Trends and cycles in New Zealand house prices

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Abstract

This exploratory study decomposes the history of New Zealand house price movements into a trend component and a cyclical component. We consider GDP, disposable income per household and interest rates as candidate drivers of the trend. A cointegration model is able to relate the trend level of house prices to disposable income per household and nominal interest rates. Results from the model suggest that house prices are still substantially higher than their trend level. We also show that section prices and residential construction prices have grown strongly over recent decades, driving up the cost of new housing substantially. It appears that the supply of new housing has exerted little, if any, moderating influence on house prices over the latest cycle.

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[1] The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Reserve Bank of New Zealand. Thanks to our work colleagues for their comments and help, especially Ashley Dunstan, Tim Hampton, Chris McDonald, Mark Smith and Aidan Yao. All errors and omissions are our own.

1. Introduction

Distinguishing the decade-long trends in house prices from several-year cycles around that trend is important for a range of macroeconomic, microeconomic and social policy reasons. For example, policy interventions may seek to influence either the trend or the cyclical component, or both. A trend-cycle decomposition is required to calibrate the interventions *ex ante*, and to measure their success *ex post*.

Unfortunately, performing such a decomposition, while unavoidable, is difficult as an empirical proposition. Both trend and cycle are likely to be driven by random shocks that cannot easily be observed. The problem of lack of precision or uniqueness of the decomposition is particularly acute at the time when it matters most – that is, at the end of the sample (i.e. now, when policy needs to be made). Policy predicated on a particular decomposition thus needs to recognise the degree of uncertainty around it and the strengths and weaknesses of the particular empirical approach chosen.

This paper illustrates some of these issues by applying a trend-cycle decomposition to the history of New Zealand house prices. First, we briefly discuss the house price boom and bust in New Zealand and other Western countries this decade, and its associated cycle in housing credit conditions, as a prominent example of the potentially large influence of cyclical factors. We then use a cointegration framework to look at the potential longer term influences in New Zealand, using data going back to the 1960s. We argue that, although factors relating most closely to the demand side are able to explain the trend in this framework, the large cycles around that trend suggest that a low elasticity of supply has also been influential in house price dynamics over the period.

2. The housing boom and bust, Western countries, 2000s

A remarkable feature of the housing market experience in Western countries this decade is how synchronised the boom and subsequent bust has been, not only across many different countries but across asset and credit markets. Even on a sample that ends before the financial crisis that emerged in 2007, empirical work has suggested that the causal links between house prices, credit and economic activity is multifaceted (Goodhart and Hofmann, 2008). Now, it is even more evident that housing credit is an empirically significant ‘financial accelerator’, tending to propagate and amplify economic disturbances in the manner suggested by Kiyotaki and Moore (1997).

The role of housing and housing finance markets in the current worldwide recession is by now an intensely studied subject. The story has by now been widely told (e.g. Bernanke, 2009; for a New Zealand perspective, see Bollard and Ng, 2009). A number of global factors came together to promote strong credit growth, much of which was channelled into house price inflation. These factors included a ‘glut’ of savings supplied to world credit markets by Asia and oil exporters, low world interest rates driven by US monetary policy, rapid growth in financial innovation and complexity as a consequence of the move to an ‘originate to distribute’ banking strategy among Northern Hemisphere banks, and a progressive relaxation of credit standards by the originating banks.[2]

[2] In ‘originate to distribute’, credit originations are securitised and sold (rather than held to maturity), removing them from the originating bank’s balance sheet. A typical securitisation would involve, along the way, the creation and sale of derivatives based on the securitised exposures, further increasing the fee-earning potential of the underlying origination.

The credit and house price growth proved unsustainable, as accumulated large credit risks eventually generated large losses. What has been surprising is not so much the boom and bust in housing and credit markets – we have seen large cycles before – but how pervasive and exaggerated the overextension and subsequent correction has been.

In contrast to the experience of the US and the UK, the impact of the crisis on the New Zealand credit markets and economy has essentially been mediated through the price of credit, rather than its availability. Throughout the episode, the New Zealand banking system remained sound and the level of impaired loans has not so far been unusual. The risk of large credit losses on housing credit exposures appears fairly low (Kida, 2009). However, this relatively sound state of the local banking system occurred alongside a house price cycle in New Zealand that was at least as pronounced as in the US and the UK. In all three countries, house prices essentially doubled over the boom phase, and have either fallen already, or are expected to fall, by double digits in the bust.

The boom phase generated an urgent policy debate to address the consequences of high house prices for economic management and social conditions – e.g. the Barker Report in the UK (Barker, 2004), and the DPMC House Prices Unit's report for New Zealand (DPMC, 2008). Although house prices are now falling, this does not abrogate the need for further understanding of the drivers of cycles and trends in house prices. Both from the point of view of managing the economic cycle, and for designing and implementing policy interventions intended to address affordability issues, it is vital to have an up-to-date sense of how far house prices might fall. Knowing what the current trend value of house prices is, and how the actual level differs from this, would provide valuable information about this.

3. Estimating trend house prices

3.1 Motivation for the approach

This section of the report takes an initial look at what the drivers of trend house prices might be, differentiating them where possible from drivers of the cycle. The idea is to find the trend level of house prices – the anchor or attractor for house prices – around which house prices will show shorter term fluctuations. Obtaining a view on how the gap between actual house prices and their trend level might close is then usually done by using a short run equation in conjunction with the long run equation.

Part of the motivation for this work was some unease regarding models based on the structure derived in Pain and Westaway (1996). The Pain and Westaway model relates the *level* of real house prices to real consumption of housing services, real consumption of non-housing services, and the real user cost of capital.

In practice, a measure of the housing stock is often used as a proxy for the real consumption of housing services. It is assumed that the flow of housing services will be proportional to this housing stock. Also, some measure of total consumption or total income is often used as a proxy for the consumption of non-housing services. The real user cost of capital is generally taken to be the real interest rate minus the expected real rate of capital gain of the housing stock.

This approach is often used in estimating a long run equation (i.e. the equation for the trend) in a co-integration framework. Such an equation is used in conjunction with a short run equation, which is based on *changes* in house prices and used to describe how house prices vary around their trend.

Models of New Zealand house prices that are based on this approach can be found in O'Donovan and Rae (1997), Grimes, Aitken and Kerr (2003) and Rosborough (2005). In these studies, expected capital gain in the user cost variable has generally been proxied by the average change in house prices over the last 3 or 4 years. Such a moving average tends to follow the cycle in house prices, resulting in similar, though inverted, cycles in the user cost variable.

This in turn means that the trend house price estimates produced by the estimated long run equations also move in cycles. The trend estimates also tend to be fairly close to the actual values, by construction. This is generally seen as being a good thing in terms of explanatory power, because the equation fits the data well. The length of the lag on the moving average term in the user cost variable is often in fact chosen in order to maximise the explanatory power of the equation. However, given that the equation values tend to be close to actual values, an implication often drawn from these models is that house prices are not very far away from their long run level, or their 'fundamental value' (Rosborough 2005).

In this paper, we take a different approach. We look at whether it is possible to identify a long run equation that describes the trend in house prices, where this trend evolves in a smooth manner, and generally does not cycle. An advantage of this approach would be that the gaps between estimated trend values and actual values would be more useful in forming a view on the extent to which actual values might adjust in the future.

In trying to identify the trend in house prices, we look at two particular issues:

- There is a 'rule of thumb' used by economic analysts and forecasters that, over the long term, average growth in house prices will equal average growth in nominal GDP.[3] We look at this rule of thumb in section 3.2. In the course of doing this, we make a short diversion to look at the prices of land and residential construction.
- Another popular belief is that, over the long term, house prices will be related to household income.[4] We examine this view in section 3.3, where we derive a co-integration equation based on average household income and interest rates. We label this model the 'affordability model' since it is related to the amount of debt that the average household is able to service.

3.2 The rule of thumb

Analysts have noted that over the long term, the rise in nominal house prices has been very similar to the rise in nominal GDP. For example, Kiernan (2009) states that house prices in New Zealand have risen on average by 8.9% per annum since 1951, while nominal GDP growth also averaged 8.9% over the same period. Figure 1 illustrates the long term relationship between house prices and nominal GDP. Clearly, in recent years – between 2003 and 2007 – the rise in house prices outstripped the rise in GDP. However, Figure 1 certainly suggests that the level of nominal GDP may provide some guidance regarding the long term trend in house prices.

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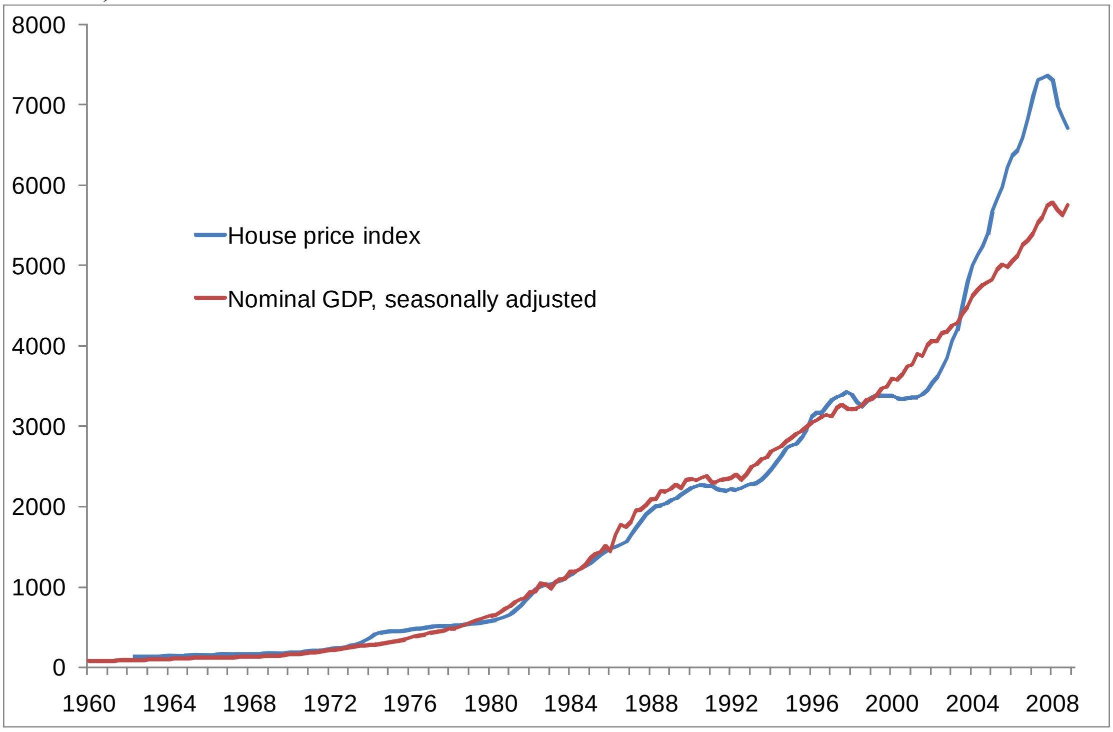
[3] See, for example, Kiernan (2009).
[4] See for example the Wikipedia article on 'Real estate pricing' at www.wikipedia.org.

Figure 1 House price index and nominal GDP
Indexes, base 1982-83=1000



Sources: Quotable Value, Statistics New Zealand, Reserve Bank of New Zealand

However, it is not immediately obvious why a price – the price of housing as shown by the QV index – should be related to a nominal measure of economic activity.

Our initial thoughts on this involved the price of land. Clearly the supply of land is fixed. Hence it might be expected that as real aggregate income rises over time, the real price of land would rise at a similar rate. However, there is also an underlying movement in prices in the economy, which is perhaps best represented by the GDP deflator. This price movement can be expected to affect both land prices and incomes. So it might also be expected that nominal land prices would rise at a similar rate to nominal GDP.

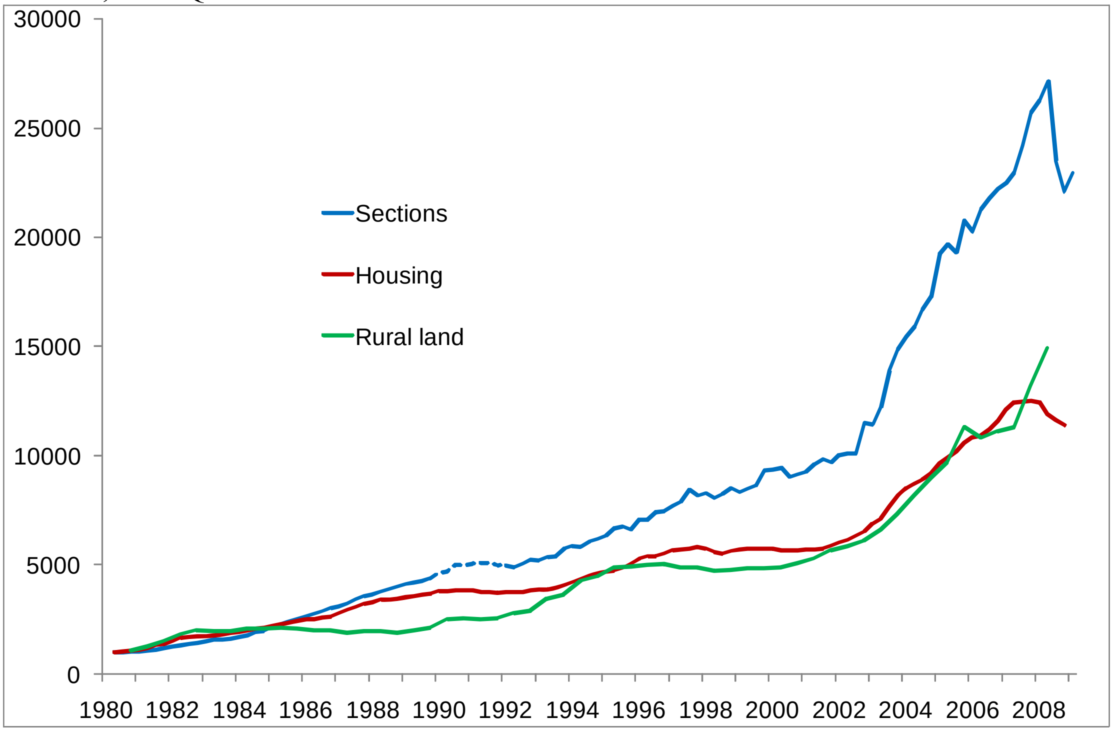
However this conclusion doesn't seem to be reflected in prices of residential sections.

Land and construction prices

As figure 2 shows, section prices have grown at a higher rate than house prices over the last 20 years, which means they have also grown at a higher rate than nominal GDP. Section prices have grown particularly strongly since around 2003, and this probably reflects, at least in part, the introduction of development levies by local authorities. Overall though, the long term rise in section prices suggests that there has been a sustained shortage of residential sections in the places where the population wants to live.

Figure 2 also shows rural land prices, which can be seen as being a proxy for the prices of 'raw land'. Even though rural land prices have been undergoing something of a boom recently they have not risen to the same extent as section prices.

Figure 2 Section prices and house prices[5]
Indexes, 1980Q2=1000



Sources: Valuation New Zealand, Quotable Value, Statistics New Zealand, Reserve Bank of New Zealand

In view of the remarkable rise in section prices, we decided to take a quick look at construction prices, which also influence the cost of housing supply. One way of doing this is to look at the implicit deflators for components of GDP, one of which is residential construction.[6] Figure 3 shows that since 1994 the rise in the deflator for residential construction was higher than for any of the deflators for the major components of GDP.

The deflator for total investment shown in Figure 3 actually includes residential investment. Figure 4 shows the deflators for some other types of investment – those related to construction – that are included in the total investment category. As can be seen, since 1986, residential construction prices have risen at a higher rate than for other forms of construction.

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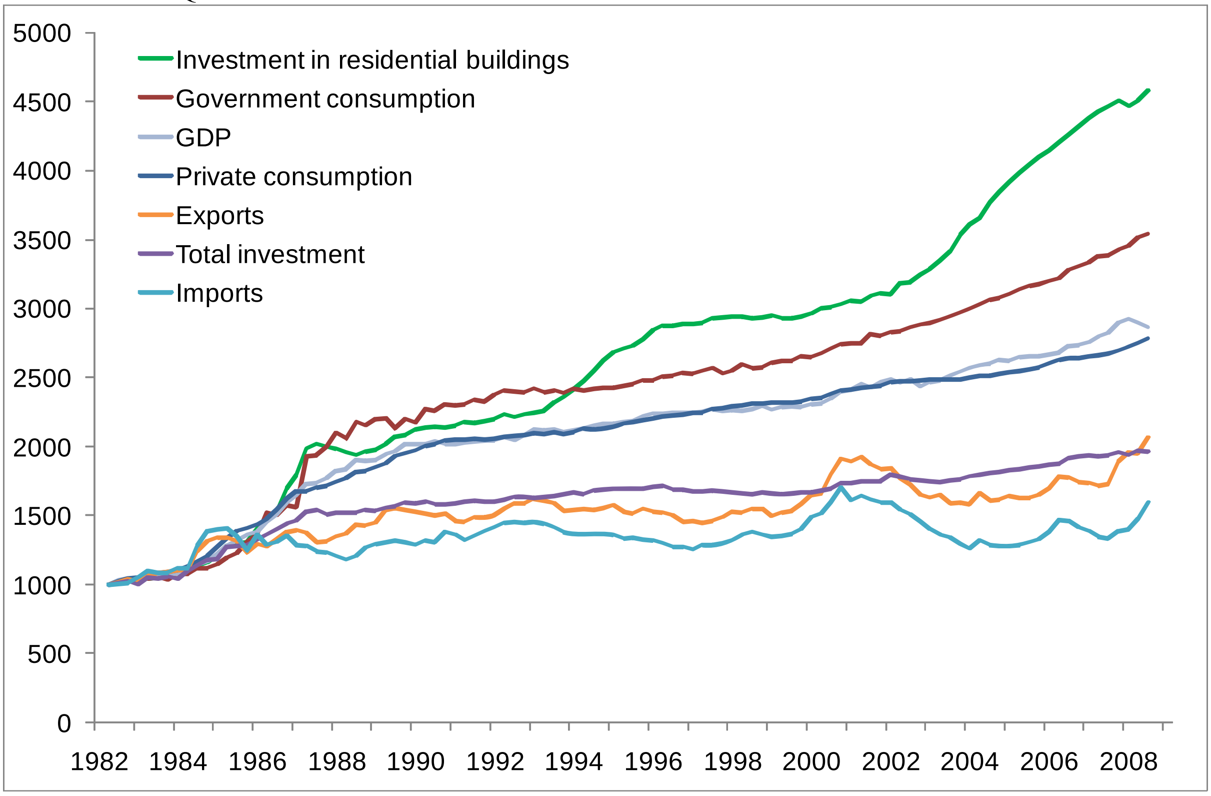
[5] Section prices as shown in this chart are based on three series. Up to 1989Q4 they are based on an index from Valuation New Zealand (1990). This index appears to provide a quality adjusted series. The second series – used for the dotted section of the line in the chart – is the 'cost of sections' from the CPI, which is also a quality adjusted series. The third series, which is used for the period from 1992Q1, is a stratified series based on REINZ data. This series has been produced by Chris McDonald and Mark Smith at the Reserve Bank. The strata used are based on local authority areas, which are grouped by house price deciles. Hence the series adjusts the REINZ sales data for any compositional shifts between deciles. This series should give a more accurate view of underlying price movements than the unadjusted series.

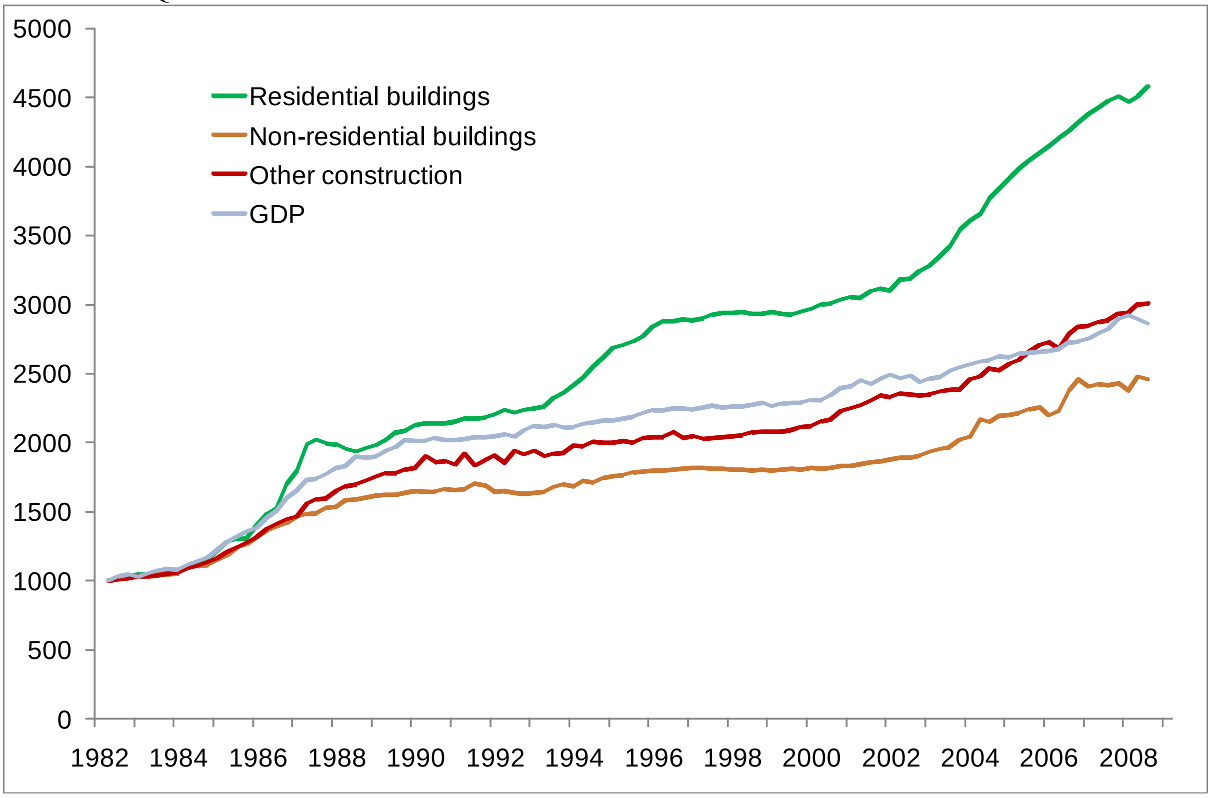
[6] An implicit deflator is derived by dividing the seasonally adjusted nominal value by the seasonally adjusted real value. The resulting series is an indicator of the movement in price in the GDP component.

Figure 3 Implicit GDP deflators
Indexes 1982Q1=1000



Sources: Statistics New Zealand, Reserve Bank of New Zealand

Figure 4 Implicit GDP deflators for construction groups
Index 1982Q1=1000



Sources: Statistics New Zealand, Reserve Bank of New Zealand

Figures 2 to 4 underscore the findings of the DPMC's House Prices Unit – that the combined cost of buying a section and building a new house on it has risen strongly over the last decade or so, and especially since 2003. The DPMC (2008) report shows that since 1999 the rise in the cost of buying a section and building a 145 square metre house has been very similar to the rise in the median house price.[7] However, Figures 2 to 4 indicate that the rise in land and construction prices is a long-standing issue, going back to at least the early 1980s.

Another approach to linking asset prices and nominal GDP

The sharp rise in section prices shown in Figure 2 doesn't appear to be consistent with the argument that over the long term land prices would grow would grow at a similar rate to nominal GDP, although the price index for rural land suggests that 'raw' land prices haven't grown as strongly as section prices.

There is another way – a more theoretical approach – to link asset prices and nominal GDP. The price of an asset should be equal to the present value of the expected returns from that asset. This can be expressed algebraically:

$$P_0 = D_1/(1+k) + D_2/(1+k)^2 + D_3/(1+k)^3 + ... \qquad (1)$$

where
P_0 is the current price
D_1, D_2, etc, are the dividends expected to be received in each future period
k is the discount rate.

Suppose now that the dividend grows at a constant rate g, and D_0 is the current dividend being paid. Then the dividend flow will be $D_0(1+g)$, $D_0(1+g)^2$, etc, and the formula for the price will be:

$$P_0 = D_0(1+g)/(1+k) + D_0(1+g)^2/(1+k)^2 + D_0(1+g)^3/(1+k)^3 + ... \qquad (2)$$

At the end of the first time period, the future dividend flow will be $D_0(1+g)^2$, $D_0(1+g)^3$, etc, and the formula for the price at this time will be:

$$P_1 = D_0(1+g)^2/(1+k) + D_0(1+g)^3/(1+k)^2 + D_0(1+g)^4/(1+k)^3 + ... \qquad (3)$$

It is easy to see that:

$$P_1 = (1+g)P_0$$

Hence when the dividend from an asset is expected to grow at a constant rate, the price of the asset will increase at the same rate.[8]

We can apply this approach to the economy as a whole. Assume that we take an equity share, say a 1% share, in every enterprise in the economy. Suppose that nominal GDP grows at a constant rate g. Then the gross operating surplus from these enterprises would also grow by g, provided that the labour share of GDP income and the rate of indirect tax doesn't change. Gross operating surplus is the equivalent of EBITDA (earnings before interest, tax, depreciation and amortisation). So if we also assume that dividend payments reflect growth in

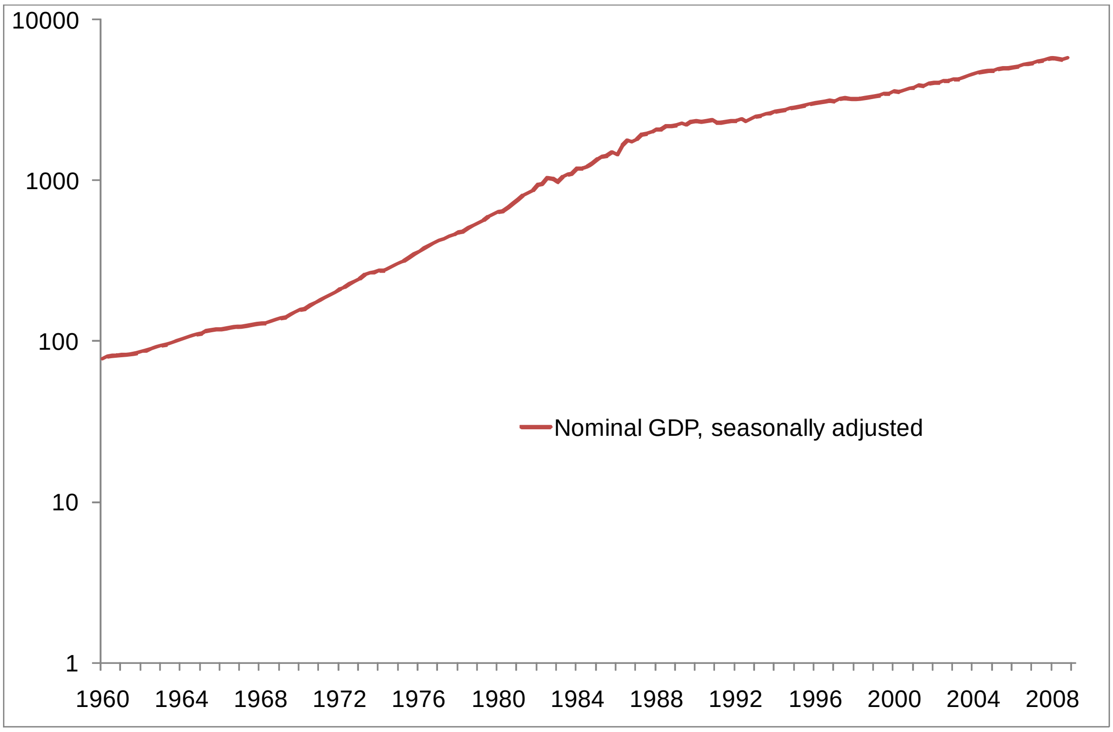
[7] Department of the Prime Minister and Cabinet (2008), Figure 23 on p45.
[8] The constant growth model is often referred to as the Gordon model. Equation (2) can be simplified and used in the following form: $P_0 = D_1/(k-g)$. This is provided that $k>g$ (Jones 1988, 256-263).

EBITDA then it follows that total dividend payments from our company shares will also grow by g.

Overall therefore, if nominal GDP grows at a constant rate, we would expect the price of the economy's assets to increase at the same rate.

In reality nominal GDP doesn't grow at a constant rate. Figure 5 graphs nominal GDP on a log scale. In such a chart, a straight section of the line indicates a constant growth rate. As can be seen there was a clear change in the nominal growth rate around 1991, with the move into a low inflation environment. It can be argued though that the growth rate in nominal GDP was roughly constant in the 1969 -1989 period, when it averaged nearly 14.8% per annum, and again in the 1991-2009 period, when it averaged 5.4%.

Figure 5 Nominal GDP, shown on log scale
$Million



Source: Statistics New Zealand, Reserve Bank of New Zealand

Have asset prices for the economy as a whole tended to move in line with nominal GDP? Figure 6 shows prices for some major asset types. It seems that there is some relationship – albeit a loose relationship – between these price tracks and nominal GDP. Clearly, the equity price track deviated markedly from the GDP track during the share price boom of the mid-1980s. And as we saw earlier, sections – which are not shown here because they alter the scale of the chart so much – are another asset type that has deviated sharply from the GDP track.[9]

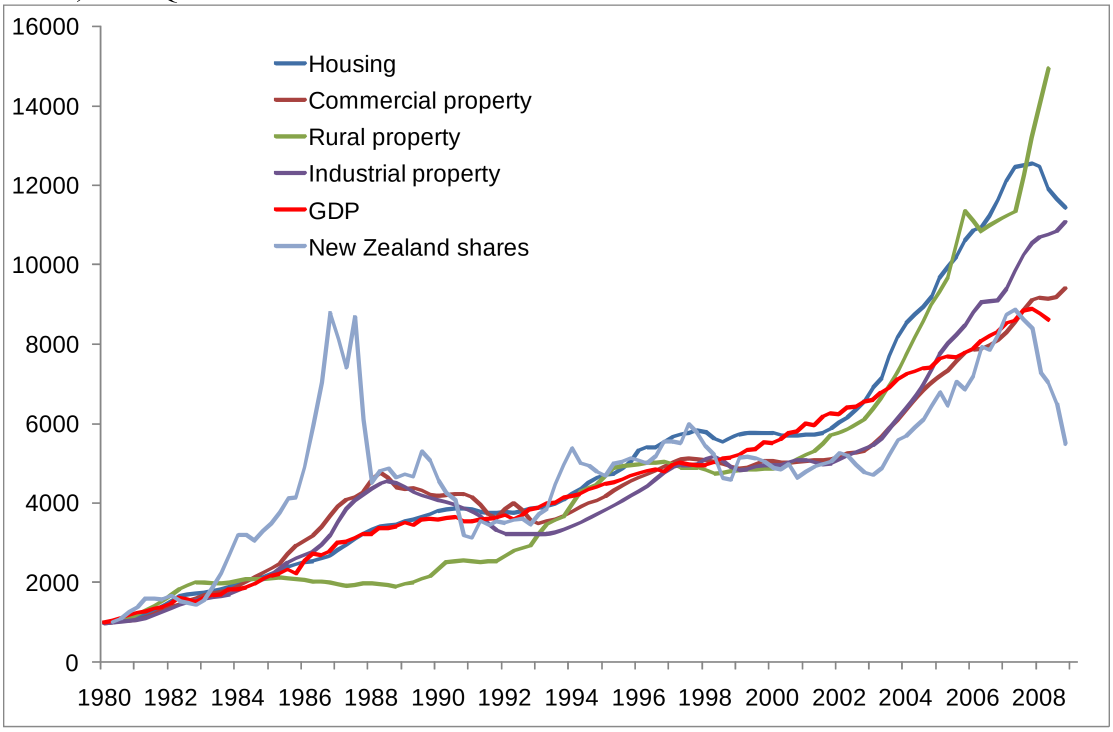
We now seem to have a new rule of thumb: that the price of an economy's total assets will tend to move in line with nominal GDP, provided that the growth in nominal GDP is expected to be constant into the future.

[9] It would be interesting to weight these indexes together to get an 'all assets' index, but as yet we haven't been able to derive an accurate set of weights for the component indexes.

It might be argued that the price indexes for the different asset types shouldn't get too far away from each other. Otherwise, there will be major opportunities for arbitrage, with investors being able to sell over-valued assets in order to buy under-valued assets. Having said that, Figure 6 suggests that different assets can follow markedly different price paths, at least over the short term. These different paths probably reflect different expectations regarding future dividends.

Figure 6 Price indexes for various asset types

Index, 1980Q2=1000



Sources: Quotable Value, Statistics New Zealand, NZX, Reserve Bank of New Zealand

Returning to our investigations of the original rule of thumb – that over the long term growth in house prices will equal the growth in nominal GDP – we estimated a simple regression equation using OLS:

$$\ln(HPI) = \underset{(167.3)}{0.9099} \ln(NGDP) - \underset{(-58.8)}{2.799} \qquad (4)$$

where
HPI is the QV house price index
NGDP is nominal GDP, seasonally adjusted.

R^2 was 0.9944. t values are in brackets.

For this regression, the sample period was 1962Q2 to 2002Q1, with the latest house price cycle being excluded from the sample. We did this because the cycle was not complete, and hence the very high values at the end of the series could act as outliers and make it difficult to obtain accurate parameter estimates.

The coefficient of 0.910 for ln(NGDP) indicates that a 1 percent rise in nominal GDP is associated with a 0.910% increase in nominal house prices. A Wald test indicates that the coefficient value is significantly different from 1.

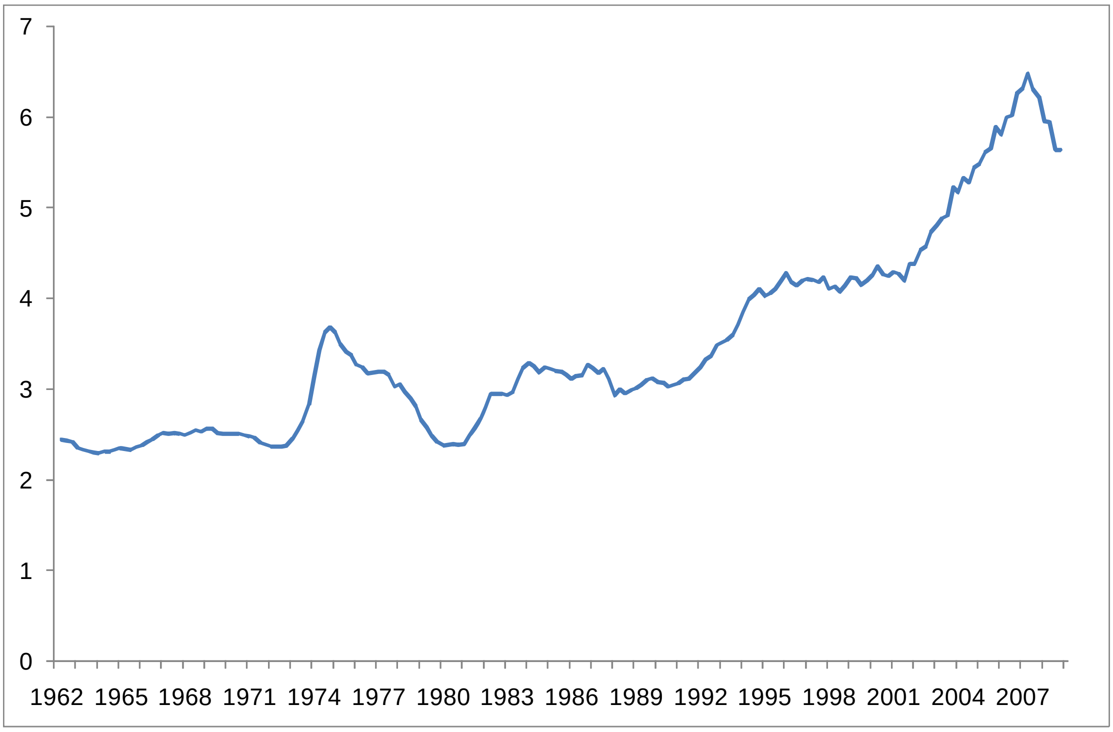
We find therefore that house prices don't increase at the same rate as GDP, but at a lower rate. This is different to what Kiernan found, although Kiernan was using data which began in 1953.

3.3 Affordability model

As Figure 7 shows, the average house price rose from being around two and a half times average household disposable income in 1980 to around six times average household disposable income in 2007. The ratio has since begun to ease, and it seems that the peak value was above its trend level. But where is the trend level? And why did the ratio ratchet up in the early 1980s, the mid 1990s and the early 2000s?

Figure 7 Ratio of average house price to average household disposable income

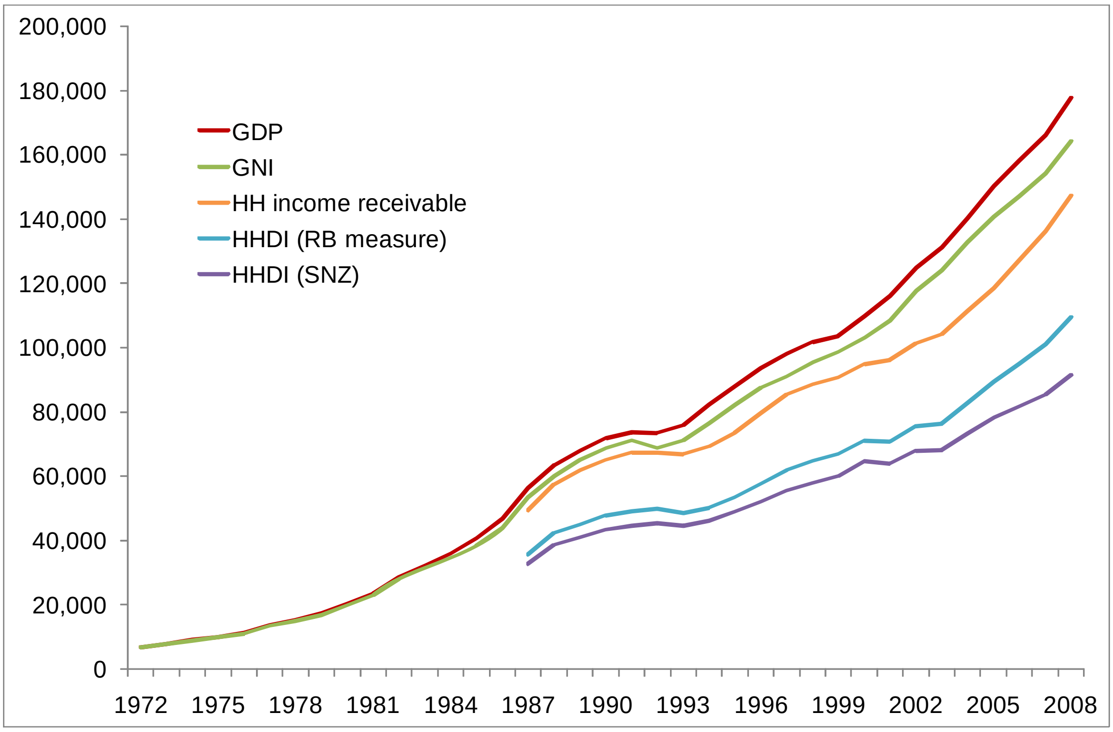
Value of ratio



Sources: Quotable Value, Statistics New Zealand, Reserve Bank of New Zealand

We first look at household disposable income and its relationship to GDP. Figure 8 shows official figures for national account aggregates; these are all nominal figures.

Figure 8 Annual national accounts aggregates
$Million



Source: Statistics New Zealand

Note that for New Zealand, gross national income (GNI) is less than GDP. The gap is due to the net investment income paid to foreigners – which is income generated by New Zealand enterprises that is not available to New Zealand households.

There is also a gap between GDI and the 'income receivable' by households. Some of this gap will be due to indirect taxes that are levied on production by government, while some will be due to firms' retained earnings. [10]

There is an even bigger gap between income receivable and the Reserve Bank measure of household disposable income. This gap is due largely to direct taxation levied by government.

The gap between the Reserve Bank's measure of household disposable income and the official measure of household disposable income is due to interest payments and depreciation. Nearly all of this depreciation is depreciation of houses.[11]

Overall, there is a significant wedge between total GDP and total household disposable income. Also, Figure 9, which plots GDP and household disposable income as indexes, shows that since the early 1990s household disposable income has not grown as much as GDP.

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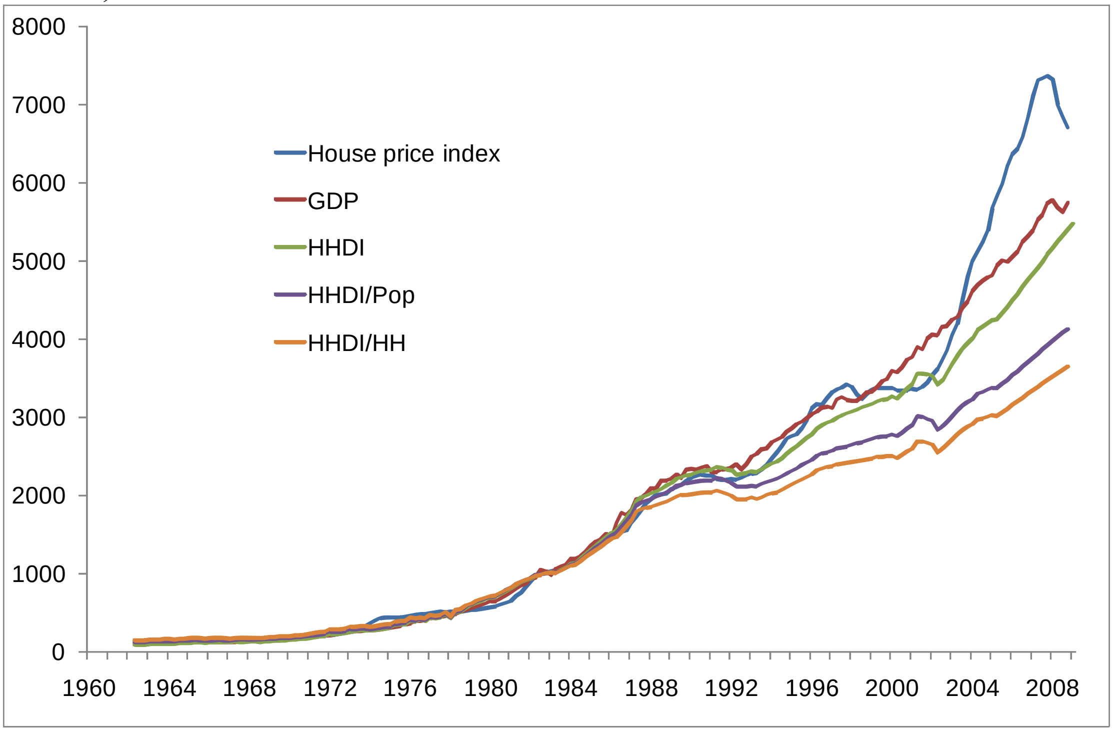
[10] Note that 'income receivable' includes some items that may not be paid out directly. For example it includes earnings attributed to insurance/pension policy holders, and imputed rent.

[11] The Reserve Bank measure is used widely in Bank publications and was used for example in Figure 7 above. The Bank adds interest payments and depreciation back into the official measure of household disposable income in order to get a measure of income before the payment of any costs related to housing. Note that the Reserve Bank's measure still includes some non-cash items. The largest of these is imputed rent from owner-occupied housing. This imputed rent, together with actual rents (which are also included in household disposable income), represent the total income that households receive from the existing housing stock. In general, this income will not change even if the home ownership rate changes.

Figure 9 House prices and household disposable income
Indexes, base 1982/83=1000



Sources: Quotable Value, Statistics New Zealand, Reserve Bank of New Zealand

Figure 9 also shows average household disposable income per person and average household disposable income per household. In this paper we assume that the decision as to whether to buy a house will be made at the household level and will be made in the light of whether the household's income is adequate to service the required mortgage payments. Hence we use average disposable income per household as the main income measure. Note though that over recent decades average income per household has increased less than average income per person. This is because of the move to smaller households, as measured on a persons per household basis.

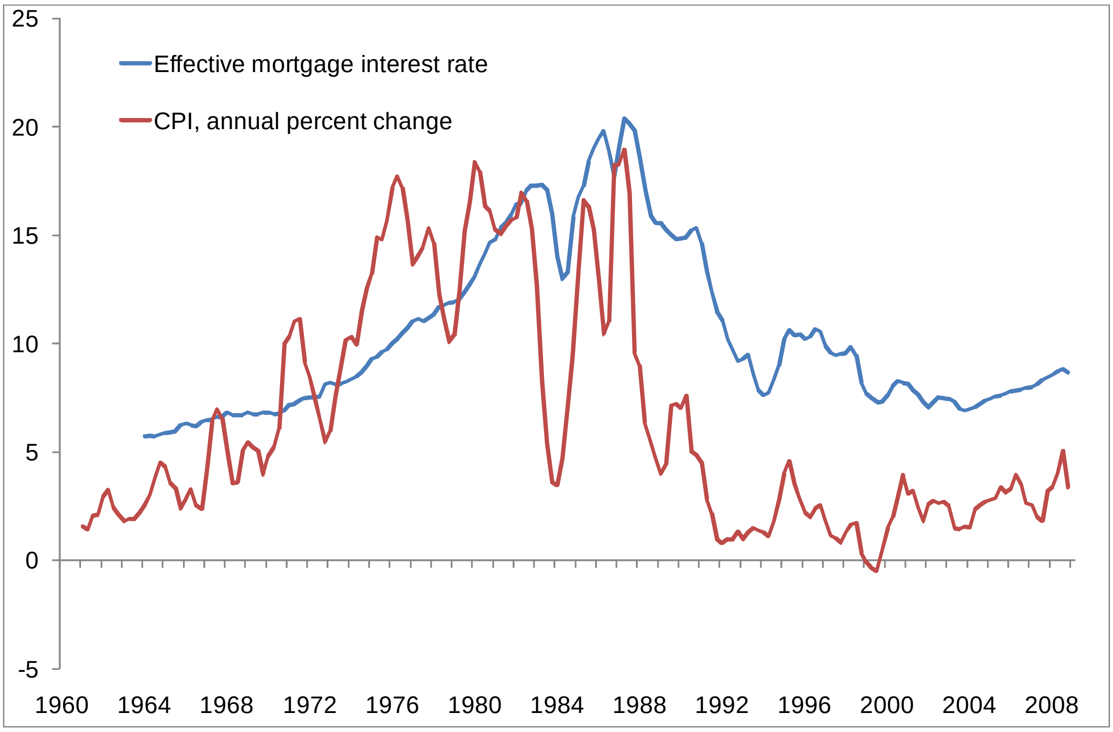
Figure 9 shows that since the late 1980s there has been a growing gap between the price of a house (the blue line in Figure 9) and average income per household (the orange line). By itself this gap would have made housing less affordable. However, this would have been offset, at least to some extent, by the general decline in nominal interest rates over the same period. Lower interest rates would have affected the level of mortgage payments, thereby making housing more affordable that it would have otherwise been.

Figure 10 shows how the effective mortgage interest rate and inflation have changed over time.[12] As can be seen, inflation fell sharply between 1987 and 1992 and has generally stayed low since then. As inflation eased, so did nominal interest rates. The effective interest rate reached a low point in 2004.

[12] The effective mortgage interest rate is the average rate of all the housing mortgages that are currently in place.

Figure 10 Mortgage interest rate and CPI inflation

Percent



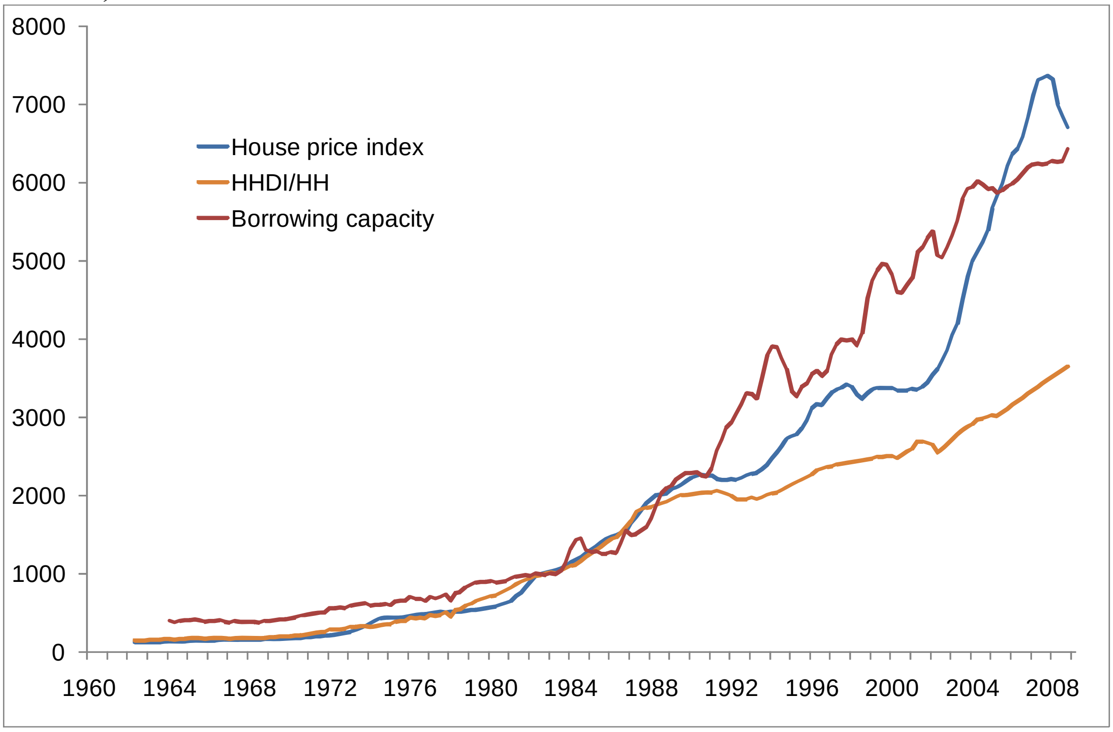
Sources: Reserve Bank of New Zealand, Statistics New Zealand

We calculated a synthetic variable, 'borrowing capacity', using average disposable income per household and the effective mortgage interest rate. For each period, this borrowing capacity was taken to be the amount that a household on the average income could borrow via a table mortgage at the effective mortgage rate. This amount was determined by the household's monthly payments, which were set at 35% of the household's monthly income. It was assumed that the mortgage term was 25 years.

As Figure 11 shows, borrowing capacity increased sharply from the late 1980s, increasing more strongly than household disposable income. During the 1980s borrowing capacity was at a low point relative to household disposable income. This is because of the high effective mortgage rate at that time.

Borrowing capacity tracks reasonably well with the house price index. In view of this, average household disposable income and the effective mortgage interest rate were seen as being prime candidates for the trend equation in our co-integration model.

Figure 11 House prices, household disposable income, and borrowing capacity
Indexes, base 1982/83 = 1000



Sources: Quotable Value, Statistics New Zealand, Reserve Bank of New Zealand

Two papers in the house price literature that have used average household income and an interest rate in a trend house price equation are IMF (2003) and Abelson et al (2005). In effect they relate the price of housing to the household sector's ability to finance a house purchase.

The IMF paper estimated a vector error correction model for UK house prices from data for 1972-2001. The trend model was for real house prices, with the independent variables being real income per household and real interest rates. The coefficient on the real income variable was 1.3. This indicates that a 1% increase in real income is associated with a 1.3% increase in real house prices. The coefficient value of 1.3 seems high, especially given that it was estimated over a long sample period. In the long run, it would be expected that the rise in real house prices would be similar to the rise in real income, and that the value of the coefficient would be close to 1. The IMF paper notes that cross-country studies have linked high income sensitivity of house prices to high loan to value rates.[13] The IMF's short run model uses lagged changes in real house prices, real interest rates and real income per household.

The paper by Abelson et al describes a model for real house prices in Australia over the 1970-2003 period. The trend equation's explanatory variables included real household disposable income per capita, the real mortgage rate, the unemployment rate, the detached housing stock per capita, and the CPI. The coefficient on disposable income per capita was 1.4 over the full sample period and 1.7 for the period from 1975. Again these values seem high.

While these overseas studies modelled real house prices, we estimated a nominal model for New Zealand. As we saw earlier, it had been changes in nominal interest rates and their interplay with nominal incomes that had resulted in substantial increases in borrowing capacity.

[13] IMF (2003), p6.

The estimated trend equation is:

$$\ln(HPI) = \underset{(109.7)}{1.171} \ln(HHDI/HH) - \underset{(-5.5)}{1.516} IR - \underset{(-62.8)}{5.959} \qquad (5)$$

where
HPI is the house price index
HHDI/HH is household disposable income per household
IR is the effective mortgage interest rate.
ADF tests indicate that all three series are I(1) variables.

t values are in brackets.
Sample period was 1965Q1 to 2002Q1. As with the earlier equation using GDP, the estimation period does not include the latest house price cycle.

The equation was estimated using dynamic OLS. Using this approach, the equation is estimated including lags and leads of changes in the independent variables, as well as the levels for the independent variables. This is done in order to produce valid t statistics. The change variables used ran from lag 3 through to lead 3. Coefficients for these variables are not shown here, but are shown in the appendix.

An Engle-Granger test was also conducted on the trend equation.[14] Under the Schwartz information criterion, with order of augmentation 3, the t-value was -4.43. This is lower than the critical value of -3.90 for the 1% significance level.[15] Hence the null hypothesis that the equation's residuals had a unit root was rejected at the 1% level.

Furthermore, the Johansen cointegration test rejected the null hypothesis that there were zero cointegrating vectors for the variables included in the equation.

The results of these two tests suggest that house prices are cointegrated with disposable income per household and the effective mortgage rate.

A short run equation that we estimated is:

$$\Delta\ln(HPI) = \underset{(18.9)}{0.824} (\Delta\ln(HPI))_{-1} + \underset{(0.7)}{0.0250} (\Delta\ln (HHDI/HH))_{-1} + \underset{(0.4)}{0.0631}\Delta IR_{-1}$$

$$- \underset{(-4.21)}{0.0418} Resid_{-1} + \underset{(1.1)}{0.00161} \qquad (6)$$

where
$Resid_{-1}$ is the lagged residual from equation (5).[16]

The sample period is 1965Q3 to 2002Q1. $R^2 = 0.746$ and t values are in brackets.

The t values for HHDI/HH and IR indicate that these variables are not statistically significant (the sign on the change in the interest rate is also wrong). However, the coefficient on the lagged residual from the long run equation is statistically significant at the 1% level, and the

[14] The equation used for this test included only level variables and was estimated using simple OLS. This is because the critical values for the Engle-Grainger test were derived assuming that this approach is used.
[15] See Wooldridge (2006), p649.
[16] $Resid_{-1}$ is equal to $[\ln(HPI) - 1.171 \ln(HHDI/HH) + 1.516\ IR + 5.959)]_{-1}$

coefficient is negative (as is required for an error-correction model). This adds some support to house prices being cointegrated with disposable income per household and the effective mortgage rate.

Fuller details on the equations are set out in the appendix.

Some general comments on the results:

- As noted earlier we would expect the coefficient on disposable income per household in the long run equation to be close to 1. The estimated coefficient is 1.17, and a Wald test indicates that the coefficient value is significantly different from 1. The results suggest that, if interest rates had stayed constant over the sample period, then over time households would have used an increasing proportion of their income on mortgage costs. This seems plausible, given the long term move to lower persons per household.

- The coefficient value of 1.17 may also reflect the influence of other factors. These factors could include increased access to credit following financial deregulation, and a higher propensity on the part of households to borrow. Another possible factor is the growth in the proportion of rental properties.[17] Furthermore, the rise in house prices, which may also be reflecting supply side factors – like the rise in section prices – as well as demand side factors, may have simply resulted in households having to devote more of their income to buying a house.[18]

- The short run equation presented here doesn't provide us with a clear explanation of the factors that might be driving the cyclical component of house price movements.[19] However, the value of the coefficient on the lagged dependent variable is high. This indicates that a large proportion of the inflation in one quarter carries through into the next. Also, the coefficient on the lagged residual from the trend equation has a low value, which indicates that the gap between the actual house price level and the equilibrium level is slow to close. Overall, the short run equation reflects the fact that house price cycles – once they get underway – tend to be large and long lasting.

We can use the long run equation from the affordability model – and also the GDP equation – to illustrate the implications of a trend/cycle decomposition. Figure 12 shows the house price index and the estimates made using both models.[20] As can be seen, the latest actual value is higher than the trend levels indicated by the equations. Figure 13 shows that the value from the affordability model is currently around 20% lower than the actual value. Note that a gap like this can close from both above and below – by falls in house prices and by increases in the trend value. For example, if income per household was to increase at the same rate as it

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17 The house price unit report (Department of Prime Minster and Cabinet 2008) indicates that the tax treatment of rental properties means that investors can generally afford to pay more for a property than owner-occupiers (p34).

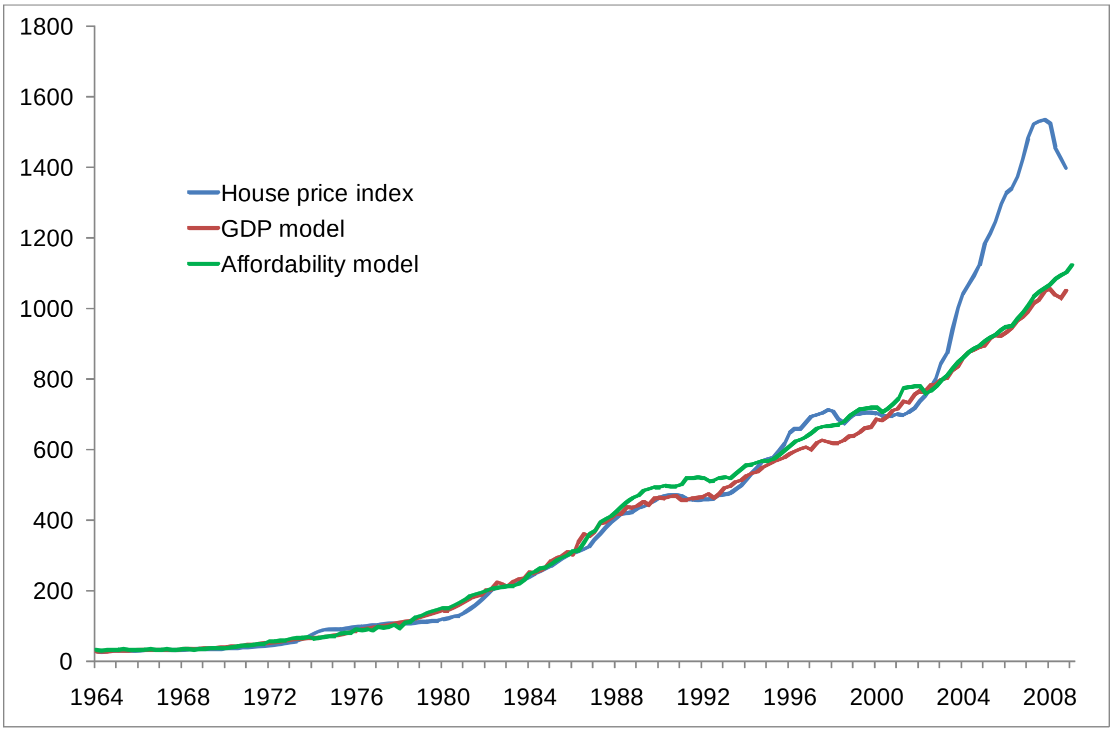
18 We estimated a regression that related the log of house prices to the log of borrowing capacity. The coefficient on the borrowing capacity term was 1.244 and this was significantly different from 1. This suggests that even if changes to interest rates are taken into account, the debt servicing ratio for a household on the average income that purchases a house has risen over time.

19 Further work would involve trying to identify a range of variables – such as changes in population or credit – that might account for cyclical variations. Surprisingly, we haven't yet found variables based on migration or changes in population that enter the short run equation. This is despite the dominant role of net migration in the equation for quarterly changes in New Zealand house prices in IMF (2008) and IMF (2009).

20 The estimates from the two models from 2002 onwards are out-of-sample estimates, given that the estimation periods for the models ended in 2002.

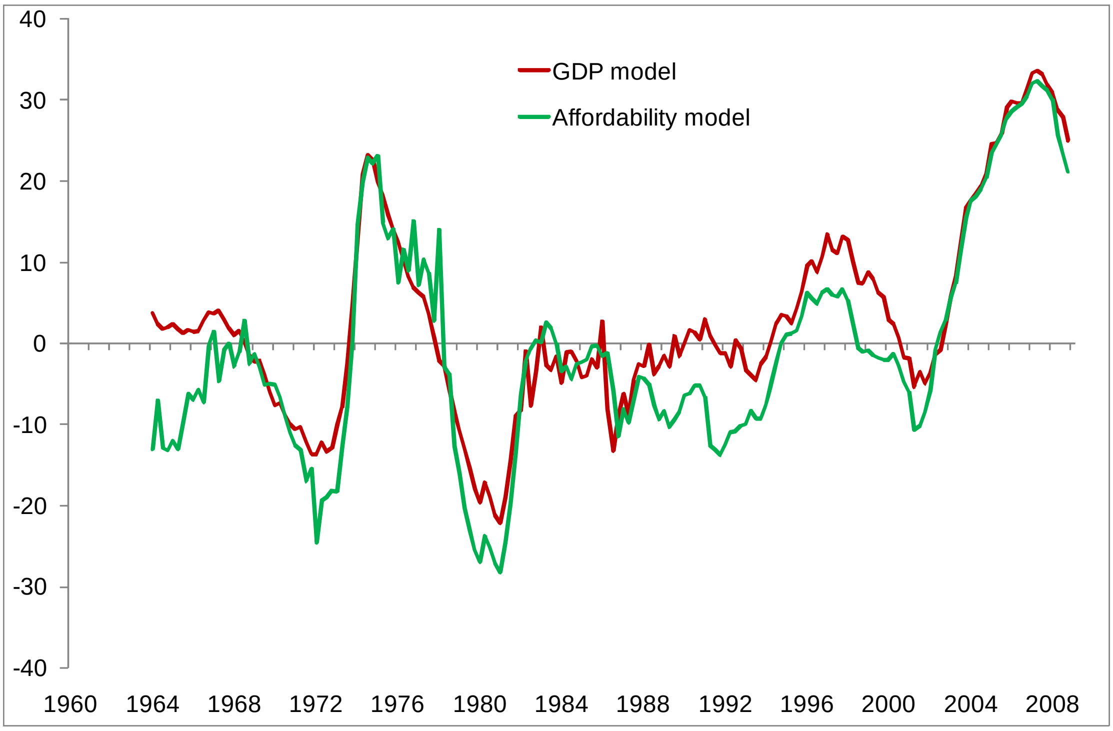
has done recently, the gap would reduce by nearly 5% a year, even if house prices and interest rates remained unchanged.[21]

Figure 12 House price index and estimates of trend values
Value of index



Source: Quotable Value, Reserve bank of New Zealand

Figure 13 Gaps between house price index and estimated trend values
Percent of actual value



Source: Reserve Bank of New Zealand

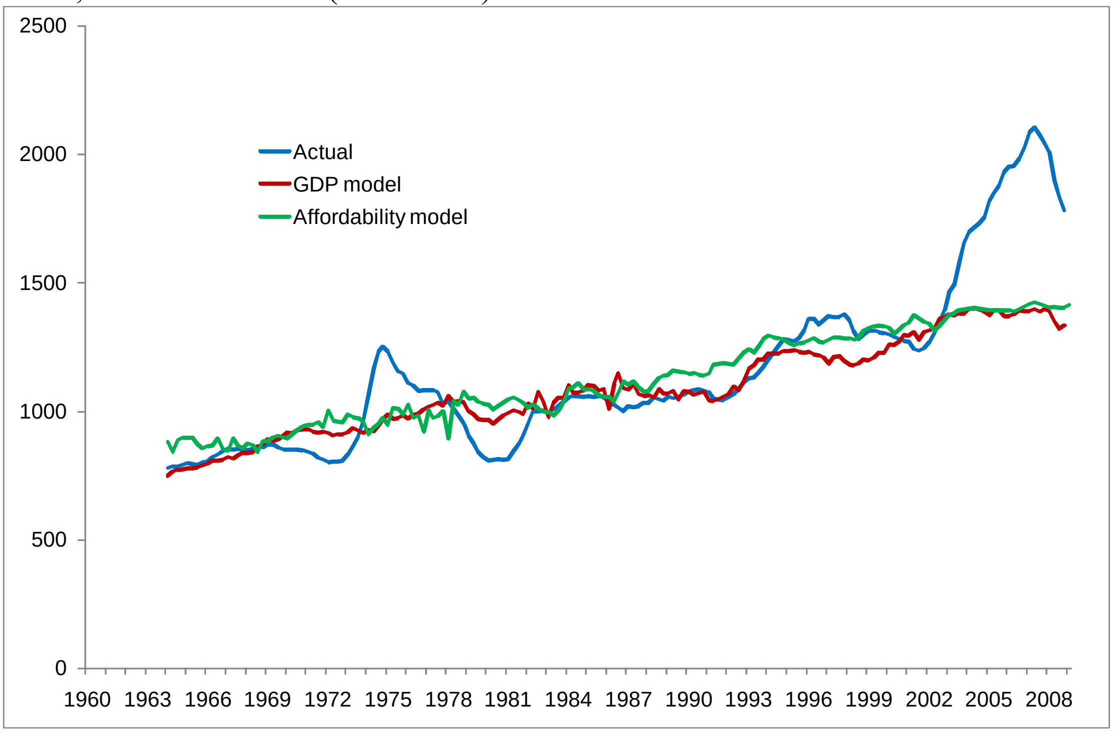
[21] The gaps in Figure 13 have been expressed as a proportion of the actual house price index, rather than the estimated trend value. They therefore indicate how much the actual value would need to change in order to match the trend value.

As yet, we have done no work on combining long and short run equations in order to increase explanatory power. It is possible that cyclical factors that are not currently in our short run equation, such as net migration, may be relevant.

Figure 14 shows estimates of the trend house price relative to disposable income per household. This chart differs slightly from Figure 7 in that it is based on ratios of indexes rather than ratios of dollar values. As can be seen, over the long term there has been a rise in the ratio of the trend house price to disposable income per household. This ratio has levelled off a bit in recent years, reflecting higher interest rates.

We can use the components of equation (4) to estimate the contributions to this trend price to income ratio. Since the coefficient on income per household variable is greater than 1, this results over time in a significant rise in the estimated trend level of house prices relative to income per household. We looked at the contributions from 1987 – when the CPI inflation rate fell and the effective mortgage interest rate began its substantial decline – through to the present. We found that the contribution coming from the income variable accounted for around half of the rise in the trend house price to income ratio that has occurred since 1987. The other half was accounted for by lower nominal interest rates.

Figure 14 Ratio of house price index to disposable income per household
Index, base 82/83 =1000 (for 'actual')



Sources: Quotable Value, Reserve Bank of New Zealand

The impact of the sample period on results

In estimating the trend equations for both the GDP model and the affordability model, we ended the estimation period at 2002Q2. As noted earlier, we excluded the latest house price cycle from the estimation period, since it was felt that the high values of house prices at the end of the series could reduce the accuracy of the parameter estimates.

We looked briefly at how extending the estimation period to 2008Q4 would affect the estimates. In the GDP model the coefficient on ln(GDP) rises from 0.910 to 0.940. In the affordability model the coefficient of ln(disposable income per household) rises from 1.171 to 1.237. Also, the coefficient on the effective interest rate changes from -1.516 to -2.865, which is a very large change. It appears that the interest rate parameter becomes unstable when the recent period of very strong growth in house prices is included in the estimation period, suggesting that this recent period is unusual and deserves further investigation.

Results obtained using the re-estimated GDP model are not substantially different from earlier results. The higher coefficient on ln(GDP) results in a slightly higher trend towards the end of the period. However the gap between the actual value and the trend value of house prices in 2008Q4 is still high, being around 18% of the actual value.

The re-estimated affordability model produces significantly higher estimates of the trend. In fact, trend values exceed actual house prices in 1996, when the 1990s house price cycle was at its peak. The re-estimated model does not seem to provide a plausible view of the trend in house prices. Despite the major shortcomings of the re-estimated model, it shows the gap between the actual value and the trend value of house prices in 2008q4 as being around 10% of the actual value.

Overall, it seems that trend estimates from the GDP model are likely to be less influenced by changes to the estimation period than those of the affordability model.

4. Conclusions

Bringing together what we have found:

- This exploratory study suggests that it is possible to model house prices in terms of factors which account for a slow-moving trend movement in the price, and short term influences which account for the cycle.

- In our cointegration framework, we find evidence that disposable income per household and mortgage interest rates have explanatory power as long run influences on house prices.

- It is perhaps a little surprising that these two variables – which together reflect households' borrowing capacity and which are largely demand-side in flavour – should by themselves account for long term movements in house prices. On the other hand, it appears that over recent decades the cost of buying a section and building a new house has generally moved in line with house prices overall. Hence, it seems that the price of new housing has not been constraining the prices of existing housing.

- Our results suggest that the fall in nominal inflation from the late 1980s, and the associated fall in nominal interest rates, did have an effect on the level of trend house prices. However, this study suggests that other factors besides interest rates are also behind the rise in the trend house prices. These factors would include increases in section prices and the cost of construction, which as noted above, will have had an impact on the cost of existing houses as well as new houses. Other factors might include increased access to credit following financial deregulation, and a higher propensity on the part of households to borrow. The tax treatment of rental properties and an increase in the proportion of rental properties may also have exerted upward pressure on prices. Overall, trend house prices have risen faster than disposable income per household. Whether the price/income ratio continues to rise may depend on whether financial deregulation has now run its course, and on whether the relative costs of housing supply can be reduced.

- The short run equation estimated here doesn't have much explanatory power. The high coefficient on the previous quarter's movement in house prices – together with the low coefficient on the error-correction term – indicates that the cycles in house prices around the trend are large and long. It may be the case that expectations about future prices have an important bearing on price setting behaviour in the short term.

- Over the long term, the price of an economy's assets can be expected to grow at a similar rate to nominal GDP. If we view housing as being an investment good, then we might expect that house prices would also grow at a similar rate to nominal GDP. This would seem reasonable, given that housing is in fact one of the economy's largest asset classes and is held by a wide proportion of the population. However, the simple GDP model that we derived indicated that growth in house prices has been lower than growth in nominal GDP. The estimates of the trend house price from this model were in fact similar to those from our affordability model, which treated housing as a consumption good. This affordability model was based on disposable income per household – which has generally grown at a lower rate than GDP – and interest rates. From this, we might conclude that, over the long term, house price growth is unlikely to exceed, or even match, growth in nominal GDP.

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Appendix: Details of equations

GDP equation

Dependent Variable: LOG(PQHPI)
Method: Least Squares
Date: 06/23/09 Time: 14:08
Sample (adjusted): 1962Q2 2002Q1
Included observations: 160 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(NOMGDP)	0.909851	0.005435	167.3998	0.0000
C	-2.798835	0.047587	-58.81500	0.0000

R-squared	0.994393	Mean dependent var	5.083129
Adjusted R-squared	0.994358	S.D. dependent var	1.161394
S.E. of regression	0.087237	Akaike info criterion	-2.027948
Sum squared resid	1.202436	Schwarz criterion	-1.989508
Log likelihood	164.2358	Hannan-Quinn criter.	-2.012339
F-statistic	28022.68	Durbin-Watson stat	0.090479
Prob(F-statistic)	0.000000		

Affordability model

Long run equation

Dependent Variable: LOG(PQHPI)
Method: Least Squares
Date: 06/23/09 Time: 14:18
Sample (adjusted): 1965Q1 2002Q1
Included observations: 149 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.958760	0.094839	-62.82998	0.0000
LOG(AVHHDI)	1.170533	0.010672	109.6810	0.0000
IR	-1.515715	0.276552	-5.480756	0.0000
DIR(-3)	2.546955	1.902822	1.338515	0.1830
DIR(-2)	0.939873	2.331744	0.403078	0.6875
DIR(-1)	1.612376	2.443543	0.659852	0.5105
DIR	1.906569	2.433441	0.783487	0.4347
DIR(1)	0.119667	2.451050	0.048823	0.9611
DIR(2)	0.604930	2.325470	0.260133	0.7952
DIR(3)	-0.279951	1.923966	-0.145507	0.8845
DAVHHDI(-3)	-0.545279	0.318057	-1.714405	0.0888
DAVHHDI(-2)	-0.916390	0.336943	-2.719721	0.0074
DAVHHDI(-1)	-0.928931	0.344054	-2.699956	0.0078
DAVHHDI	-0.880207	0.350570	-2.510789	0.0133
DAVHHDI(1)	0.324859	0.341724	0.950647	0.3435
DAVHHDI(2)	0.461128	0.328869	1.402165	0.1632
DAVHHDI(3)	0.383646	0.318768	1.203525	0.2309

R-squared	0.993469	Mean dependent var	5.213423
Adjusted R-squared	0.992678	S.D. dependent var	1.095633
S.E. of regression	0.093754	Akaike info criterion	-1.789247
Sum squared resid	1.160248	Schwarz criterion	-1.446515
Log likelihood	150.2989	Hannan-Quinn criter.	-1.650001
F-statistic	1255.017	Durbin-Watson stat	0.090816
Prob(F-statistic)	0.000000		

Short run equation

Dependent Variable: D(LOG(PQHPI))
Method: Least Squares
Date: 06/22/09 Time: 16:34
Sample: 1965Q3 2002Q1
Included observations: 147

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDEQDOLSALT(-1)	-0.041782	0.009930	-4.207502	0.0000
D(LOG(PQHPI(-1)))	0.824314	0.043561	18.92310	0.0000
DIR(-1)	0.063126	0.179539	0.351599	0.7257
D(LOG(AVHHDI(-1)))	0.024951	0.035221	0.708426	0.4798
C	0.001605	0.001432	1.120866	0.2642

R-squared	0.745807	Mean dependent var	0.021631
Adjusted R-squared	0.738647	S.D. dependent var	0.022450
S.E. of regression	0.011477	Akaike info criterion	-6.063546
Sum squared resid	0.018704	Schwarz criterion	-5.961831
Log likelihood	450.6707	Hannan-Quinn criter.	-6.022218
F-statistic	104.1578	Durbin-Watson stat	1.781360
Prob(F-statistic)	0.000000		