0}^{m} un_{t-i}$	0.1965 (0.862)	0.9733 (2.250)	-0.7678 (-2.010)	-0.6445 (-1.943)	0.6984 (2.511)	0.2391 (1.459)	-0.3574 (-1.120)	0.2265 (0.695)
Joint Sig.	0.7236	0.0002	0.2423	0.1094	0.0172	0.0056	0.0720	0.0094
$\sum_{i=0}^{m} sfdg_{t-i}$	1.4129 (1.9264)	-0.8849 (-1.860)	-0.1599 (0.510)	0.3239 (0.871)	-0.2091 (-1.036)	-0.2994 (-1.540)	0.3641 (1.937)	-0.0029 (-0.016)
Joint Sig.	0.0257	0.0666	0.2963	0.7711	0.0830	0.3058	0.4206	0.8232
$\sum_{i=0}^{m} popg_{t-i}$	-1.5528 (-0.384)	35.1402 (3.385)	6.6856 (2.440)	4.3375 (0.530)	7.3627 (2.049)	21.6225 (5.065)	2.5872 (1.061)	-3.1499 (-2.053)
Joint Sig.	0.0002	0.0000	0.0325	0.5030	0.0281	0.0000	0.1274	0.0179
$\sum_{i=0}^{m} nrate_{t-i}$	-2.7801 (-4.957)	-1.6065 (-3.000)	-0.8617 (-2.240)	-1.8685 (-2.348)	-2.3130 (-3.682)	-2.4109 (-4.706)	-1.6779 (-3.337)	-0.0615 (-0.115)
Joint Sig.	0.0000	0.0163	0.0530	0.0152	0.0000	0.0000	0.0000	0.2946
$\sum_{i=1}^{m} \inf_{t-i}$	5.4727 (5.859)	0.8356 (1.186)	1.4066 (2.919)	0.4532 (0.642)	1.8423 (3.709)	-0.3386 (-0.875)	1.7648 (2.210)	-0.9465 (-1.048)
Joint Sig.	0.0000	0.4430	0.0008	0.1428	0.0005	0.8494	0.0243	0.2944
$\sum_{i=1}^{m} hpgs_{t-i}$	-	0.3015 (2.587)	0.2167 (1.352)	0.4532 (1.636)	0.7297 (5.049)	0.3083 (3.188)	0.2187 (2.085)	-0.2345 (-1.491)
Joint Sig.	-	0.0116	0.0080	0.2042	0.0000	0.0023	0.1521	0.0164
R-barsq	0.6450	0.5393	0.5435	0.2819	0.5809	0.4542	0.4416	0.0908
SC(5) p-value	0.3505	0.4921	0.7483	0.6293	0.9057	0.8209	0.2086	0.2294
BPK p-value	0.5944	0.8131	0.0755	0.0071	0.0125	0.1686	0.6920	0.5626
RESET p-value	0.2683	0.0031	0.0003	0.1726	0.0005	0.9842	0.0604	0.0269

Notes: Heteroskedasticity robust t-statistics are reported in (.) (White, 1980). Sc(5) is a test for serial correlation up to order five (Breusch, 1978; Godfrey, 1978), BPK is a test for heteroskedasticity (Breusch and Pagan, 1979; Koenker, 1981) and RESET is a test for functional form misspecification (Ramsey, 1969).

Table 3: Restricted Model for Growth Rate of House Prices in State and Territory Capital Cities: 1987:3 – 2004:3 - Dependent Variable ***hpg***

	Sydney	Melbourne	Brisbane	Adelaide	Perth	Hobart	Canberra	Darwin
constant	1.1783 (1.018)	2.2397 (1.966)	3.2021 (1.645)	8.4890 (4.655)	-0.1433 (-0.184)	3.7786 (4.344)	7.1243 (3.593)	1.2925 (1.403)
gstdum	-0.5068 (-0.870)	-11.1575 (-11.741)	-1.6506 (-2.904)	-5.3695 (-10.659)	-3.5423 (-6.357)	-1.1121 (-1.299)	-3.9918 (-5.314)	-3.3775 (-3.960)
seasdum	-	0.0118	-	-	-	0.0580	0.0030	0.1165
hpg(-1)	0.1414 (1.282)	-	0.3379 (3.057)	-	-	-0.3710 (-2.452)	0.1658 (1.577)	0.0981 (0.864)
hpg(-2)	0.2898 (3.065)	-	-0.1504 (-1.045)	-	-	-0.1649 (-0.165)	0.0493 (0.589)	0.2015 (1.811)
hpg(-3)		-	0.1445 (1.225)	-	-	-0.2038 (-1.352)	0.1981 (2.745)	-
un	-	-	-	-0.2489 (-0.289)	-	-	-0.5467 (-1.808)	-
un(-1)	-	-	-0.1513 (-0.253)	0.4430 (0.594)	-	-	0.0734 (0.150)	-
un(-2)	-	-	-0.4907 (-0.904)	-0.8161 (-1.025)	-	-	0.5622 (1.374)	-
un(-3)	-	-	-	-	-	-	-0.7298 (-2.371)	-
Δun		-3.6266 (-4.927)	-	-	-0.0895 (-1.720)			-0.3516 (-1.405)
Δun(-1)	-	-	-	-	-	-0.5349 (-1.438)	-	-0.3710 (-1.357)
Δun(-2)	-	-	-	-	-	-	-	-0.4078 (-1.038)
sfdg	0.4219 (2.302)	-	-	-	-	-	-	-
sfdg(-1)	0.5554 (3.299)	-0.5525 (-2.732)	-	-	-	-	-	-
sfdg(-2)	-	-3.7833 (-2.031)	-	-	-	-	-	-
popg	9.4176 (3.571)	-13.9114 (-2.515)	4.7234 (1.863)	-	4.6427 (2.114)	3.3852 (1.183)	2.3964 (1.528)	-
popg(-1)	3.9100 (1.285)	17.7507 (3.351)	-3.4877 (-1.273)	-	3.0237 (1.367)	3.8500 (1.256)	-	-
popg(-2)	-7.4982 (-1.952)	9.5669 (1.778)	0.0757 (0.026)	-	-2.0573 (-0.906)	7.7500 (2.811)	-	-
popg(-3)	-7.7903 (-3.052)	-	4.6279 (1.884)	-	-3.1847 (-1.256)	2.3646 (0.836)	-	-
Δpopg	-	-	-	-	-	-	-	1.4952 (1.592)
Δpopg(-1)	-	-	-	-	-	-	-	1.9060 (1.564)
Δpopg(-2)	-	-	-	-	-	-	-	3.4658 (2.117)
nrate	-	-	-2.6399 (-1.068)	-7.458 (-2.435)	-0.9702 (-0.515)	-1.5337 (-0.702)	0.2085 (0.010)	-3.3888 (-0.886)

nrate (-1)	-4.1730 (-1.475)	-5.3152 (-2.030)	-3.6826 (-0.821)	10.2533 (2.063)	-9.2429 (-2.778)	1.3024 (0.340)	-7.3645 (-1.758)	-2.5806 (-0.352)
nrate(-2)	-9.4803 (-1.867)	4.1049 (1.542)	0.1602 (0.037)	-3.9416 (-1.282)	9.4120 (4.659)	-1.8955 (-0.889)	2.1752 (0.532)	9.3204 (1.282)
nrate(-3)	-1.9000 (-0.363)	-	5.1745 (1.556)	-	-	-	3.8300 (1.477)	-3.7306 (-0.960)
nrate(-4)	13.2271 (3.946)	-	-	-	-	-	-	-
inf(-1)	1.2889 (4.054)	-	1.2820 (3.668)	-	0.4696 (2.126)	-	0.0120 (0.452)	-
inf(-2)	1.9928 (5.776)	-	-0.1925 (-0.700)	-	0.4731 (1.742)	-	-0.0916 (-0.293)	-
inf(-3)	0.7610 (2.892)	-	0.5992 (1.515)	-	-	-	0.7764 (2.877)	-
inf(-4)	0.7097 (1.973)	-	-	-	-	-	-	-
hpgs(-1)	-	0.3241 (2.717)	0.3536 (3.594)	-0.0797 (0.741)	0.2681 (2.121)	0.2970 (4.885)	-	-
hpgs(-2)	-	-	-	0.2699 (2.169)	0.1382 (1.073)	-	-	-
hpgs(-3)	-	-	-	-	0.3451 (3.846)	-	-	-

Notes: Heteroskedasticity robust t-statistics are reported in (.) (White, 1980).

Table 4: Long-run Marginal Effects and Diagnostic Tests for Restricted Model

	Sydney	Melbourne	Brisbane	Adelaide	Perth	Hobart	Canberra	Darwin	Mean
Unemployment	-	-	-0.968 (-2.76)	-0.622 (-3.10)	-	-	-1.092 (-2.69)	-	-0.335
State Final Demand	1.718 (3.77)	-0.931 (-2.75)	-	-	-	-	-	-	0.098
Population Growth	-3.447 (-0.48)	13.406 (4.12)	8.958 (2.54)	-	2.425 (0.94)	9.973 (8.94)	4.084 (1.33)	-	4.425
Mortgage Rate	-4.090 (-4.44)	-1.210 (-3.36)	-1.490 (-2.00)	-1.147 (-4.34)	-0.801 (-2.00)	-1.223 (-9.15)	-1.961 (-2.28)	-0.542 (-1.04)	-1.558
Inflation	8.355 (4.71)	-	2.547 (2.41)	-	0.943 (2.37)	-	1.372 (1.27)	-	1.652
Sydney Effect	-	0.324 (2.72)	0.533 (3.81)	0.190 (1.89)	0.751 (8.16)	0.171 (4.27)	-	-	0.281
R-barsq	0.699	0.565	0.577	0.298	0.611	0.433	0.512	0.137	-
SC(5) p-value	0.404	0.770	0.862	0.280	0.526	0.865	0.201	0.281	-
BPK p-value	0.641	0.736	0.506	0.674	0.006	0.645	0.520	0.145	-
RESET p-value	0.340	0.103	0.001	0.363	0.000	0.233	0.639	0.167	-
Test of Zero Restrictions p-value	0.785	0.749	0.624	0.293	0.796	0.126	0.643	0.662	-

Notes: See Table 2.

Figure 1: Real quarterly growth rate of established house prices in Sydney (1986:3 to 2004:3)

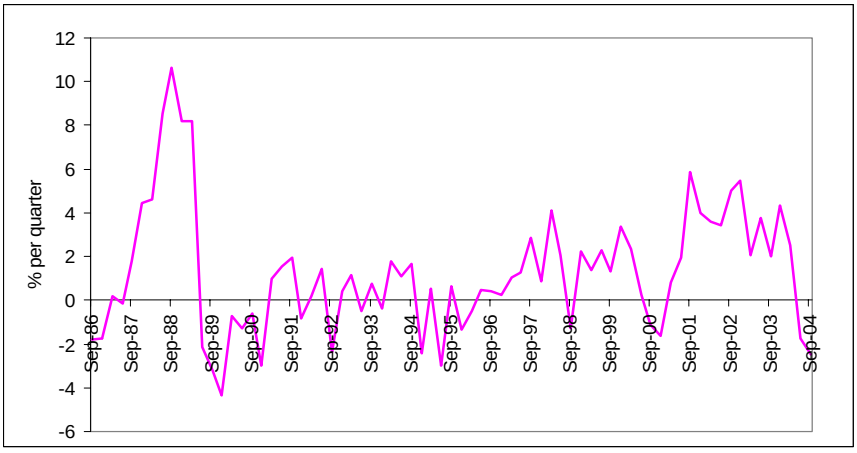


Figure 2: Real quarterly growth rate of established house prices in Melbourne (1986:3 to 2004:3)

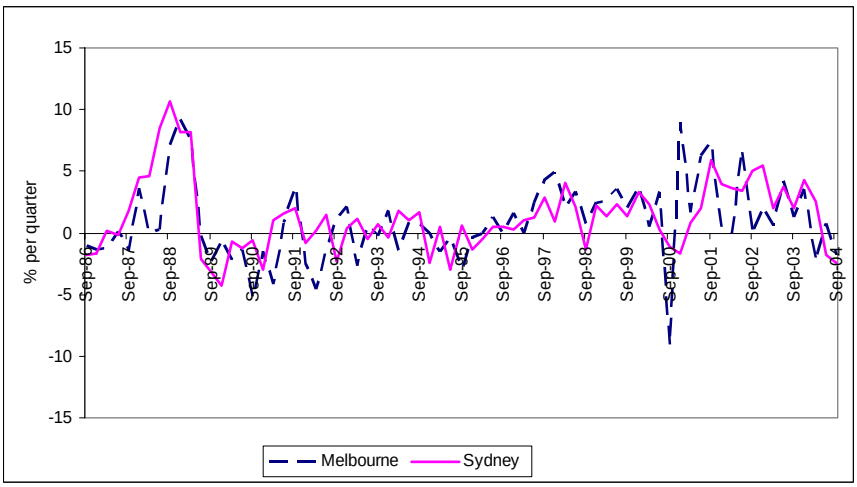


Figure 3: Real quarterly growth rate of established house prices in Brisbane (1986:3 to 2004:3)

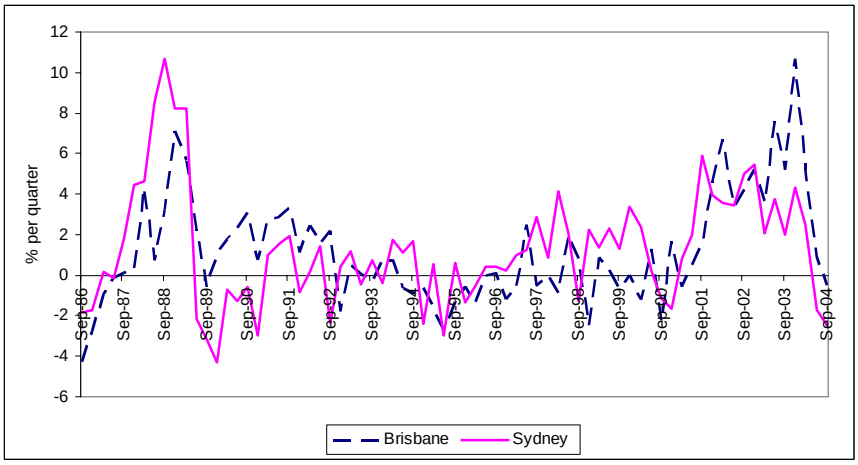


Figure 4: Real quarterly growth rate of established house prices in Adelaide (1986:3 to 2004:3)

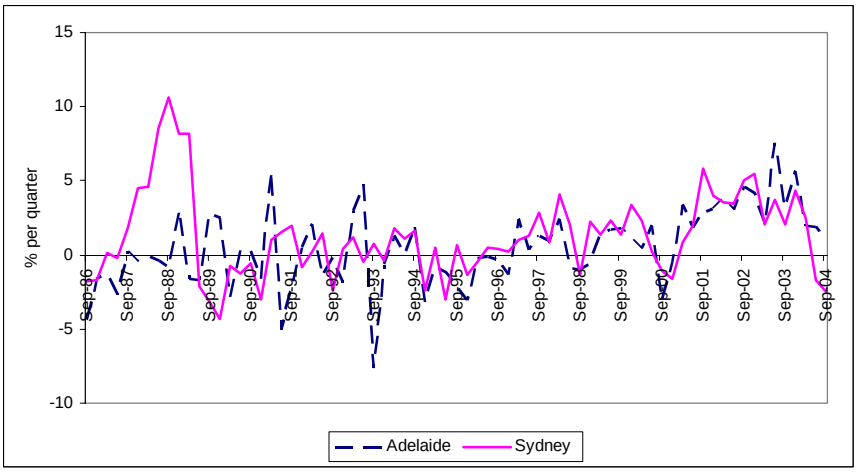


Figure 5: Real quarterly growth rate of established house prices in Perth (1986:3 to 2004:3)

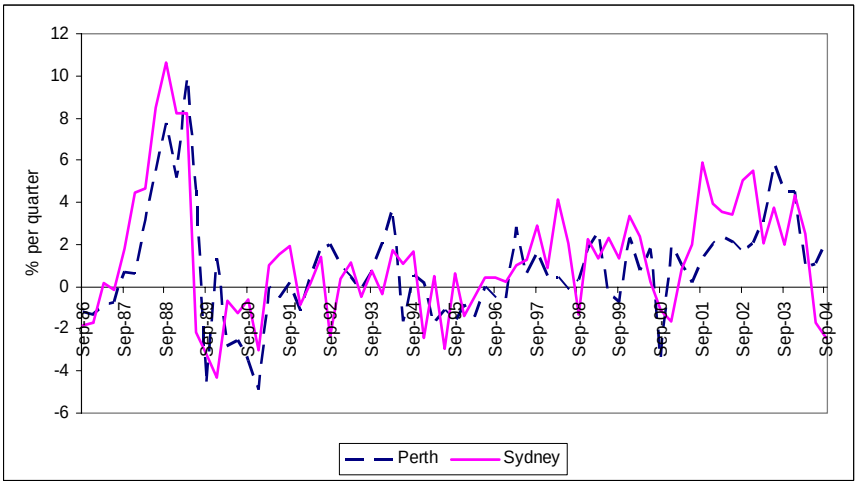


Figure 6: Real quarterly growth rate of established house prices in Hobart (1986:3 to 2004:3)

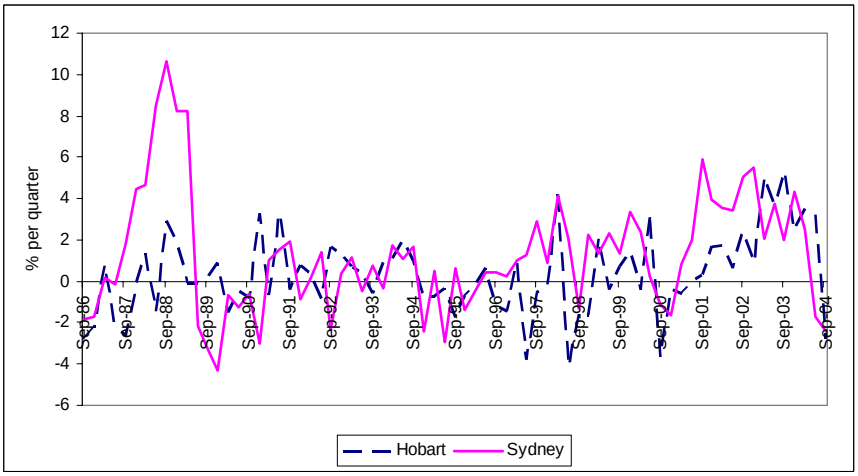


Figure 7: Real quarterly growth rate of established house prices in Canberra (1986:3 to 2004:3)

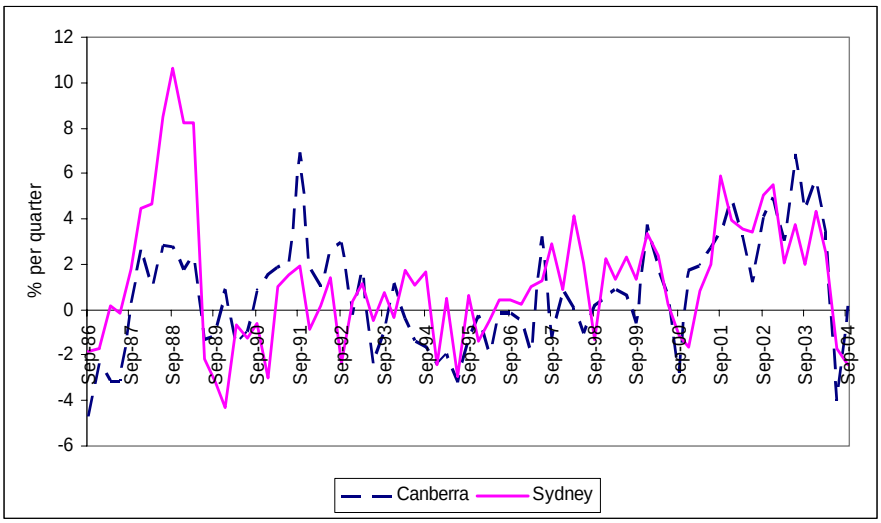


Figure 8: Real quarterly growth rate of established house prices in Darwin (1986:3 to 2004:3)

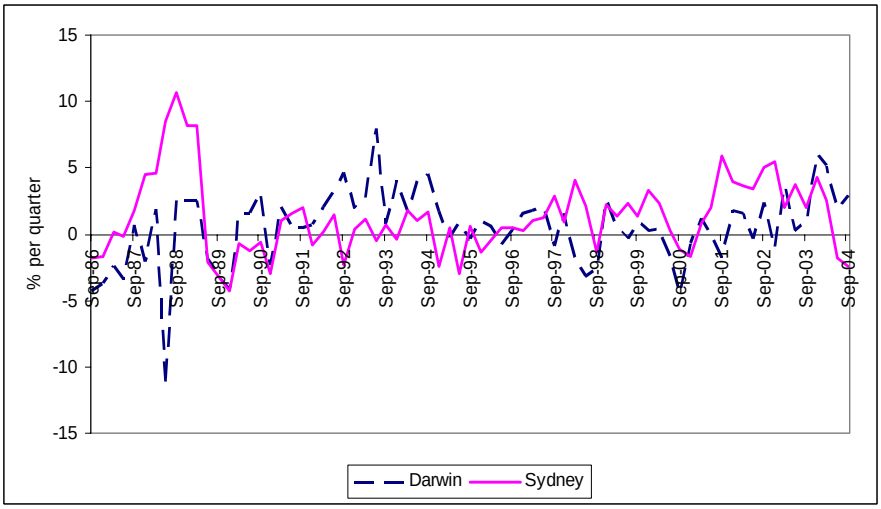


Figure 9: Actual and predicted growth rates of Sydney house prices

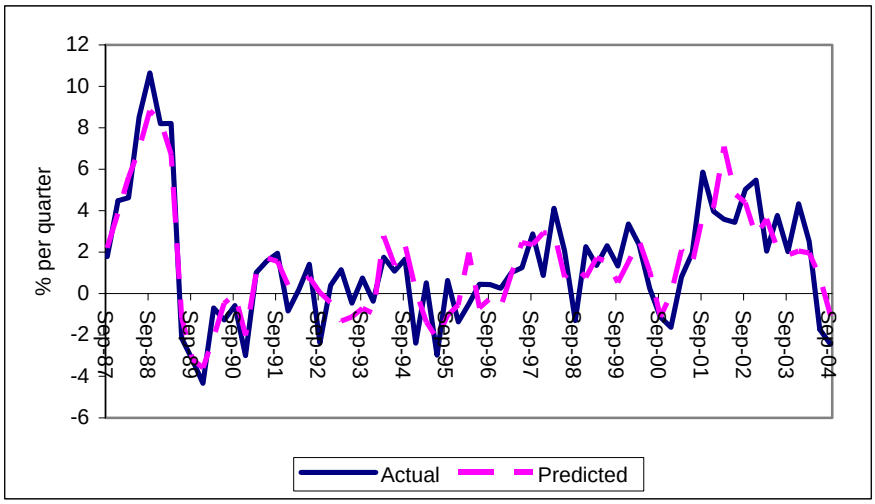


Figure 10: Actual and predicted growth rates of Melbourne house prices

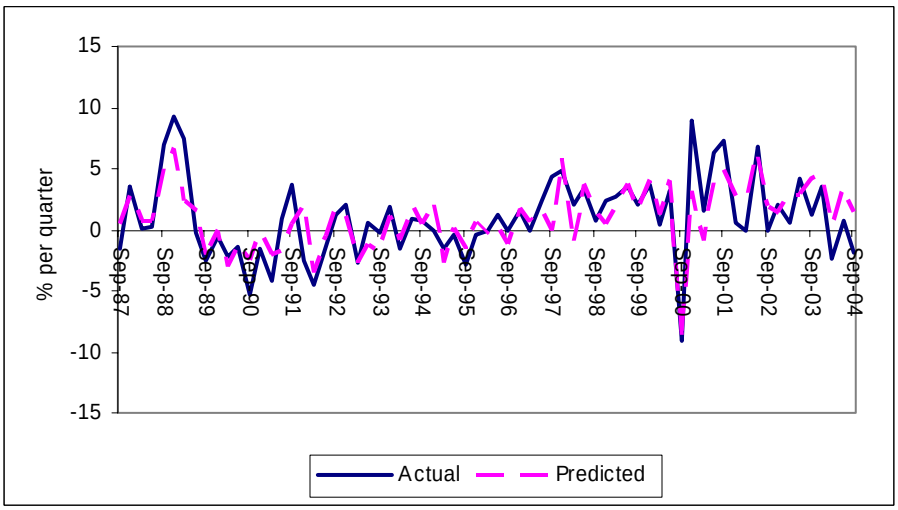


Figure 11: Actual and predicted growth rates of Brisbane house prices

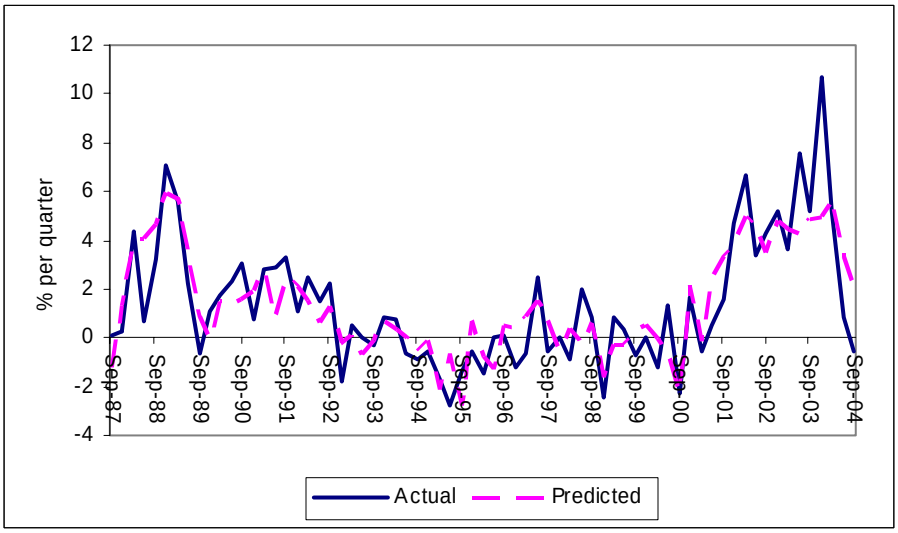


Figure 12: Actual and predicted growth rates of Adelaide house prices

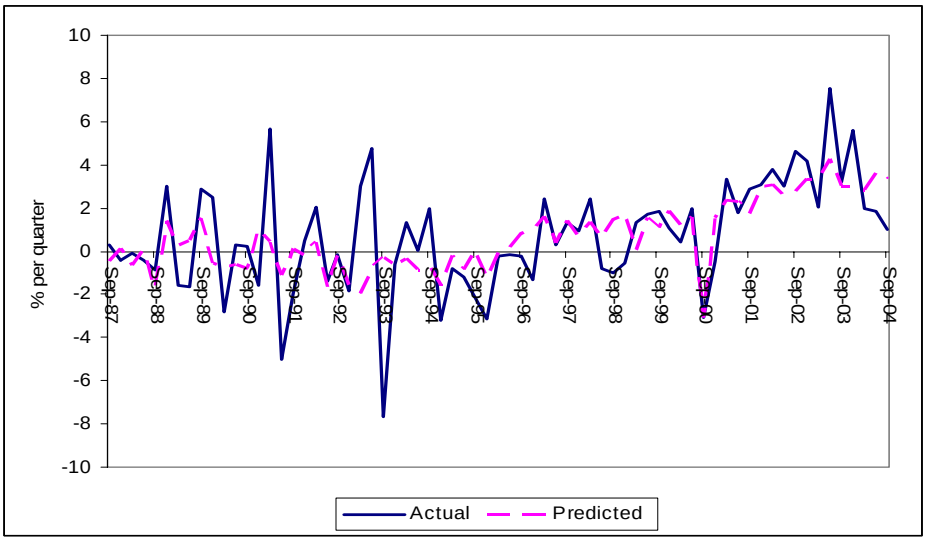


Figure 13: Actual and predicted growth rates of Perth house prices

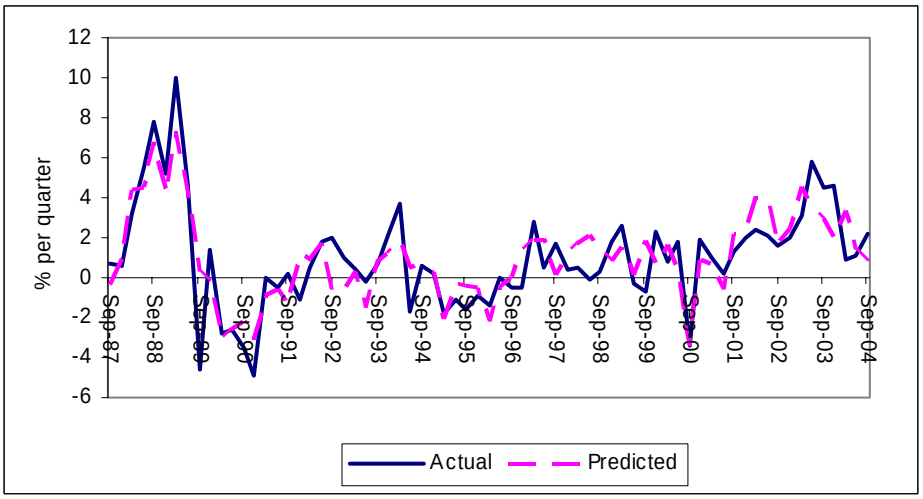


Figure 14: Actual and predicted growth rates of Hobart house prices

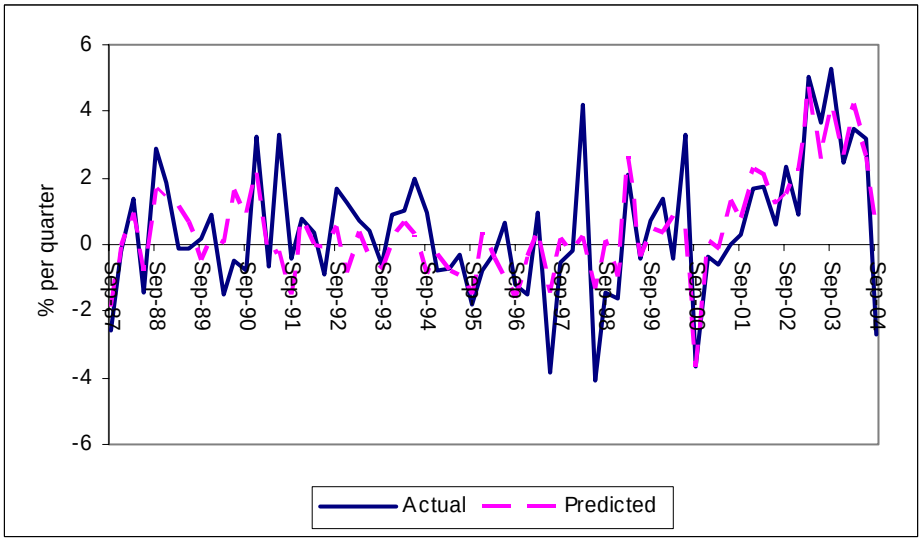


Figure 15: Actual and predicted growth rates of Canberra house prices

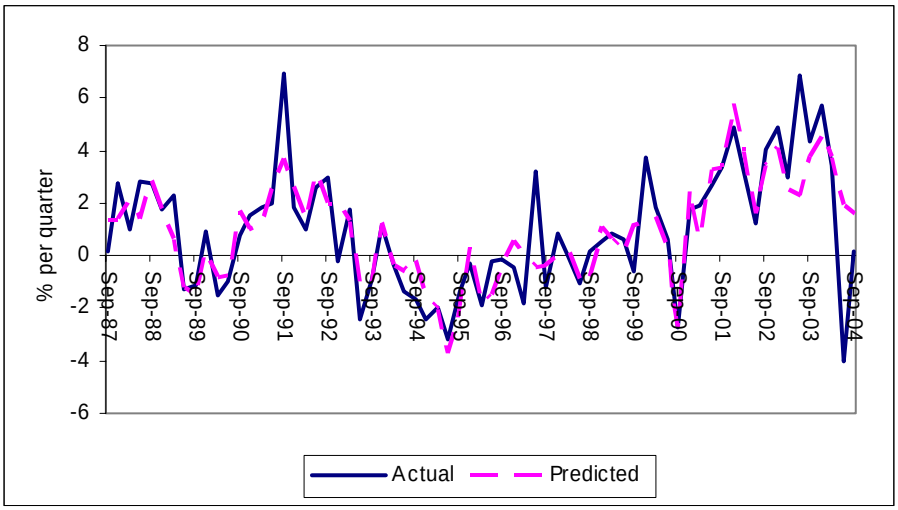
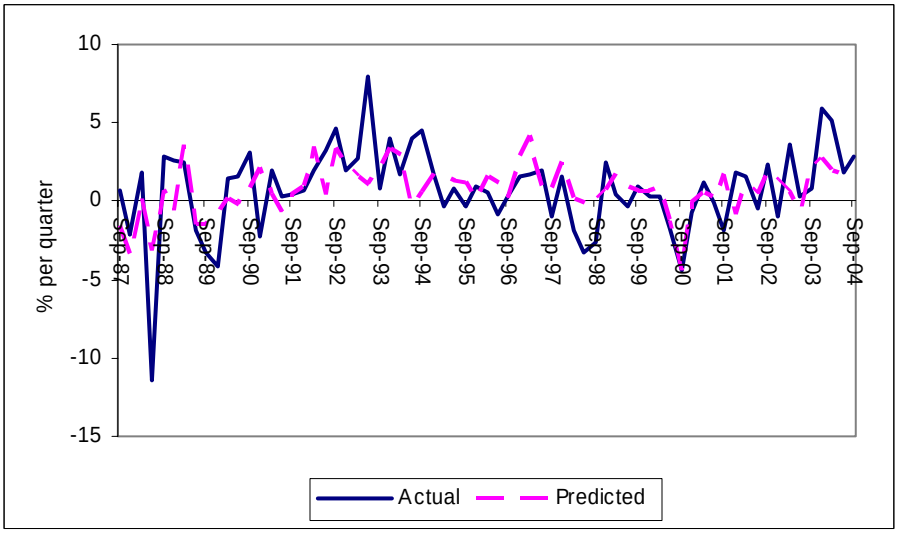


Figure 16: Actual and predicted growth rates of Darwin house prices



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Data Appendix

The definitions and sources of the variables used in the empirical analysis are provided below. All of the variables are measured on a quarterly frequency and the full data sample is 1986:3 – 2004:2. All series are obtained from the 10 December 2004 release of the DX database (either ABS Time Series Statistics or RBA Bulletin Database).

hpg

The real growth rates of house prices in the state and territory capitals are derived from quarterly price indices for established houses (Source: DX Table 6416-01). These indices are converted to real terms by dividing them by the relevant state or territory capital city CPI (Source: DX Table 6401-01).

un

Unemployment rates for the six states are available on a seasonally adjusted basis (Source: DX Tables 6202-04B to 6202-09B). For the two territories the unemployment rates are not seasonally adjusted (Source: DX Tables 6202-12G and 6202-12H).

popg

The growth rates of population in the state and territories are derived from estimated resident populations (Source: DX Table 3101-04).

nrate

The nominal mortgage rate is measured by the standard variable home loan rate offered by banks (Source: DX Table F.05).

sfdg

The growth rate of final demand for the states and territories is derived from the seasonally adjusted CVM ($m 2000-03) measure of state final demand (Source: DX Table 5206-25).

inf

Inflation rates for the state and territory capitals are derived from the corresponding CPIs (Source: DX Table 6401-01).

gstdum

Dummy variable for the introduction of the goods and services tax (GST). It takes the value 1 in the September quarter 2000 and 0 elsewhere.

Table 1a: Quarterly growth rates and standard deviations for explanatory variables: 1986:3 – 2004:3

	Sydney	Melbourne	Brisbane	Adelaide	Perth	Hobart	Canberra	Darwin
Population Growth								
- Mean	0.271	0.247	0.543	0.114	0.424	0.107	0.308	0.359
- Std	0.085	0.094	0.120	0.069	0.141	0.132	0.240	0.260
Un Rate								
- Mean	7.357	7.554	8.406	8.558	7.321	9.471	5.810	6.537
- Std	1.541	2.093	1.209	1.499	1.450	1.274	1.374	1.717
Final DD Growth								
- Mean	0.810	0.825	1.183	0.751	0.982	0.636	0.976	0.713
- Std	1.077	1.565	1.574	1.478	2.282	2.896	2.549	4.588
Inflation								
- Mean	0.916	0.883	0.891	0.910	0.878	0.871	0.863	0.799
- Std	0.853	0.849	0.789	0.817	0.891	0.812	0.821	0.787
Mortgage Rate								
- Mean	2.442	2.442	2.442	2.442	2.442	2.442	2.442	2.442
- Std	0.832	0.832	0.832	0.832	0.832	0.832	0.832	0.832