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Keywords: Real house prices; Real disposable income; Fundamentals; Present value; Time-varying risk; Bubbles; New Zealand.

JEL Classification Codes: G12, R31, G18.

House Prices and Bubbles in New Zealand

Introduction

Much attention is given by policy-makers and the media to the state of the housing sector, with the interest generated by the importance of housing on the general economy. For example, not only is housing the major asset in household portfolios (Englund et al., 2002; Flavin & Yamashita, 2002), but wealth effects have been shown to be greater for housing than for financial assets (Case et al., 2005; Benjamin et al., 2004). Helbling and Terrones (2003) also report that during 1970-2002 the output effects associated with housing price busts were twice as large as those of equity price busts and that the slowdown after a housing market collapse lasted about twice as long as the slowdown after a stock market crash (see also, Goetzmann & Ibbotson, 1990; Liang et al., 1996). Hence much of the attention on whether or not a housing bubble exists is driven by the need to control inflationary pressures in the economy as well as the negative impact that a sharp decline in house prices would have on the general economy.

House price bubbles have been the focus of several academic studies (for example, Abraham & Hendershott, 1996, for the U.S.; Ayuso & Restoy, 2003, for the U.K. and Spain; Chan et al., 2001, for Hong Kong). Housing bubbles have, however, been found to be quite modest in several countries (see Bourassa & Hendershott, 1995, for Australia; Hort, 1998, for Sweden; Bourassa et al., 2001, for New Zealand) although some evidence of regional speculative behavior is reported (Levin & Wright,

The focus of this paper is on the New Zealand housing sector. This is motivated by several unique reasons. First, New Zealand has experienced a relatively high number of housing peaks in recent years. In his OECD study, van den Noord, 2006, identifies four peaks in New Zealand during the period 1970-2005\(^1\) whereas, over the same period, most countries experienced two to three peaks. Second, the probability of reaching another peak if interest rates were to increase is substantially greater in New Zealand: van den Noord (2006), reports a probability of a turning point occurring of 34 percent if interest rates were to increase by 1 percent.\(^2\) This probability is only 12 percent, 9 percent and 14 percent for the U.S., U.K. and France, respectively. It is even zero in countries such as Germany, Japan and Switzerland. New Zealand has also figured prominently in The Economist House Price Indices as a country vulnerable to higher interest rates (The Economist 2006a, 2006b). Hence, given New Zealand households hold a disproportionately high percentage, eighty percent, of their assets in housing (Claus & Scobie, 2001), and also by OECD standards have extremely low holdings of direct and indirect equities,\(^3\) this makes it unique in comparison to other OECD countries. In fact, the value of residential rental property in New Zealand exceeds the capitalized value of the New Zealand stock market (Balmer, 2004), with the composition of direct holdings by households in the New Zealand domestic share market having declined rapidly since the 1980s and reached a point at the turn of the century whereby 50 percent of equity holdings were held offshore (Thorp & Ung, 2001).

Finally, recent studies of the New Zealand housing market have taken place against a background which is unusual with respect to the extent to which and speed with which it evolved from a highly interventionist economy to one of the most liberal in the world (Bollard et al., 1996). Starting in 1984, New Zealand began to institute a series of policies that shifted the country away from extensive state ownership of enterprises, public provision of services, price controls, regulation of business

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\(^1\) These occurred in 1974Q3, 1984Q2, 1989Q1 and 1997Q3.

\(^2\) Due to the high incidence of fixed rate mortgages (typically of two to five years) in New Zealand, an increase in interest rates may take some time to impact fully on market prices.

\(^3\) New Zealand households hold less than 4 percent of total assets in direct holdings of domestic and foreign equities; in the U.S., the comparable figure is 17 percent. The equivalent figures for indirect
investment, interest and foreign exchange rate controls, and centralized labor bargaining. As a result of these policies, government enterprises were “corporatized” and privatized, provision of services was contracted out, regulatory monopolies and price and entry controls were removed, the currency was allowed to float, centralized labor agreements were replaced by voluntary unions and bargaining at the enterprise and individual levels, and monetary policy was focused on maintaining low inflation. As we investigate a relatively long time period (1970-2005), some effects of these changes should be apparent.

We compute the fundamental value of housing based on the present value of real disposable income, thus capturing what households have to spend after taxes and inflationary pressures in the economy. This is in contrast with much of the housing literature, which derives fundamental values from an equilibrium model containing variables such as real income, employment, real construction costs, and real interest rates. When a present value model is used, then generally a constant discount rate is considered (for example, Chan et al., 2001), while in this study we follow the empirical framework of Black et al. (2007) and allow the risk premium to vary over time according to the product of the coefficient of relative risk aversion (CRRA) and the expected variance of returns. The model is therefore forward-looking and dynamic in nature – arguably a necessary requirement for an analysis of what was a fast evolving and interesting period in New Zealand history.

Our analysis of housing deviations from fundamentals is firmly embedded in the financial economics literature where deviations from fundamental values are commonly envisaged in terms of explosive, intrinsic and momentum explanations. We model the bubble component that is related to fundamentals (the intrinsic component), making it possible to highlight whether a bubble still exists after that component is accounted for. We then analyze any remaining bubble to detect any momentum behavior. We find that disparities between the actual and fundamental price of housing are particularly noticeable in the early 1970s and 1980s and from 2000 to 2005. As of the end of 2005, actual prices are 24.73 percent higher than that warranted by real disposable income. Much of the overvaluation of the housing market is found to be due to price dynamics rather than an overreaction to fundamentals.

Ownership of equities (% of GDP) are 4 percent and 35 percent respectively (Reserve Bank of New Zealand Governor’s speech, 2006).
The remainder of the paper is organized as follows. We first present our empirical framework, then a discussion of the data and some preliminary results. The empirical results are discussed next, while concluding remarks are contained in a final section.

Empirical Framework: Fundamental House Prices v. Actual House Prices

We begin by assuming that the real value of the representative agents residential property, \( V_t \), will be a constant proportion, \( \gamma \), of the expected value of future real disposable income, \( Y_t \), discounted at the real, possibly time-varying, discount rate, \( \rho^* \), representing the rate of return required by householders. Hence the real value of household property can be written as:

\[
V_t = \gamma E_t \sum_{i=1}^{\infty} \frac{1}{\prod_{j=1}^{i}(1 + \rho^*_{t+j})} Y_{t+i}
\]

Following the representative agent method, we assume equation (1) to hold for the economy as a whole and in our empirical work we use an aggregate house price index rather than market capitalization as the variable on the left-hand side. This involves the assumption of a constant relationship between the real house price index, \( P \), and market capitalization, \( V \). Moreover, the application of (1) to the whole economy involves a further constancy assumption about the relationship between the value of all income (to which \( Y \) applies) and those covered by the index. These two constancy assumptions are therefore maintained in the empirical work that follows.

We assume \( P_t = \beta V_t \), and, defining \( \beta = \beta'(\gamma) \) and \( Q_t = \beta Y_t \), equation (1) can be re-written as:

\[
P_t = E_t \sum_{i=1}^{\infty} \left( \frac{1}{\prod_{j=1}^{i}(1 + \rho^*_{t+j})} \right) Q_{t+i}
\]

Both \( P_t \) and \( Q_t \) therefore are linked to \( Y_t \) via \( \beta' \) and \( \gamma \) and we have a relationship between house prices and income such that: \( P_t = \beta'(\gamma)Y_t \). Equation (2) is a particular solution to: \( P_t = E(P_{t+i} + Q_{t+i})/(1 + \rho^*_{t+i}) \), which converges to (2) by...
applying the transversality condition \( i \to \infty, E(P_i)/(1 + \rho_i^*) = 0 \) (i.e. ruling out bubbles) and solving recursively forward. There exists evidence of course that in the long run the ratio of house prices to income is not constant.\(^4\) However given that we use quarterly data, our sample period is relatively short, and we do not impose a constant cost of capital, these ratios are unlikely to vary substantially in practice – most of the variation in \( V \) reflects fluctuations in \( P \) and index coverage changes infrequently. Hence the real value of residential property is modeled as the expected value of future real disposable income discounted at the real discount rate with real income and interest rates being key determinants of real house prices (for further supporting evidence, see Capozza et al., 2004; Sutton, 2002; Case & Shiller, 2003; Farlow, 2004).

Equation (2) therefore forms the basis for the calculation of fundamental house prices and we capture the size of the deviations of New Zealand residential real house prices from their fundamental value by the adaptation of the vector autoregressive (VAR) methodology initiated by Campbell and Shiller (1987, 1988a, 1988b).

Using a first order Taylor approximation, transforming the variables to ensure stationarity, and taking conditional expectations, we arrive at the following expression for the empirical model - see the Appendix to this paper for a full discussion of the model:

\[
pq_t = \frac{k - f}{(1 - \mu)} + \sum_{j=0}^{\infty} \mu^{j+1} E_t^\prime \Delta q_{t+j+1} - \alpha \sum_{j=0}^{\infty} \mu^{j+1} E_t^\prime \sigma^2_{t+j+1}
\]

where \( \mu \) and \( k \) are linearization constants; \( f \) is the constant real-risk free component of real required returns; \( E_t^\prime \Delta q_{t+j+1} \) is the conditional expectation of income growth; \( E_t^\prime \sigma^2_{t+j+1} \) is the conditional expectation of the variance of returns; and \( \alpha \) is the coefficient of relative risk aversion (CRRA). Hence we follow the work of Merton (1973, 1980) on the intertemporal CAPM and model the time-varying required return as the product of the CRRA and the expected variance of returns.

In order to utilize (3) to find the implied or fundamental house price, \( p_t^* \), we use a 3-variable VAR (\( pq_t, \Delta q_t, \) and \( \sigma^2_t \)) to forecast real income growth and housing return variance and, from this, construct a measure of the fundamental house price-

\(^4\) Meen (1996) for example shows that a range of policy shocks can cause a shift in the relationship between prices and income over the long-term, particularly if the user cost of capital is constrained to be constant.
disposable income ratio, \( pq_t \). Finally, from the fundamental (log) price-income ratio \( pq_t^* \), we can generate the (log) of fundamental house prices as:

\[
p_t^* = pq_t^* + q_t
\]

(4)

where \( p_t^* \) denotes the (log) fundamental measure of house prices.

A formal test of whether \( p_t \) and \( p_t^* \) are significantly different from zero is conducted by restricting the VAR coefficients and constructing a Wald test with degrees of freedom equal to the number of restrictions imposed – in this case three.

Given the above, we can identify the sign, size and significance of any deviations of actual house prices from their fundamental value (as warranted by real disposable income).

**Data and Preliminary Statistics**

Data

The data covers quarterly periods from 1970:1 through to 2005:4. Data on house prices were sourced from Quotable Value New Zealand’s Residential Sales Summary quarterly publications and the Reserve Bank. This index measures average prices of freehold house sales adjusted for the quality mix of sales in each period. The interest rate data used throughout this study were obtained from the Ibbotson Associates database. Since reliable IMF Treasury bill data were only available from May 1986, the (real) IMF New Zealand Long-Term Government bond series was used to provide a continuous series of total returns from a relatively risk-free asset. Investigation of the data reveals a very high degree of correlation between the substituted interest rate and the optimal short-term rate for the later period that both series are available. The macroeconomic data were obtained from various sources: the consumer price index (CPI) was obtained from the Reserve Bank and was used to deflate asset data, thus providing prices in real terms. Real disposable income (RDI) was sourced from Statistics New Zealand. Where comparisons are made between housing and equity asset classes, the latter data were sourced from Ibbotson Associates and covers the period 1988 through 2005.\(^5\)

In the empirical work reported below, real disposable income data are scaled so that the log of real house prices–income ratio, \( pq_t \), is in the same units of
measurement as the log of the real house price-rent ratio (or the price-dividend ratio in the case of stock prices). The scale factor is calculated as \( ((1+R)P_{t-1}P_t)/Y_{t-1} \) where \( R \) is the real required return, \( P_t \) is the value of the house price index at time \( t \) and \( Y_{t-1} \) is lagged real disposable income. The value of \( R \) is calculated as the sample average quarterly change in the gross price index.\(^6\) The log of the product of the scale variable and real disposable income gives a time series of disposable income in the same dimensions as those of rents (or dividends) and is denoted \( q_t \). The restrictions imposed on the model also require a measurement of the CRRA, \( \alpha \). In accordance with Merton (1973, 1980), Campbell and Shiller (1988a), and Boyle (2005), \( \alpha \) is imposed on the model and measured as:

\[
\frac{\bar{er} + (\sigma_{er}^2/2)}{\sigma_{er}^2}
\]

where \( er \) denotes returns in excess of the risk-free rate, an overbar denotes a mean value and \( \sigma_{er}^2 \) denotes the variance of returns in excess of the risk-free rate. All variables in the VAR are in terms of their deviations from means, thus avoiding the necessity of including a constant in the VAR equations.

Preliminary Statistics

Table 1 provides some summary statistics for key variables of interest. It indicates that, over the period, the average quarterly real capital gain to housing was 0.7 percent or 2.8 percent per annum. With an average real return of 1.6 percent per annum from the risk-free investment, this implies an annual excess return on housing over a long-term government bond of 1.2 percent. Further, the housing out-performance appears to have been achieved while facing relatively less \textit{ex post} risk as measured by sample standard deviations. Interestingly, further analysis shows (not reported) that over the period 1988–2005, average real housing capital gain rose to 4.06 percent per annum, whereas for New Zealand stock prices this was negative at -0.25 percent per annum. However, when dividend income was included in the stock return the average real annual stock return rose to 4 percent. While no data on rents are available, the literature assumes this to be around 5 percent per annum which would imply an annual real total housing return of 9.06 percent over this sub-period, thus indicating an

\(^5\) No consistent time series of equity data is available for New Zealand prior to this date.

\(^6\) Due to the lack of rental data, it is common in the real estate literature to add 5 percent per annum to the price index to proxy the gross index.
average total (non-risk adjusted) out-performance of housing over stocks of 5.06 percent per annum.\(^7\)

Claus and Scobie (2001) in arguing why housing is such an important element in New Zealand households’ portfolio suggest that relative rates of return to real assets tend to be higher during periods of high inflation. In New Zealand this was the case for much of the 1970s and 1980s, and Claus and Scobie suggest that this led to low and falling real interest rates and negative real returns on some financial assets as prices and inflation expectations only adjusted sluggishly. With the exception of housing returns, the J-B statistics provide evidence of non-normality for the variables of interest and they also appear to be stationary at conventional levels of significance.

**Empirical Results**

Fundamental v. Actual Prices

Table 2 reports the statistics and tests for the time-varying risk model discussed in the empirical framework section of this paper. On the basis of Ljung-Box tests for serial correlation and Akaike Information Criterion (AIC) and Schwarz information Criterion (SC) tests for the optimum lag order, two lags were imposed on the VAR system to ensure the model was correctly specified.

The \( CRRA (1.451) \), computed as described above and imposed on the model is similar to that reported for the New Zealand stock market over an overlapping period (Boyle, 2005 calculated this at 1.4), the latter also being at the low end to those reported for stock prices in other developed markets (the conventionally accepted range being 1-10 for stock prices, Abel, 1991, p. 9).

The (adjusted) \( R^2 \) is highest for the price-disposable income ratio due in part to the high significance of own lagged house price-income ratio. According to the \( Q \) statistic, the lag length is adequately specified.\(^8\) As far as the reported linear Wald statistics are concerned, for house prices and real disposable income we can convincingly reject the null hypothesis that the difference between the fundamental price and actual price is zero.

\(^7\) The *nominal* annual capital gain and total return to equity over this sub-period was 1.6 percent and 6.84 percent, respectively.

\(^8\) The VAR coefficient estimates (not reported) indicate one-way causality from income growth to the house price to disposable income ratio and dual causality between the price income ratio and house price return variance.
Figure 1 plots the actual and computed fundamental (warranted by real disposable income growth) residential house prices over the sample period. Disparities between the actual and fundamental price are particularly noticeable in the early 1970s and 1980s, and during 2000 to date. By the end of the time period, actual prices are 24.73 percent higher than that warranted by real disposable income, there being a steep rise in house prices following on from an undervaluation, the trough of which occurred in 2001:2. However, unlike other studies using international housing data, there is no evidence of large overvaluation in the mid-late 1980s (see for example Black et al., 2007; Hawksworth, 2004; Ayuso & Restoy, 2003) – in fact from the late-1980s to 2000, New Zealand house prices would appear to be quite close to fundamental value and, if anything, tending to lie at, or just below, fundamental value. This is consistent with results contained in Bourassa et al. (2001) who point to only modest bubbles in the housing markets of Auckland, Christchurch and Wellington and would tend to suggest that the market took some time to recover from the dramatic decline in prices at the end of the 1970s and early 1980s. Importantly, the economy during this period was in the final stages of high state intervention and was performing poorly.\(^9\) Related to the poor economic performance, New Zealand was experiencing net external migration: during 1977 through 1981 this averaged approximately 0.66 percent, this from a population of approximately 3.2 million. Notably, the three years from 1973 to 1975 had above average excess of arrivals to New Zealand (New Zealand Official Yearbook, 1984), a feature that Bourassa et al. also find important over different time periods. Further, the dip in house prices in the late 1990s to 2001 was shorter lived than those reported for the U.K., where so-called ‘negative housing equity’ was evident from 1992 through 2001 with the turning point being in 1996.

The propensity of the New Zealand market to experience ‘negative housing equity’ however, does imply that deviations from fundamental value over periods of undervaluation are unlikely to have been driven by an explosive rational bubble due to

\(^9\) Inflation peaked in 1980 at 18.4 percent and was 15.2 percent in 1981. The five years preceding 1980 had inflation of 13.0 percent, 17.6 percent, 13.2 percent, 14.7 percent and 10.6 percent. Unemployment rose steadily between 1978 and 1980, in 1981 it was 3.1 percent. This latter figure is to be compared with the maximum between 1960 and 1977 which was 0.6 percent. Employment growth was actually negative for 1981, only the third negative figure in 21 years. The six years from 1976 through till the end of 1981 were poor for real output growth, over the period it only averaged 0.5 percent. Real wages were at a level slightly below that of 1972 (Dalziel & Lattimore, 2001). Real disposable income growth was also negative in 1980 and again during 1982 and 1983.
extraneous factors (that is factors other than those related to fundamentals): such an explosive bubble cannot be negative as this would imply a negative expected asset price at some date in the future and violate free disposability (see for example Diba & Grossman, 1988; Campbell et al., 1997, p. 259). However, while a zero price floor puts a limit on how far prices can fall, as Farlow (2004), p. 12, explains, it does not exclude the possibility that real payoffs in debt-backed housing can go below zero, with the New Zealand experience of negative equity in the late 1970s and late 1999 to early 2003 demonstrating this.

As a comparison between asset classes, Figure 2 considers actual and fundamental stock prices using real dividend growth as the driver of the stock prices but over the period where consistent time series were available, i.e. 1988:1 – 2005:4. Unlike real house prices, real stock prices have been relatively close to their fundamental value as warranted by real dividend growth and, with a Wald statistic of 3.2395 (p=0.356), we cannot reject the null of no significant difference between the two equity series. In contrast to house prices, at the end of the sample, real stock prices were approximately 5 percent below their measured fundamental value. Again, this is in contrast to results reported for the U.S. and Australia (see for example Black et al., 2003a and 2003b).

Overall, real house prices deviations from fundamentals display different behavior than those for stock prices, with the latter, in recent years at least, appearing to be able to track fundamentals relatively well. One reason for this may be that the New Zealand stock market has historically had one of the highest real income returns in the developed world.10 In such a scenario, investors will be insulated to some extent from booms and busts as a change in price will have a relatively small impact on the overall return. Further, the New Zealand market missed the ‘dot com’ bubble of the early 2000s.

Hence while discussions above would tend to preclude the existence of an explosive rational bubble due to non-fundamental factors as being the driving force of deviations from fundamental value in the housing market, it does not preclude the existence of a type of bubble which could be both negative and in the process of collapsing. An interesting question therefore is how can we interpret what drives deviations of house prices from their fundamental present value?

10 Over the period 1988Q1 to 2005Q4, the New Zealand real income return was 5.22% compared to 2.36% for the U.S., 3.28% for the U.K., and 4.02% for Australia (Ibbotson Associates database).
Deviations from Fundamental Value: Fundamentals v. Price Dynamics

Froot and Obstfeld (1991, p. 1180) posit that deviations in asset prices from fundamental values can be explained by the presence of a particular type of rational bubble that depends exclusively on aggregated values of the fundamental: here, this is real disposable income. They call such rational bubbles ‘intrinsic’, being non-linear deterministic functions of the fundamentals of asset value alone.11

In common with explosive rational bubbles, intrinsic bubbles rely on bounded rationality and self-fulfilling expectations, but such expectations are driven by a non-linear relationship between prices and the fundamentals themselves, rather than factors extraneous to the asset value. Further, unlike explosive rational bubbles, such bubbles do not continuously diverge but periodically revert toward their fundamental value. Hence the ‘bubble’ element in house prices is constant if the fundamental is constant but will change in a non-linear way along with the level of fundamentals: if the fundamental is persistent then so is the bubble and prices will exhibit persistent deviations from fundamental present value (see for example Cuthbertson, 1996, p. 163). This captures the idea that asset prices overreact to news on fundamentals:12 for a given innovation in (log) fundamentals and the belief that the relevant price function is non-linear, the expected change in the asset price will, for some time, deviate from the present value or fundamental price (Froot & Obstfeld, 1991, p. 1193).

Essentially, the existence of an intrinsic bubble violates the transversality condition that the expected asset price goes to zero as time goes to infinity. However, agents will eventually learn that their expectations regarding fundamental realizations are unreasonable, and therefore are not forever stuck on a path along which fundamental price ratios eventually explode (Froot & Obstfeld, 1991, p. 1190).13 At the heart of such an argument is the concept of arbitrage, which in housing markets is impeded by the fact that the asset is heterogeneous, is traded in a highly segmented

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11 If bubbles are uncorrelated with fundamentals, in order to be arbitrage free they must be expected to grow at a rate of $1 + \rho$ per period and the bubble and fundamentals will be driven apart at an explosive rate.
12 There exists a large literature on stock market overreaction including evidence on predictability (see for example Dissanaike, 1997, using U.K. data) and overreaction persistence (see for example Chen & Sauer, 1997, using U.S. data).
13 It is important to note, however, that other ‘rational’ explanations are observationally equivalent to the intrinsic bubble explanation: regime shifts and managed fundamentals, can also explain non-linearities in the price-fundamental process (Froot & Obstfeld, 1991; Ackert & Hunter, 1999).
market where information on fundamentals can be costly, does not have close substitutes and experiences relatively high and lumpy transaction costs, all of which would imply that any correction toward ‘true’ value can be a relatively prolonged process.

Alternatively, prolonged deviations from fundamental value can be due to so-called momentum investor behavior driven by price alone, 14 whereby agents buy after price increases and sell after price decreases (see evidence from stock markets, for example Shiller, 1984; Kyle, 1985; DeLong et al., 1990; Daniel et al., 1998; Barberis et al., 1998; Hong & Stein, 1999; Lui et al., 1999). Such momentum occurs when a price rise or fall is expected to continue to rise or fall: hence in an ‘up’ market buyers will pile in pushing prices up even further encouraging other buyers to do likewise, while in a ‘down’ market price falls lead to falling demand, discouraging buyers as they fear prices will fall further, leading to slowing demand even further. Given that housing tends to be demand determined over the business cycle (due to relatively high supply constraints) this, along with the impediments to arbitrage cited above, can lead to ‘inefficient’ pricing of real estate being perpetuated for relatively long and often uncertain periods when compared to financial assets. 15 As Farlow (2004) argues, this is particularly relevant to residential real estate, as housing markets tend to be short on the aggressive intervention of ‘efficient’ arbitrageurs.

In an attempt to distinguish between the competing hypotheses of rationality versus irrationality in the New Zealand housing market, we focus on the rational intrinsic argument and its implications. To consider this we begin with a comparison of price deviations from fundamental present value with a series that represents periods when real disposable income was either above or below its long term trend – the ‘disposable income gap’ – and which is depicted in Figure 3. Essentially, if the intrinsic explanation of price deviations being due to overreaction to fundamentals has some value, then we should see some evidence of this by considering the association between deviations from trend and changes in asset price trends not explained by the present value model.

By inspection, the two series display different behavior at different periods in time. With the exception of the periods around 1980 and 2000, positive price

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14 Momentum in the changes in house prices can also result from momentum in the changes in fundamentals.
15 The fact that sellers of the residential housing stock tend to use local prices as a benchmark also perpetuates this process.
deviations from the present value fundamental appear to increase when real dispos- able income is rising toward or above its long-term trend value (and ability to pay is or expected to be relatively high) and similarly, negative price deviations also tend to be associated with periods when real disposable income is falling below its long-term trend value (and ability to pay is, or expected to be, relatively low). Since 1993, real income has gradually risen from below to above its long-term trend and, with the exception of the fall in house prices in around 1999, this has been associated with an upward trajectory in house prices culminating in the dramatic overvaluation since 2003. Essentially, when in mid-2001 negative price deviations from fundamental had peaked, real disposable income had already begun to quickly rise above trend value. There is some evidence therefore that housing costs relative to the ability to pay is a factor in housing price paths (see for example, Himmelberg et al., 2005).

Intrinsic rationality also implies that deviations from fundamental value will be more highly correlated with real income than with prices themselves, again suggesting that the dominant driving force is fundamentals rather than activities due to price dynamics. We report the relevant correlations in Table 3.

While we find that both pairs of variables depict a positive relationship, the association between deviations from fundamental value and house prices is relatively strong with the test statistic unambiguously rejecting the null of no association at the 1 percent level of significance. Thus contrary to the intrinsic rationality argument, the association between deviations from fundamentals and house prices is greater than that reported for deviations from fundamentals and real disposable income. While such features imply that, on average, differences between actual and fundamental values are dominated by irrational activities, it does not inform about the extent to which, over the sample period, bubbles are rational, due to fundamentals, or irrational due to price dynamics associated with momentum trading and the implied lack of aggressive arbitrageurs.

To investigate this further, we begin with the suggestion that (in levels):

\[ P_t = P_t^r + B_t \]  

(5)

where \( P_t^r \) is the present value fundamental price as denoted by equation (2) and \( B_t \) is an intrinsic bubble driven exclusively by fundamentals such that \( B_t = E(B_{t+1})/(1 + \rho_{t+1}^r) \) and is a solution to the present value model but one which violates the transversality
condition imposed on equation (2) that the expected price goes to zero as time goes to infinity.

How then might we empirically measure the extent of any intrinsic bubble inherent in house prices? Assuming that real disposable income follows an autoregressive process with drift, we hypothesize that the intrinsic bubble is a nonlinear function of the deviations of real disposable income from trend, thus

$$B_t = c Q_{d,t}^\lambda$$

where $c$ is a constant ($c > 0$), $Q_{d,t}$ denotes real disposable income deviations from trend and $\lambda$ ($\lambda > 1$) is the exponent that permits the bubble to grow in expectation at rate $1 + \rho_{t+1}$.

Substituting (5) into (6) and dividing through by $P_t^*$, re-arranging, taking logs of each side and using a first order Taylor series expansion allows us to specify a log-linear regression of the form:

$$p_t - p_t^* = b_t = c^* + \lambda^* q_{d,t} + \sigma_t$$

where lower case letters denote logs and $\sigma_t$ is an error term measuring the element of the deviations from present value that is not attributable to an intrinsic bubble. The fitted values of (7) will permit the construction of a series that mimics the path a bubble might take in response to whether income is above/below trend. When the bubble series, $B_t$, is combined with $P_t^*$, we have a present value price which includes a bubble price which can then be compared to actual prices, $P_t$.

The (heteroskedasticity and autocorrelation robust) regression results, are shown in Table 4. Notably, the constant term, which is insignificantly different from zero implies a value of $c$ close to unity. The slope coefficient is clearly insignificantly different from zero and the regression only explains 2.4 percent of movements in these deviations. According to the unit root statistic, the part of deviations from present value not explained by the regression (the residual series, $\sigma_t$), is non-stationary. Further investigation of the model residuals indicated that around 1975, 1980 and 2001, the residuals were significantly different from zero, implying that between 1982 through 2000, fundamentals had a more important role to play in explaining the path of actual house prices than in the remaining parts of the sample.
Figure 4 depicts three price series: the actual house price series, $P_t$, the fundamental (present value) house price series, $P^*_t$, and the present value house price series plus the bubble component ($P^*_t + B_t$). Interestingly, and in accordance with the above discussion, the fundamental price with the inclusion of the intrinsic bubble component does not appear to make a significant difference to the ability of the present value model to track actual prices, particularly in periods when over/under valuation is greatest – for example the 1970s, early 1980s and early 2000. Over the full sample, the gap between the actual price and the fundamental price with a bubble had a correlation with the actual price of 0.401, while from mid 1999 through 2005 this was 0.898. Over the same recent period, the ‘fundamental price with bubble gap’ had an association with income of 0.616, thus indicating that over this period both price dynamics and fundamentals were at work. However, while the present value model alone would predict that house prices were 24.73 percent overvalued at the end of the sample, with the inclusion of the intrinsic bubble component this only reduces to 20.89 percent, thus suggesting that much of the overvaluation is due to price dynamics rather than an overreaction to fundamentals. Interestingly, this result is in contrast those reported in Black et al. (2007) and Levin and Wright (1997), who present U.K. evidence at different levels of aggregation and over different time periods suggesting that the relationship between current house prices and the direction of the price path can be a relatively weak one.

Overall our evidence suggests that, in New Zealand, overreaction to fundamentals has a less important role to play in determining house price bubbles than price dynamics, particularly when the housing market is a long-way off its fundamental value.

Conclusion

The housing sector is an important asset class for household wealth. This is because the wealth effects from housing exceed those from financial assets, and housing busts have a greater impact on the economy than stock market busts. This paper compares real house prices relative to fundamental real house values, an issue that is important in both investment and policy-making decisions. Additionally, limited arbitrage opportunities imply that mispricing may occur for prolonged periods. In New
Zealand, this situation is exacerbated due to the composition of household asset portfolios. Our analysis considers whether ‘bubbles’ exist in the New Zealand housing market and whether they are driven by fundamental or momentum explanations.

It is crucial that policy makers identify the causes of escalating house prices. Rapid growth in housing wealth increases consumption, aggregate demand and the Reserve Bank’s fears of future inflation, which it has a mandate to maintain in the 1 to 3 percent band. If this growth is recognized as a speculative boom, this may signal the need for the Reserve Bank to contain inflation while, at the same time, avoiding a potential economic slowdown when the bubble bursts. If on the other hand, increases in house prices are justified by changes in expectations about fundamentals then no intervention may be required, since this may result in misallocation of scarce resources. Further, the analysis of the ‘intrinsic’ bubble component of prices provides scope for the authorities to consider ‘talking’ expectations on fundamentals either ‘up’ or ‘down’ depending on whether they view such expectations to be unjustified. The model presented in this paper enables these important issues to be analyzed.

A time-varying present value model driven by the state of the economy, as proxied by real disposable income, was used to model fundamentals. Our results indicate that in residential housing there are significant deviations from fundamental value. The empirical model allows us to mimic the path that an intrinsic bubble might take and combine this with the actual ‘fundamental’ price. We find that our present value model predicts that house prices are overvalued by as much as approximately 25 percent at the end of the sample period. With the inclusion of the intrinsic bubble component this reduces to circa 21 percent, thus suggesting that much of the overvaluation is from price dynamics rather than an overreaction to fundamentals.

Further work should focus on what drives price dynamics, considering for example, the role of migration in driving house prices. Cross-country comparisons would also be interesting. Australia is an obvious case. Mergers of New Zealand and Australian stock markets have recently been proposed as has a joint currency, and a comparison of links between the less studied property markets may yield valuable insights into possible future economic integration. Additionally, as New Zealand is at one end of the spectrum concerning both the recent growth in house prices and household ownership of property assets, it would be interesting to compare its experience with countries where house prices have not increased markedly, as well as
comparing it with countries where residential property does not dominate household asset portfolios. Also, an analysis of the timing of deviations from fundamentals for the housing and stock markets would be useful so as to better understand the correlations between these asset classes, and so better allocate household wealth between assets.
References


Appendix: The Fundamental Price-Income Model

The model described in the empirical framework section above has the following present value expression for the real value of household property, \( V_t \):

\[
V_t = \gamma E_t \sum_{n=1}^{\infty} \frac{1}{\prod_{i=1}^{n} (1 + \rho_{t+i}^*)} Y_{t+i}
\]

(A1)

where \( V_t \) is a constant proportion, \( \gamma \), of the expected value of future real disposable income, \( Y_t \), discounted at the real discount rate, \( \rho_t^* \). Assuming the relationship between the real house price index \( P \) and market capitalization \( V \), and the relationship between the value of all income, \( Y \), and income covered by the house price index, are constant, then equation (A1) is re-written as:

\[
P_t = E_t \sum_{i=1}^{\infty} \frac{1}{\prod_{j=1}^{i} (1 + \rho_{t+j}^*)} Q_{t+i}
\]

(A2)

where \( P_t = \beta V_t \), and, defining \( \beta = \beta' \gamma \) and \( Q_t = \beta Y_t \).

We define the time stream of realized discount rates, \( \rho_t \), to satisfy:

\[
P_t = \sum_{i=1}^{\infty} \frac{1}{\prod_{j=1}^{i} (1 + \rho_{t+j}^*)} Q_{t+i}
\]

(A3)

Given the discussion of (A2) above, (A3) is a particular solution to \( P_t = (P_{t+1} + Q_{t+1})/(1 + \rho_{t+1}) \), and it follows that:

\[
1 + \rho_{t+1} = (P_{t+1} + Q_{t+1})/P_t
\]

(A4)

where \( P_t \) is the real price at the end of period \( t \), and \( Q_{t+1} \) is real disposable income measured during \( t+1 \). Taking logs and using lower case letters to represent the logs of their upper-case counterparts, we can write:

\[
r_{t+1} = \ln(1 + \exp(q_{t+1} - p_{t+1})) + p_{t+1} - p_t
\]

(A5)

where \( r \) is defined as \( \ln(1+\rho) \) and the term \( (q-p) \) can be viewed as the economy-wide income-price ratio. The first term in (A5) can be linearized using a first-order Taylor’s approximation and (A5) can be written as:

\[
r_{t+1} = -(p_t - q_t) + \mu(p_{t+1} - q_{t+1}) + \Delta q_{t+1} + k
\]

(A6)

where \( k \) and \( \mu \) are linearization constants:
\[
\begin{align*}
  k &= -\ln \mu - (1-\mu) (q - p) \\
  \mu &= 1/(1 + \exp (q - p))
\end{align*}
\]

where \((q - p)\) is the sample mean of \((q-p)\) about which the linearization was taken. Clearly, \(0 < \mu < 1\) and in practice is close to 1.

Empirically, it is common that both \(p\) and \(q\) are \(I(1)\) so that the variables are transformed to ensure stationarity. Denote by \(pq\) the (log) price-income ratio, \(p_t - q_t\), and rewrite equation (A6) as:

\[
pq_t = k + \mu pq_{t+1} + \Delta q_{t+1} - r_{t+1} \tag{A7}
\]

After repeated substitution for \(pq_{t+1}, pq_{t+2}, \ldots\) on the right-hand side of (A7), we get:

\[
pq_t = \frac{k(1-\mu^i)}{(1-\mu)} + \sum_{j=0}^{i-1} \mu^{i-j} \Delta q_{t+j+1} - \sum_{j=0}^{i-1} \mu^{i-j} r_{t+j+1} + \mu^i pq_{t+i} \tag{A8}
\]

Letting \(i \to \infty\) and assuming that the limit of the last term is 0, results in the following alternative form of (A8):

\[
pq_t = \frac{k}{(1-\mu)} + \sum_{j=0}^{\infty} \mu^{j+1} \Delta q_{t+j+1} - \sum_{j=0}^{\infty} \mu^{j+1} r_{t+j+1} \tag{A9}
\]

Hence, if \(q_t \sim I(1)\) then \(\Delta q_t \sim I(0)\) and, assuming that \(r_t \sim I(0)\) (recall that it is the real discount rate), then \(pq_t\) will be \(I(0)\) and we have the model linearized and expressed in terms of stationary variables. Finally, taking conditional expectations of both sides:

\[
pq_t = \frac{k}{(1-\mu)} + \sum_{j=0}^{\infty} \mu^{j+1} E^c_j \Delta q_{t+j+1} - \sum_{j=0}^{\infty} \mu^{j+1} E^c_j r_{t+j+1} \tag{A10}
\]

where \(E^c_j\) are conditional expectations and we interpret \(r_{t+j+1}\) as investors’ required return.

In order to use (A10) to generate a series for \(pq^*_t\), the price-income ratio implied by the model and from it the implied or fundamental house price, \(p^*_t\), we need to obtain empirical counterparts to the terms on the right-hand side involving expectations. For the first of these, the expectation of disposable income growth, we incorporate disposable income growth into a 3-variable VAR model (see below) while for the second we assume a time-varying risk premium, which we also include in the empirical VAR. Here we follow the work of Merton (1973, 1980) on the intertemporal CAPM, and model the time-varying risk premium as the product of the coefficient of relative risk aversion, \(\alpha\), and the expected variance of returns, \(E^c_j \sigma^2_j\). 16

The equation for the price-income ratio then becomes:

\[
pq_t = \frac{k - f}{(1-\mu)} + \sum_{j=0}^{\infty} \mu^{j+1} E^c_j \Delta q_{t+j+1} - \alpha \sum_{j=0}^{\infty} \mu^{j+1} E^c_j \sigma^2_j r_{t+j+1} \tag{A11}
\]

16 We also experimented with measures of conditional variance derived from various specifications of GARCH-type models of housing returns. However, the results were very similar to those reported below.
where $f$ is the constant real-risk free component of real required returns. In this case, we forecast both real income growth and the housing return variance using a 3-variable VAR in $z_t = (pq_t, \Delta q_t, \sigma_t^2)'$. The empirical VAR is written in compact form as:

$$z_{t+1} = Az_t + \varepsilon_{t+1}$$

(A12)

where $A$ is a (3x3) matrix of coefficients and $\varepsilon$ is a vector of error terms. We assume a lag length of 1 for ease of exposition. If, in the empirical application, a longer lag length is required, the companion form of the system can be used.

Forecasts of the variables of interest $j+1$ periods ahead are achieved by multiplying $z_t$ by the $j^{th}+1$ power of the matrix $A$:

$$z_{j+1} = A^{j+1}z_t$$

(A13)

The equation from which we compute the fundamental price-income ratio (and hence the fundamental house price) is:

$$pq_t^* = \frac{k - f}{1 - \mu} + (e_2' - \alpha e_3')A(I - \mu A)^{-1}z_t$$

(A14)

where $e_2' A^{j+1} z_t = E_t^c \Delta q_{t+j+1}$ and $e_3' A^{j+1} z_t = E_t^c \sigma_{t+j+1}^2$ where $e_2'$ and $e_3'$ are, respectively, the second and third unit vectors. Hence the fundamental value of the price-income ratio is generated by a combination of the present value model and the forecasting assumptions.

Therefore $pq_t^*$ provides a measure of the fundamental house price series once we have estimated the VAR coefficients and the constants $\mu$, $k$, and $f$. Given that we wish to generate a series for real house prices that is warranted by (predicted) income growth, we generate (the log of) fundamental house prices as:

$$p_t^* = pq_t^* + q_t$$

(A15)

Equation (A14) can also be used to derive tests of how far actual house prices deviate from their fundamental value as warranted by real disposable income. This is simply a test of $pq_t = pq_t^*$ for all $t$. Since $pq_t = e_1' z_t$ where $e_1'$ is the first unit vector, we can write (A14), after transforming the variables to deviations from their means to remove the constant term, as:

$$e_1'(I - \mu A) = (e_2' - e_3') A$$

(A16)

This restriction is linear in the elements of $A$ (denoted $a$) and in the present case simply amounts to:

$$\mu a_{11} - a_{11} + a_{21} = 1;$$
$$\mu a_{12} - a_{22} + a_{12} = 0;$$
$$\mu a_{13} - a_{22} + a_{13} = 0.$$  

(A17)

and can be tested with a standard Wald test which is asymptotically $\chi^2$–distributed with 3 degrees of freedom.
Table 1  

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Jarque-Bera (J-B)</th>
<th>Unit Root Test (DF-GLS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$r_{hp,t}$ (housing returns)</td>
<td>0.007</td>
<td>0.024</td>
<td>3.864 (0.145)</td>
<td>-4.606*** (constant)</td>
</tr>
<tr>
<td>$r_{f,t}$ (risk-free rate of return)</td>
<td>0.004</td>
<td>0.056</td>
<td>365.395 (0.000)</td>
<td>-9.982*** (constant)</td>
</tr>
<tr>
<td>$pq_{di,t}$ (price-income ratio)</td>
<td>7.549</td>
<td>0.119</td>
<td>17.956 (0.000)</td>
<td>-2.012** (constant)</td>
</tr>
<tr>
<td>$\Delta q_{di,t}$ (real income growth)</td>
<td>0.006</td>
<td>0.012</td>
<td>24.754 (0.000)</td>
<td>-4.453*** (constant &amp; trend)</td>
</tr>
<tr>
<td>$\sigma^2_{hp,t}$ (housing return variance)</td>
<td>0.001</td>
<td>0.001</td>
<td>978.974 (0.000)</td>
<td>-5.141*** (constant)</td>
</tr>
</tbody>
</table>

$r_{hp,t}$ is the continuously compounded quarterly return from New Zealand residential housing. $r_{f,t}$ is the continuously compounded quarterly return on a Long-Term Government bond. $pq_{di,t}$ is the constructed price-(scaled) real disposable income ratio. $\Delta q_{di,t}$ is the rate of growth of real disposable income and $\sigma^2_{hp,t}$ is the t-period variance of the housing return series. The sample period is 1970:1 through 2005:4. The figures in parenthesis below the J-B statistics are marginal significance levels. The test for unit roots in the series is the DF GLS whereby all exogenous variables are removed from the series prior to running the test regressions. The bracket term below the test statistic denotes the exogenous variable removed (constant or constant & trend), while the asterisks denote rejection of the null of non-stationarity at 10%(*); 5%(**) and 1% (***) levels of significance. Critical values for the DF-GLS statistics with an intercept removed are: 1% -2.58; 5% -1.94; 10% -1.62, while with an intercept and trend removed they are: 1% -3.54; 5% -3.00; 10% -2.71.
Table 2
VAR Statistics and Tests for the Estimation of the Time-Varying Risk Present Value Model

\[ z_{t+1} = Az_t + \varepsilon_{t+1}; \quad \alpha = 1.415 \]

<table>
<thead>
<tr>
<th>( z_{t+1} )</th>
<th>( \bar{R}^2 )</th>
<th>( Q )</th>
<th>Linear Wald Restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>( pq_{di,t} )</td>
<td>0.979</td>
<td>0.430</td>
<td>36.352</td>
</tr>
<tr>
<td>(price-income ratio)</td>
<td></td>
<td>(0.980)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>( \Delta q_{di,t} )</td>
<td>0.217</td>
<td>6.290</td>
<td></td>
</tr>
<tr>
<td>(real income growth)</td>
<td></td>
<td>(0.179)</td>
<td></td>
</tr>
<tr>
<td>( \sigma^2_{hpdi,t} )</td>
<td>0.493</td>
<td>0.230</td>
<td></td>
</tr>
<tr>
<td>(housing return</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>variance)</td>
<td></td>
<td>(0.994)</td>
<td></td>
</tr>
</tbody>
</table>

\( \alpha \) is the coefficient of relative risk aversion (CRRA) imposed on the model. \( pq_{di,t} \) is the constructed price-(scaled) real disposable income ratio, \( \Delta q_{di,t} \) is the rate of growth of real disposable income and \( \sigma^2_{hp,t} \) is the \( t \)-period variance of the housing return series. \( pd_t \) is the dividend- stock price ratio. The sample period is 1970:1 through 2005:4. The model was estimated using SUR. \( R^2 \) is the coefficient of determination adjusted for lag length. The \( Q \) statistic is the Ljung-Box test statistic for significance of up to the fourth autocorrelation coefficient. Figures in parentheses below the \( Q \) statistic are marginal significance levels. \( R^2 \) is the adjusted coefficient of determination. The Wald test statistic corresponds to a test of restrictions imposed on the VAR as described by equation (A17). Under the hypothesis that the model is true, the Wald statistic is asymptotically \( \chi^2 \)-distributed with degrees of freedom equal to the number of restrictions imposed; the marginal significance level appears in parentheses below the reported Wald statistic.
Table 3
Summary Statistics on Price Deviations from Fundamental Value

<table>
<thead>
<tr>
<th></th>
<th>Corr(deviations,income)</th>
<th>Corr(deviations,house prices)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.155*</td>
<td>0.442***</td>
</tr>
<tr>
<td></td>
<td>(t=1.845)</td>
<td>(t=5.725)</td>
</tr>
</tbody>
</table>

Deviations denotes (logged) actual real house prices less (logged) fundamental house prices \((p_t - p^*_t)\). Income denotes (log) demeaned and detrended real disposable income \((q_t)\) and house prices, the (log) of actual real house prices \(p_t\). Corr(.) denotes the correlation coefficient. The t-statistic is calculated as \(\frac{\text{corr} \sqrt{n - 2} \sqrt{1 - \text{corr}^2}}{\text{corr}^2}\), where \(\text{corr}\) is the correlation coefficient and \(\text{corr}^2\) is the squared correlation coefficient. Asterisks denote rejection of the null of zero correlation at 10%(*) and 1% (*** levels of significance.

Table 4
Regression of Deviations from Present Value on Income

\(p_t - p^*_t = c' + \lambda' q_{d,t} + \sigma_i\)

<table>
<thead>
<tr>
<th>(c')</th>
<th>(\lambda')</th>
<th>(R^2)</th>
<th>Unit Root Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.0007</td>
<td>0.332</td>
<td>0.024</td>
<td>-1.415</td>
</tr>
<tr>
<td>(0.020)</td>
<td>(0.363)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(p_t - p^*_t\) denotes (logged) house price deviations from present value, \(q_{d,t}\) is demeaned and detrended real disposable income and \(\sigma_i\) is the error term of the regression. \(c', \lambda'\) are the parameters of interest with the figures in parenthesis below the coefficient estimates being Newey-West standard errors. \(R^2\) denotes the coefficient of determination and ADF, the augmented Dickey-Fuller test statistic. Critical values for the ADF statistics with an intercept and trend removed are: 1% -2.58; 5% -1.94; 10% -1.62.
Figure 1
Actual ($P_t$) and Fundamental ($P_t^*$) Real Residential House Prices as Warranted by Real Disposable Income

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[Diagram showing actual and fundamental real residential house prices from 1970 to 2005. The actual prices are represented by a solid line, while the fundamental prices are represented by a dashed line.]
Figure 2
Actual ($P_t$) and Fundamental Real Stock Prices as Warranted by Real Dividends
(1988Q1-2005Q4)
Figure 3
Real (logged) House Price Deviations from Fundamental Value \( (p_t - p_t^*) \) and the Real Disposable Income Gap \( (\log \text{real disposable income (q)}_t) \) demeaned and detrended.
Figure 4

Actual (real) House Prices ($P_t$), Fundamental (Present Value) House Prices ($P'_t$), and Fundamental House Prices with an Intrinsic Bubble ($P'_t + B_t$).