South African House-Price Dynamics

Economics Masters Dissertation

By

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Abstract

Motivated by concerns that a speculative price bubble may have formed in the South African house market, this paper examines South African house-price dynamics over a three-decade period spanning 1976 to 2005. Estimation of error-correction models reveals that real changes in the prices of medium- and large-sized South African homes are associated with short-run changes in economic growth, real mortgage rates and sovereign risk. Empirical analysis suggests that the real prices of small-sized homes are not associated with real mortgage rates in the short run. Estimation of the house-price models also revealed that property prices exhibit mean reversion in the long run, although adjustment to long-run equilibrium (governed by economic growth, real mortgage rates and sovereign risk) is slow. The slow rate of adjustment to long-run equilibrium is partly a function of the presence of substantial inertia in house-price changes. These findings are consistent with the consensus of housing-market research and the possibility that the South African housing-market may be subject to speculative bubbles. However, on the basis that economic fundamentals are unlikely to deteriorate substantially in the current economic context, house prices are not likely to crash as occurred in the mid 1980s.

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I. INTRODUCTION

It is widely acknowledged that an asset-price bubble had calcified in the South African housing market during the early 1980s. Faced by a crumbling economy, unsustainably high prices prefaced a 43% collapse in the real value of homes between 1983:Q4 and 1987:Q1. More than a decade of anaemic real estate performance followed the mid-1980s housing bust and led into the onset of the current boom in 1999:Q3. Between then and 2005:Q4, nominal house prices more than trebled, while real house prices grew at an average annual rate of 14 percent. Real house prices escalated by a record annual rate of 28 percent in 2004 alone. The size of real house-price increases during the current upturn has been striking, while real house prices had topped their 1984 peak by 21 percent at end-2005. Further, the duration of the housing boom has surpassed that of similar episodes of large real price increases for almost all countries (Nel and Mbeleki, 2005). Put together, these factors have raised concerns – which to an extent mirror those in international markets – over whether the domestic housing market is subject to bubble conditions. These concerns are lent weight when considering that South African buyers (generally being naïve to the boom-bust cycle followed by domestic house prices in the mid-1980s) are largely unaware of the dangers posed by speculative behaviour.

However, realization of rapid house-price increases is not in itself *prima facie* evidence of a bubble. The seminal definition of a bubble as proposed by Stiglitz (1990, p. 13) states that: "If the reason the price is high today is *only* because investors believe that the selling price will be high tomorrow – when 'fundamental' factors do not seem to justify such a price - then a bubble exists". With this definition in mind, the key characteristics of an asset bubble are that prices have been bid up beyond a level consistent with underlying fundamentals and that buyers of the asset have done so with the expectation of future capital gains. In this light, while expeditious price increases may represent a necessary condition for identification of a speculative price bubble, such increases do not provide sufficient evidence. Instead, rapid price increases may be explained by changes in economic fundamentals, which impact on housing demand and supply.

Several fundamentals forces are purported to have precipitated and driven the current boom. Broadly, these forces are an outcome of effective macroeconomic policy implementation post-1994. Government's macroeconomic strategy tabbed GEAR (Growth, Employment and Redistribution) was launched in 1996[1]. The strategy represents a commitment to fiscal prudence, conservative monetary policy (under an inflation targeting framework launched in

[1] While the central tenants of GEAR are expected to remain in place, government tabled a new macroeconomic strategy under the banner of ASGI (the Accelerated and Shared Growth Initiative) in 2005.

2000), as well as the fast tracking of trade- and financial-liberalisation. Apart from developing a more propitious environment for economic growth – that had seen economic expansion maintain for 25 consecutive quarters as of 2005:Q4 – sound implementation of credible policies has strengthened government's fiscal position, lowered inflation and interest rates to structurally lower levels, and fortified the economy's external position substantially. In turn, combined with relative political stability, the intersection of improved growth prospects, sustainable fiscal operations, monetary stability and a strengthened external position; has contributed to a significant decline in South Africa's sovereign risk spreads. This development was reflected by a series of sovereign credit rating upgrades for South Africa by international rating agencies in 2004 and 2005.

Notwithstanding these positive macroeconomic developments, the magnitude and duration of the current boom has led to a sharp decline in the affordability of South African homes. The real cost of servicing housing debt has increased sharply, while the house price to disposable income ratio (a simple measure used to detect the presence of a house-price bubble) has approached levels reached at the peak of the early 1980s boom. This is consistent with the international experience where record real house prices have driven the affordability of housing (as measured by the house price to income ratio) to historic lows[2].

The empirically supported consensus in the housing literature dictates that any theoretical approach to modelling house-price dynamics must describe a fundamental price to which the housing market constantly adjusts (Abraham and Hendershott, 1996). In this regard, determinants of real house price changes can be split into two groups. The first group accounts for changes in the equilibrium price of a home and can include a broad range of determinants that shift housing demand and/or supply. The second group accounts for adjustment dynamics and comprises a lagged real appreciation rate (capturing persistence in house-price changes) and the difference between the actual and equilibrium real housing values.

In light of these theoretical underpinnings, as well as recent developments in the South African housing market and economy, the objectives of this paper are twofold. First, by developing a sound theoretical framework and empirical analysis, this paper seeks to bring the fundamental forces and adjustment dynamics that drive South African real house-price changes to light. This is achieved by estimating an econometric error correction model broadly in line with that

[2] See, for example, The Economist (29 May 2003a) "Property Survey: Castles in Hot Air", The Economist (18 June 2005) "The Global Housing Boom – Special Report" or Baker (2002a) "The Run Up in Home Prices: Is it Real or is it Another Bubble?"

of Capozza, Hendershott, Mack and Mayer (2002). Second, the paper aims to form an assessment of the outlook for the domestic housing market.

The latter objective does not necessarily demand an explicit determination of whether a price-bubble has formed in the domestic housing market. Indeed, as noted in the literature review, such an exercise is precluded by methodological constraints. Instead, the inclusion of a sovereign risk variable (an intrinsically forward-looking indicator) in the house-price equation is employed as a primary device for concluding on the domestic housing-market outlook. The importance of assessing the outlook for housing is lent credence when considering the severe impact of housing busts on the real and financial sectors of economies. According to Bernanke and Lown (1991) at least some part of the 1990 recession in the United States of America (US) could be attributed to the preceding decline in commercial real estate prices, which weakened the capital positions of banks and the balance sheets of corporate borrowers[3].

The format of this paper is as follows. The literature review of Part II opens by developing a theoretical framework for house price dynamics using a standard asset-price model, which separates house-price changes into fundamental and non-fundamental components. The former of these is discussed using a simple demand and supply framework describing the long-run equilibrium price of homes. A review of research into housing-market efficiency validates the use of adjustment dynamics to describe house-price changes. Finally, Part II concludes with a brief review of methodological issues and research related to tests for speculative house-price bubbles. Part III presents stylised facts on the South African housing market and economy over 1976 to 2005. Periods of boom and bust, and the forces that may have driven the housing market, are highlighted. Particular emphasis is spent on comparing the current boom with the house-price boom of the early 1980s. The exercise provides a useful pedagogical device for evaluating the current boom in the greater historical context of the domestic housing market. Part IV begins by developing the error correction model estimated. Following this, variables include in the model are tested for unit roots and cointegration. Next, results from estimation of the model are presented and discussed. Concluding remarks and areas for future research are given in Part V.

[3] See the IMF World Economic Outlook (September 2004) for a full discussion of the real and financial effects associated with the bursting of a house-price bubble.

II. LITERATURE REVIEW AND DISCUSSION OF RELEVANT THEORY

A. House-price dynamics: a theoretical framework

Following Flood and Hodrick (1990) and Gatzlaff and Tirtiroglu (1995), Cho (1996) employs the Efficient Market Hypothesis (EMH) with a standard asset-pricing model, as a starting point for understanding house-price dynamics. The development of the asset-pricing model specified below, and the arguments underlying it, is based on that of Cho. Fama (1970) defined a market, where prices fully and instantaneously reflect all information, as efficient. Hence, if new information arrives randomly, the current price of a home is an unbiased predictor of its future value. Assuming a discrete time let the expected rate of return (r) on holding a home from time t to time $t + 1$ be:

$$E_t\,[r_{t+1}] = E_t\,[(P_{t+1} - P_t + d_{t+1}) \,/\, P_t], \tag{1}$$

where E is an expectation operator, P is the house price and d is the appropriate home rental-price. In effect, equation [1] states that the expected return, from holding a home for one period, is a function of expected capital gain and expected rental income components. Suppose $E_t\,[r_{t+1}] - \rho = 0$ is a fair game, where ρ is a constant[4]. Then by substituting equation [1] into this identity and rearranging we obtain:

$$P_t = E_t\,[(P_{t+1} + d_{t+1}) \,/\, (1 + \rho)]. \tag{2}$$

Next, by solving equation [2] forward for n periods and using iterative expectations, it can be shown that:

$$P_t = \Sigma^{n}_{i=0}\,\{E_t\,[d_{t+i}] \,/\, (1 + \rho)^i\} + \{E_t\,[P_{i+n}] \,/\, (1 + \rho)^n\} = P^f_t + P^{nf}_t. \tag{3}$$

Equation [3] expresses the price of a home as the sum of two components. The first is termed the fundamental price, P^f_t, and represents the long-run equilibrium price. The second is a measure of price deviation away from fundamentals, and is termed the non-fundamental price, P^{nf}_t.

If (for sufficiently large n) the second bracketed term on the right-hand side of equation [3] converges to zero, equation [3] will then give the long-run equilibrium price of a home. In this case, the sum of the expected present values of all future rents represents the price of a home. Further, under the condition that new information arrives randomly, equation [3]

[4] A stochastic process y_t is considered a fair game if $E_t\,[y_{t+1}] = 0$; here $E_t\,[y_{t+1}] = E_t\,[r_{t+1}] - r_t$.

implies in this instance that the housing market will be efficient. In other words, the market prices homes using all available information.

Alternatively, if the second bracketed term in equation [3] does not converge to zero, then house prices include a speculative bubble component (given by $P^{nf}{}_{t}$). Under this scenario, the current price of a home is not an unbiased predictor of its future value, and the housing market is informationally inefficient. Further, it implies that demand for capital gain is present, which is in accord with the seminal definition of a bubble as forwarded by Stiglitz (1990, p. 13), which states: "If the reason the price is high today is *only* because investors believe that the selling price will be high tomorrow – when "fundamental" factors do not seem to justify such a price - then a bubble exists".

B. The long-run equilibrium price of homes and fundamentals

The standard asset-pricing model detailed by equations [1] to [3] is informative as a device for partitioning house prices into equilibrium and speculative bubble components. However, the model's practical application is limited, as it requires accurate forecasts of the rental income accruing over the life of a home. Hence, housing researchers have turned to other methods for determining the long-run equilibrium price of a home in terms of fundamentals. Fundamental analysis of house prices is rooted in the supply and demand for housing, and is especially useful when gauging long-run equilibrium trends (Tse and Webb, 1999). Employing the model proposed by Gallin (2003), housing demand can be expressed as:

$$Q_d = D(Y, N, W, UC; \theta_d), \qquad [4]$$

where Y is household income; N is the population; W is wealth; UC is the user cost of housing; and θ_d represents other demand shifters. The user cost of housing is a function of the price of homes, P; mortgage rates, m; income and property taxes, T_y and T_p; maintenance and depreciation, δ; and expected capital gains, cg:

$$UC = P[(1 - T_y)(m + T_p) + \delta - cg] = P \cdot A, \qquad [5]$$

where A represents the bracketed term. Housing supply can be expressed as:

$$Q_s = S(P, C; \theta_s), \qquad [6]$$

where C is the cost of new construction and θ_s represents other supply shifters. Combining equations [4] to [6], house prices can be expressed as a function of all the other variables:

$$P = F(Y, N, W, C, A; \theta_d, \theta_s). \qquad [7]$$

Gallin (2003) continues by stating that a log-linearised solution to the standard fundamentals model given by equations [4] to [7] would relate the log of house prices to the logs of all the explanatory variables. Further, assuming that unobserved components of the model are stationary and that coefficients of the log-linearised solution do not change; house prices and explanatory variables that are integrated of the same order will be cointegrated and share a long-run equilibrium relationship, which will depend on the elasticities of demand and supply. As regards these elasticities, Meen (1998), in his survey on UK house-price models, suggests the following central estimates for the main long-run elasticities: real income (1.7 to 3.0); real interest rates (-0.02 to –0.04); number of households (2.0 to 3.0); housing stock (-2.0 to –3.0). This implies that a 1 percent increase in real income is typically associated with a 1.7 to 3 percent increase in real UK house prices, while real UK house prices will typically decline by 2 to 4 percent in response to a 1 percent increase in real interest rates.

The asset-pricing model given by equations [1] to [3] suggests that house price dynamics may not be determined by fundamentals alone. A review of the research into housing market efficiency and speculative house-price bubbles illuminates other factors - outside of fundamentals - that can be used to model house-price dynamics.

C. Housing market efficiency

The predominant theoretical issue explored in housing research is the EMH and the associated question of whether housing markets are informationally efficient. Empirical studies on housing market efficiency can be delineated into four categories: *tests of weak-form efficiency*; *tests of semi-strong-form efficiency*; *tests of efficiency using market fundamentals*; and *tests for speculative bubbles*. According to Fama (1970), strong-form efficiency implies that investors cannot consistently earn excess risk-adjusted returns using any publicly or privately held information. Semistrong-form efficiency restricts the available information set, F_t, to publicly held information. Finally, weak-form efficiency restricts the information set to include only publicly held data on past prices and returns. As noted by Cho (1996) the majority of housing research into the EMH focuses on testing weak-form or semi-strong form efficiency, and uses the following framework:

$$r_t = u_t + e_t, \qquad [8]$$

where u_t is the mean return on housing, and e_t is an error term. The error term is assumed to be serially uncorrelated and orthogonal to any element of F_t., the available information set at time *t*.

Weak-form efficiency is examined by adding lagged returns as independent variables to equation [8] and testing the hypothesis that e_t follows a random-walk process (Cho, 1996). Several studies testing weak-form efficiency reject the EMH. Case and Shiller (1989) use repeat sales data for homes in Atlanta, Chicago, Dallas and San Francisco and test for autocorrelation both in annual changes in real house prices and in after-tax excess housing returns. Finding that both house prices and after-tax excess returns are positively autocorrelated, they reject weak-form housing-market efficiency. Following the methodology used by Case and Shiller (1989), Hosios and Pesando (1991) and Ito and Hirono (1993) reject weak-form efficiency in the Toronto and Tokyo housing markets respectively.

Evidence of positive serial correlation in house-price movements identified by these studies confirms that house-price changes in one period tend to be followed in the next period by changes in the same direction. As noted by Nakamura and Morita (2002), persistence in the direction of house price changes suggests that market participants form naïve rather than rational expectations. In other words, expectations are formed by looking backwards, with homebuyers and investors expecting house prices to rise/fall because they have done so in the recent past.

Semistrong-form efficiency is examined through including regressors taken from the available information set F_t in equation [8], and then testing the hypothesis that their coefficients equal zero. These studies generally use variables representative of market fundamentals in equation [8], reject semistrong-form efficiency and include those of Mankiw and Weil (1989), Case and Shiller (1990), Clapp and Giacotto (1994) and Meese and Wallace (1993, 1994).

Mankiw and Weil (1989) identify the importance of demographic forces as determinants of housing demand and house prices. Mankiw and Weil report that the entry of the "baby-boom generation" into home-buying years was the major driver of aggregate US house prices in the 1970s. Moreover, Mankiw and Weil claim that since demographic shifts are perfectly foreseeable, they should not influence asset prices under the EMH. The findings imply that naïve expectations rather than rational expectations as under the EMH better characterise the housing market.

Case and Shiller (1990) and Clapp and Giacotto (1994) regress changes in house prices on income growth, construction costs, tax rates and unemployment rates. These papers both find that macroeconomic variables can be used to forecast house prices and accordingly conclude that housing markets are not consistent with the EMH. Similarly, Poterba (1991) finds that shifts in income and construction costs have a significant effect on real house prices. Meese and Wallace (1993, 1994) add a disequilibrium variable to the standard fundamentals model. They find that fundamentals tend to explain house prices in the long run, but short-run variations are more difficult to explain using fundamentals.

The studies reviewed here largely reject the hypothesis of housing markets being informationally efficient. In this regard, Cho (1996) finds the general consensus in the literature to be that house price changes systematically exhibit positive serial correlation in the short run and negative serial correlation (mean reversion) in the long run. Explanations for housing-market inefficiency and persistence in house-price changes include: the lack of liquidity in housing markets; the infrequency of trade in residential property; high transaction costs; and imperfect information since there is no central exchange for housing (Herring and Wachter, 2002). As noted in The Economist (2003b), the market imperfections described above and housing-market inefficiency make house prices particularly prone to bubbles.

D. Speculative bubbles and house prices

Discussing house-price bubbles in US housing markets, and following Shiller (2000), Case and Shiller (2003) argue that speculative bubbles are caused by "precipitating factors" that have an immediate impact on demand, and by an "amplification mechanism" that takes the form of price-to-price feedback. Case and Shiller propose that this "amplification mechanism" is generally generated through optimistic word-of-mouth that leads homeowners and buyers to anticipate further capital gains. In effect, bubbles are formed by accelerated price increases (precipitated by positive fundamental developments), which generate price-to-price feedback (as evidenced by positive serial correlation in the short run) and amplify house-price changes to levels inconsistent with fundamentals.

Although dramatic house price boom-to-bust cycles that have occurred in several international markets imply house-price bubbles are an empirically observed reality, few researchers have explicitly tested for the presence of bubbles in housing markets. This reflects the fact that the application of econometric modelling - as a means of testing for asset-price bubbles - is synonymous with methodological concerns[5]. Most importantly, researchers' efforts to distinguish between fundamentals-driven house-price changes and bubbles are hamstrung since it is impossible to know the "true" fundamental model (Flood and Hodrick, 1990).

[5] Flood and Hodrick (1990) provide a review of methodological issues and complications related to asset-price bubble testing.

Consequently, econometric results pointing toward the existence of a bubble could be an outcome of model misrepresentation.

Abraham and Hendershott (1996) disregard this concern, however, on the basis that housing researchers have strong priors on what house-price fundamentals should include. Testing for bubbles in US metropolitan housing markets they (Abraham and Hendershott, 1996) elaborate on the standard asset pricing model given by equations [1] – [3]. They (Abraham and Hendershott, 1996) model house prices changes as being determined by fundamentals (i.e. real income per capita, employment, real interest rates and construction costs), as well as a bubble builder term (caused by the expectation of capital gains) and a bubble burster term (which captures the tendency for the bubble to eventually burst owing to actual house prices diverging from equilibrium prices). Results of their empirical estimation showed that the bubble variables were significant and, together with changes in market fundamentals, accounted for around 60 percent of house-price fluctuations. Following a similar methodology to Abraham and Hendershott (1996), Kalra, Mihaljek and Duenwald (2000) tested for evidence of speculative bubbles in the Hong Kong property market. They (Kalra, Mihaljek and Duenwald, 2000) found that market fundamentals together with adjustment dynamics (as captured by the bubble burster terms) explained around 66 percent of the variation in Hong Kong house prices.

III. HOUSE PRICES AND THE SOUTH AFRICAN ECONOMY: STYLISED FACTS

Smoothed quarterly series of nominal and real average prices for all sizes of homes are depicted in Figure 1[6]. Smoothed quarterly series of real average prices for small-, medium, and large-sized homes are shown in Figure 2. Smoothed quarterly series of nominal and real average prices for affordable and luxury homes are depicted in Figure 3 and Figure 4 respectively. Over the three-decade period spanning 1976:Q1 to 2005:Q4, two distinct house-price cycles can be distinguished: the boom to bust cycle of the early 1980s and the current up cycle. These two cycles, and the attendant sets of economic circumstances, are reviewed in turn below. Analysis highlights that while both housing booms shared one feature of price bubbles – namely expeditious price increases – the macroeconomic circumstances accompanying the two periods are widely divergent. For ease of exposition, analysis refers to the prices of medium-sized homes for the remainder of Part III of this paper (unless otherwise indicated).

Fig. 1: Nominal and real house prices (all sizes)

(Smoothed quarterly averages)

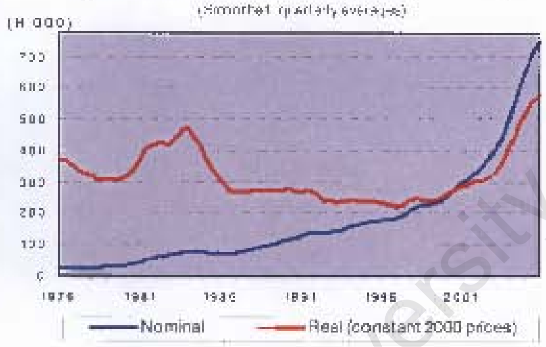


Fig. 2: Real house prices (small, medium, large)

(Smoothed quarterly averages)

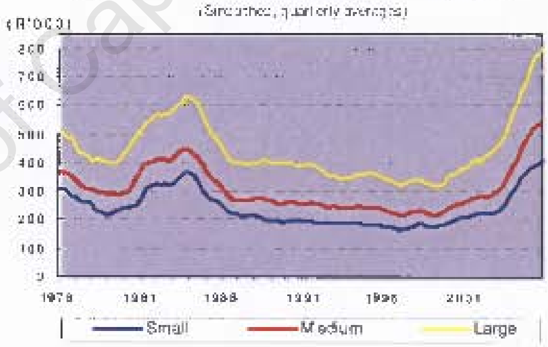


Fig 3: Nominal and real house prices (affordable)

(Smoothed quarterly averages)

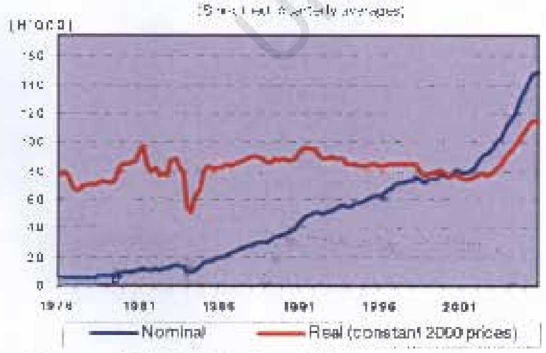
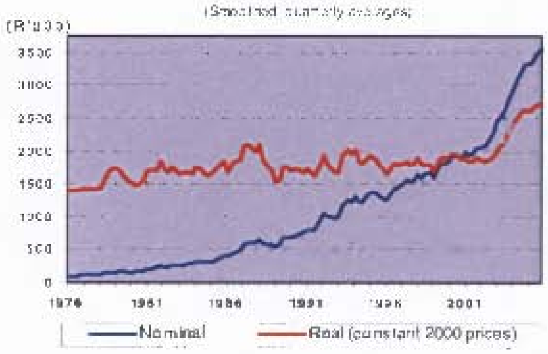


Fig. 4. Nominal and real house prices (luxury)

(Smoothed quarterly averages)



Sources: ABSA, Statistics South Africa.

[6] See Part IV for time-series descriptions, transformations and sources.

A. Cycle I: The early 1980s house-price boom to bust cycle

After a downturn that followed the political unrest of the mid 1970s (Figure 6), real house prices boomed during 1980:Q1 to 1982:Q3. Over this period, real year-on-year quarterly house-price growth averaged 12.9 percent (Figure 5). Record nominal increases in house prices were observed during this period, with a peak year-on-year quarterly rate of 40 percent set in 1981:Q2 (Figure 7). The current housing boom and boom of the early 1980s are the only stages within the sample period where nominal house-price growth has exceeded consumer price inflation for a sustained length of time (Figure 7). Real year-on-year quarterly house price growth briefly turned negative in 1982:Q4, before recovering to average 5.5 percent during 1983. However, after a reversal of the economic conditions that precipitated the boom, this led into a housing-market collapse. The severity of the collapse was such that the empirical anomaly of nominal house-price declines was observed[7]. From a record high of R 476 150 in the first quarter of 1984, real house prices collapsed to R 269 017 by the corresponding quarter of 1987.

Fig. 5: Real GDP and house-price growth

(Year-on-year change, quarterly averages)

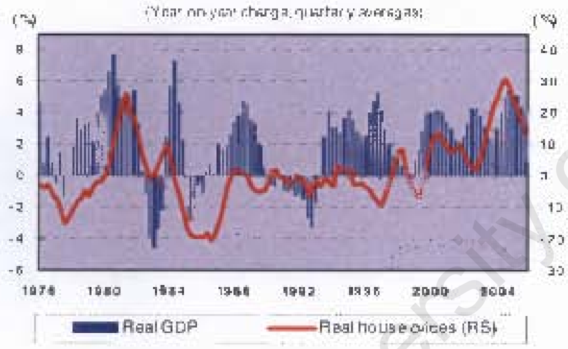


Fig. 6: Gold price and sovereign risk

(quarterly averages)

Fig. 7: Inflation and nominal house-price growth

(Year-on-year change, quarterly averages)

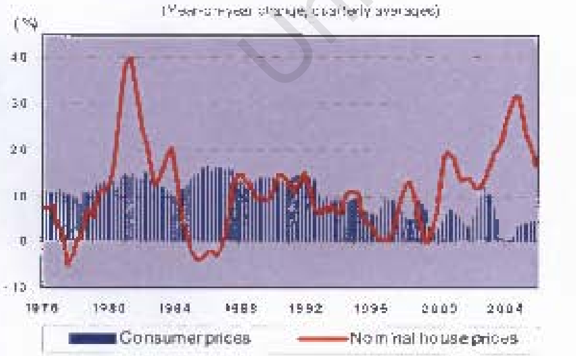
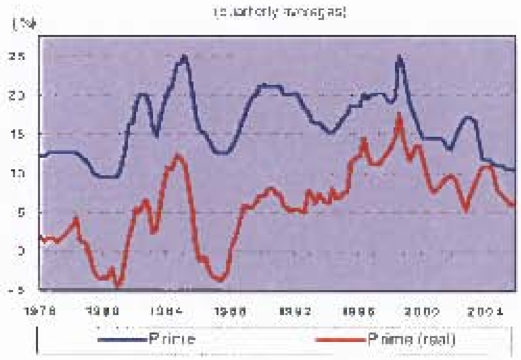


Fig. 8: Interest rates

(quarterly averages)



Sources: ABSA, Statistics South Africa, South African Reserve Bank, International Financial Statistics.

The onset of the early 1980s boom was accompanied by robust performance for the domestic economy. Fuelled by the gold-price boom (Figure 6), real GDP growth averaged 5.6 percent per annum in 1980 and 1981 (Figure 5), while households enjoyed strong gains in disposable income and employment levels. Further impetus to a booming economy and house prices was provided by negative real interest rates, which were served up by lax monetary policy between 1979:Q1 and 1981:Q2 (Figure 8). Households borrowed heavily to finance housing purchases (Figure 9), leading to a rapid increase in the ratio of household debt to household income (Figure 10). Consequently, at the onset of the housing market collapse to follow, household debt amounted to 57 percent of household income in 1984:Q1, up from 35 percent in 1980:Q1.

Fig. 9: Real credit and house-price growth

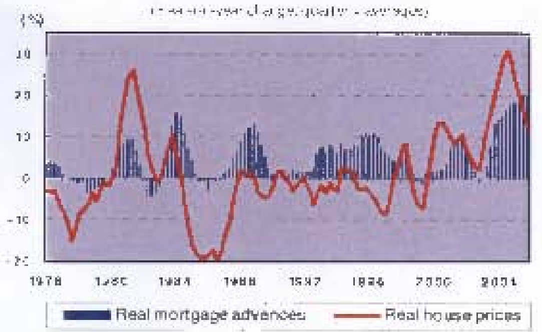


Fig. 10: Household debt to disposable income

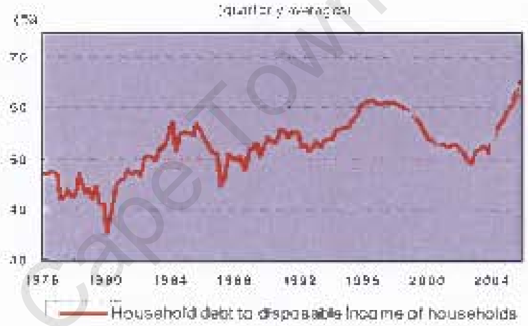


Fig. 11: Housing affordability

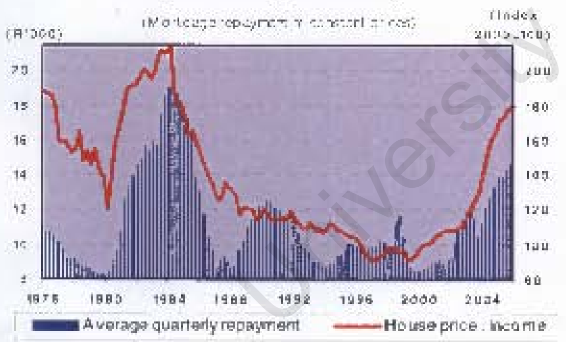
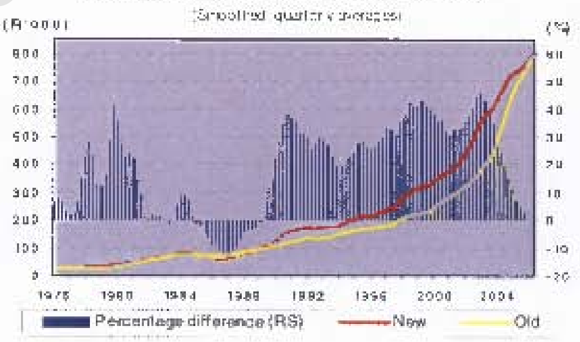


Fig. 12: New and old house prices (all sizes)



Sources: ABSA, Statistics South Africa, South African Reserve Bank.

Regulatory developments also impacted on house prices in the early 1980s. As noted by Martin (1989), the housing market was supported by government provision of incentives designed to promote home ownership. Aron, Muellbauer and Smit (2004) highlight the most quantitatively

[7] The empirical irregularity of nominal house-price declines is discussed by Krainer, J. (2003) "House Price Bubbles" FRBSF *Economic Letter* 2003-06 (March 7).

important of these as being: tax benefits on deposits at building societies; tax benefits to employers who provide housing to employees; and housing fringe benefits (in the form housing cost subsidies provided to many private sector and government sector employees) not treated as taxable income.

The latter stages of the early 1980s house-price boom coincided with a sharp deterioration in previously accommodative economic conditions. Prompted by the Reserve Bank, interest rates began to climb in 1981:Q1, so as to prevent the economy from over-heating. As the price of gold slumped, growth rates of real GDP and household disposable income turned negative, while unemployment rose. In an endeavour to support a rand that was flailing towards the end of the housing-boom period on the back of severe balance of payments distress, interest rates were hiked further. Interest rates peaked at 21.5 percent in 1985:Q2, lifting the real cost of servicing housing debt to record levels (Figure 11). Combined with macroeconomic instability, political pressure from both domestic and foreign sources contributed to a significant widening of sovereign risk spreads, and culminated in economic sanctions being imposed by the international community in 1986.

Consequently, with real house price growth continuing and economic fundamentals worsening in 1983 and 1984, it is likely that house prices departed from their long-run equilibrium value, with house-price growth being driven by demand for future capital gains. Two pieces of evidence support the conjecture that a price bubble had calcified in the housing market during the early 1980s. Figure 11 reveals that the house price to disposable income per capita ratio reached record levels in late 1984, suggesting a departure of house prices from long-run equilibrium value[8]. Further, as shown in Figure 12, the average price of new homes had fallen below their replacement cost, suggesting that the housing market was due a downward correction (ABSA, 2004).

Following the housing market collapse, average real house price growth approached a negative percent per annum through 1988:Q1 to 1999:Q1. During this period, macroeconomic performance was poor, and characterised by intermittent periods of recession, high and volatile inflation and interest rates, as well as political uncertainty. Further pressure on house prices stemmed from the exodus of skilled professionals during most of the 1990s (Luüs, 2005). On the back of moderately good economic growth, an improved fiscal position, lower inflation and interest rates, as well as an easing of fears regarding South Africa's political situation, robust

[8] The house price to income ratio is widely used as simple non-parametric measure for detecting house-price bubbles; see for example Youngblood (2002), Case and Shiller (2003), or Baker 2002b).

real house price growth returned in 1997:Q4. Financial liberalisation and a softening rand, which attracted foreign buyers towards South African property, aided the recovery. The impact of foreigners on domestic house prices was felt strongest in the tourist-friendly Western Cape region, where quarterly, year-on-year nominal growth averaged 24 percent from 1997:Q4 to 1998:Q3. However, contagion effects from the Asian crisis led to a sharp fall in the rand and a spike in interest rates, which sent house-price growth back to sub-inflation levels, leading into the current housing up-cycle.

B. Cycle II: Economic reform and the current housing boom

Because housing market performance was weak during the twelve years succeeding the mid-1980s crash, real house prices came off a low base at the onset of the current boom in 1999:Q3. Since then, average nominal house prices have more than tripled, lifting from R210,389 in 1999:Q3 to R706,002 by 2005:Q4, while real year-on-year quarterly house-price growth averaged 13.8 percent. Nominal year-on-year quarterly house-price growth approached 32 percent in 2004:Q4, the fastest rate achieved since 1981:Q3. By 2005:Q4, real house prices exceeded the 1984:Q4 peak by 21 percent.

Between 1999:Q3 and 2005:Q4, house prices benefited from significantly improved macroeconomic conditions. Real GDP growth lifted to an average annual rate of 4 percent between 2000 and 2005, after average less than 2% in the 1990s. Robust economic growth performance has supported strong gains in household disposable income growth. Improved economic performance has been built on a platform of prudent macroeconomic policies. A conservative fiscal stance has lowered government deficits and debt to favourable levels. Combined with effective implementation of monetary policy (guided by an inflation-targeting framework adopted in February 2000), fiscal prudence has helped reduce inflation and interest rates to structurally lower and stable levels.

Having averaged over 10% during the first half of the 1990s, consumer price index (CPI) inflation has steadily declined, with an annual rate of 3.3% recorded in 2005. Consumer price index excluding mortgage costs (CPIX) inflation – the Reserve Bank's targeted measure – remained within the 3-6 percent target range for 28 consecutive months to December 2005, and generally trended below the midpoint of the range since mid-2004. By anchoring inflation expectations, credibility of monetary policy has reduced the economy's vulnerability to adverse external shocks. Disinflation under inflation targeting enabled a 650 basis point cut in the repo rate (the repo rate was cut by 550 basis points in 2003 alone) between June 2003 and

December 2005. Bank lending rates followed suit, allowing households to borrow heavily in order to finance consumption and real estate purchases. As a result, although households' balance sheets initially improved during the early phases of the current housing boom, the ratio of household debt to disposable income reached record levels by end-2005.

According to ABSA (2004) housing market demand has also received a boost from demographic forces. These are: a rapidly growing black middle-class, a steady increase in the number of households over the years, and a strong foreign interest in domestic property. Moreover, ABSA (2004) posits that shifting demographics have heightened the scarcity of suitable and properly serviced land, in close proximity to central business districts – adding to a supply constraint. On the regulatory front, ABSA (2004) reports that annual reductions in property transfer duties - since February 2001 - have helped sustain house price growth. The cost of buying homes was further reduced in March 2004 through the abolition of the mortgage bond stamp duty. Housing subsidies for low-income householders are providing added impetus to the housing market. Once allowed into the property market, low-income households can sell their subsidised homes and upgrade. The improved investment status of property relative to other asset classes has also supported by the residential property boom (Nel and Mbeleki, 2005). Between 2001 and 2004, the percentage of homebuyers that are investors rose from 5 percent to 10 percent[9].

Despite favourable macroeconomic and regulatory conditions, the affordability of housing deteriorated sharply during the second half of the current house-price boom. Average quarterly mortgage repayments on homes have lifted to 1985:Q1 levels, while the house price to income ratio has approached levels recorded prior to the mid-1980s crash. Further, on the back of rapid increases, the ratio of mortgage instalments to rental income began steadily increasing in 2004 (Nel and Mbeleki, 2005); hence, reducing the attractiveness of residential property as an investment vehicle. As a result, by rendering residential property increasingly unaffordable, expeditious price increases have dampened consumption demand for housing, while also weakening investment demand owing to the divergence of prices from yields. Consequently, the rate of house-price growth began to moderate in 2004:Q4 and, by end-2005, annual house price growth had slowed for fourteen consecutive quarters. Despite this slowdown, the prices of new and existing homes rapidly converged in 2004 and 2005, suggesting that house prices may be due a correction.

[9] Source: Standard Bank. Investors are distinguished from owner-occupiers on the basis that they own more than one home.

IV. MODELLING SOUTH AFRICAN HOUSE PRICES

A. An error-correction model of house prices

Following Capozza, Hendershott, Mack and Mayer (2002), it is assumed that there is a long-run equilibrium price for homes, P^f, in each time period, t, that is determined by macroeconomic conditions, X, such that:

$$P^f_t = p[X_t] \qquad [9]$$

where P^f is the log of the real fundamental value of housing and X_t is a vector of exogenous explanatory variables. Using an error correction framework, it is assumed that changes in the real price of homes are determined by reversion to their long-run equilibrium value, short-run changes in macroeconomic conditions, as well as serial correlation according to the following relation:

$$\Delta P_t = \alpha(P^f_{t-1} - P_{t-1}) + \beta\Delta P^f_t + \gamma\Delta P_{t-1} \qquad [10]$$

where P_t is the log of real house prices (at time t) and Δ is a difference operator. The first term on the right-hand side of equation [10] describes reversion to long-run equilibrium and α ($-1 < \alpha < 1$) measures the rate of adjustment to equilibrium. The second term on the right-hand side of equation [10] captures short-run real house prices movements in response to changes in economic conditions. The third term on the right-hand side of equation [10] is the serial correlation term, where γ is the serial correlation coefficient.

The exogenous explanatory variables investigated (for both the long-run equilibrium solution and short-run changes in economic conditions) are:

$$X_i = \{RGDP; RISK; RMRATE\} \qquad [11]$$

where the variables in equation [11] are the log of real GDP, sovereign risk, and the real predominant rate on mortgage advances. The limited number of variables investigated reflects a desire to develop a parsimonious representation of house prices, while the selection of the variables used is based on their theoretical appeal.

The coefficient of the real GDP (income) variable is expected to be positive since greater income levels are likely to raise housing demand and hence exert upward pressure on prices. Case and Shiller (2003) suggest two compelling theoretical arguments for house-price growth to track per capita income growth in the long run. First, if land zoned for new construction is fixed while individuals allocate a certain fraction of their incomes for housing; then with fixed supply, the price of that fixed land should increase with income. Secondly, construction costs (which mostly comprise labor costs and form a substantial component of new house prices) tend to track per capita income as well; hence house prices and income levels should track each other. House prices studies generally utilise a *per household* income measure and not an aggregate measure of income. However, following the IMF (2005), the latter is used in this paper because it captures two effects simultaneously: (i) the increase in average household income; and (ii) the rise in the number of households, which is pertinent to South Africa given prevailing demographic trends and, in particular, the emergence of the black middle class.

The coefficient of the real mortgage rate variable is expected to be negative, owing to higher financing costs dampening demand and lowering pressure on prices[10]. The inclusion of real mortgage rates can also be motivated in terms of the asset-pricing model given by equations [1] to [3] since, as noted by Abraham and Hendershott (1996), the conversion of a future stream of rents into a value introduces the real interest rate as a determinant of real house prices.

The inclusion of a sovereign risk variable is relatively unique within the housing literature but is motivated on several grounds[11]. Sovereign risk can be used as a proxy measure for a broad range of determinants including: political stability; economic growth prospects; the credibility and efficacy of macroeconomic policies and, as such, the sustainability of a sovereign's fiscal position and the stability of its monetary environment; and, finally, the strength of a sovereign's external position. Hence, combined with the real GDP variable, the sovereign risk variable allows the model to capture the effect of economic growth, as well as the *sustainability* of economic growth and macroeconomic conditions during a given time period.

B. Data properties

Quarterly time-series data spanning 1975:Q1 to 2005:Q4 has been collected for the analysis. South African house-price data is sourced from Absa bank's Residential Property Market Database (RPMD). The RPMD is widely acknowledged as the authoritative source of South African housing data[12]. House prices are examined on a disaggregated basis in this paper. In

[10] See Harris (1989) for a full discussion of the impact of real interest rates on house prices.
[11] Barr and Kantor (2002) include a political risk variable in an equation for South African house prices.
[12] For a full discussion of the process used to compile the RPMD see "The ABSA Residential Property Market Database for South Africa: Key Data Trends and Implications" (Luüs, 2005), taken from "Real Estate Indicators and Financial Stability" (BIS Paper No 21).

this regard, the model given by equations [9] to [11] is estimated for five different house-price series, namely:

i. The prices of small-sized homes ($80m^2$-$140m^2$ in size);
ii. The prices of medium-sized homes ($141m^2$-$220m^2$ in size);
iii. The prices of large-sized homes ($221m^2$-$400m^2$ in size);
iv. The prices of affordable homes ($40m^2$-$80m^2$ in size and less than R100,000 in value in constant 2002 prices);
v. The prices of luxury homes (properties with a value in excess of R1,500,000 in constant 2002 prices).

The use of disaggregated house-price data in this paper is motivated on two grounds. First, it represents an attempt to account for the wide socio-economic disparities prevalent in South Africa (and the attendant distinctions in house-price dynamics across different housing-market segments). Second, the use of disaggregated house-price data is motivated by the need to account for differing house-price dynamics across different sizes of homes during periods of boom and bust. A review of Figure 2 reveals that house prices increased more for large- than medium-sized homes during housing boom periods, while the prices of small sized-homes have tended to decrease relative to medium sized-homes during boom periods and vice-versa. In reviewing size trends in South African homes, Luüs (2003) interprets this trend as suggesting that homeowners tend to "downscale" during periods when the property market was under pressure and "upscale" during housing-boom periods.

All the house-price series are smoothed by ABSA so as to exclude the distorting effect of outliers in the data. The nominal house-price series have been converted into real terms (constant 2000 prices) using the consumer price index (CPI) for metropolitan and other urban areas published by Statistics South Africa. This conversion differs from other studies, which utilise the consumer price index excluding mortgage costs (CPIX)[13]. However, the CPIX series has only been published since 1997, and hence, its use is precluded from this analysis. Descriptions and basic summary data for the five house-prices series examined in this paper are shown in Table 1.

[13] See for example Aron, Muellbauer and Smit (2004).

Table 1: House-price time series descriptions and basic summary data (1979:Q1 – 2005:Q4)

Variable	Description of variable	Mean	Std. Deviation
Log (RHP_S)	Log of price of small-sized homes deflated by CPI (metropolitan and other urban areas)	12.34	0.2428
Log (RHP_M)	Log of price of medium-sized homes deflated by CPI (metropolitan and other urban areas)	12.59	0.2413
Log (RHP_L)	Log of price of large-sized homes deflated by CPI (metropolitan and other urban areas)	12.96	0.2277
Log (RHP_AFF)	Log of price of affordable homes deflated by CPI (metropolitan and other urban areas)	11.34	0.1166
Log (RHP_LUX)	Log of price of luxury homes deflated by CPI (metropolitan and other urban areas)	14.42	0.1255

Source: ABSA and Statistics South Africa.

The real GDP series (seasonally adjusted at constant 2000 prices) is sourced from the South African Reserve Bank. The real GDP and house price series have been converted into logarithmic form and transformed into year-on-year growth rates using the continuously compounding growth rate formula. The sovereign risk series is calculated as the difference in yield between long-term South African and US government bonds. The relevant series are sourced from International Financial Statistics. The predominant rate on mortgages series is sourced from the South African Reserve Bank. Subtracting the year-on-year change in the consumer price index series from the mortgage rate series generates the real mortgage rate series. Descriptions and basic summary data for the exogenous variables used in estimating equations [9] to [11] are shown Table 2.

Table 2: Exogenous variables time series descriptions and basic summary data (1979:Q1 – 2005:Q4)

Variable	Description of variable	Mean	Std. Deviation
Log (RGDP)	Log of real GDP (constant 2000 prices, seasonally adjusted at an annualised rate)	13.59	0.1482
RISK	Spread between long-term South African and US government bonds	6.010	3.4317
RMRATE	Predominant rate on mortgage advances/100 less the annual change in the log of CPI	0.061	0.0455

Source: South African Reserve Bank, Statistics South Africa and International Financial Statistics.

C. Testing for unit roots and cointegration

As a precursor to estimation of the error-correction model, the variables employed are tested for unit roots and cointegration. Testing for unit roots is performed in EVIEWS using the Augmented Dickey-Fuller unit root test procedure. In applying Augmented Dickey-Fuller unit root tests on the data series, appropriate lag lengths have been chosen using the Schwartz Information Criterion. A trend term has only been included in the test if significant. Table 3 reports the Augmented Dickey-Fuller unit root results for the relevant variables. Results of unit root testing reveal that none of the variables are stationary in levels. However, year-on-year growth rates and changes for all the variables are stationary; hence the variables are all integrated of the same order, i.e. I (1)[14].

Table 3: Unit root tests (1979:Q1 – 2005:Q4)‡

Variable	Test specification	Lag	ADF t-statistic†‡
Log (RHP_S)	Levels	3	-1.0294
	Year-on-year change	3	-3.2316*
Log (RHP_M)	Levels	3	-0.7710
	Year-on-year change	2	-3.2654*
Log (RHP_L)	Levels	2	-1.0457
	Year-on-year change	3	-3.2289*
Log (RHP_AFF)	Levels	3	-2.5511
	Year-on-year change	2	-5.8816**
Log (RHP_LUX)	Levels	3	-0.9580
	Year-on-year change	2	-5.2600**
Log (RGDP)	Levels	5	0.4155
	Year-on-year change	3	-4.2669**
RISK	Levels	1	-1.7161
	Year-on-year change	1	-5.0597**
RMRATE	Levels	2	-1.9617
	Year-on-year change	2	-4.0471**

‡Null hypothesis: Series has a unit root.

*(**) Denotes rejection of the null hypothesis at the 5% (1%) levels of significance.

[14] Although real interest rates are expected to be I(0) in theory, the non-stationarity of the real interest rate series in South Africa over 1979:Q1 to 2005:Q4 is an empirical characteristic of the data. This probably stems from the fact that the real interest rate series was constructed from a deflated nominal interest rate series, and is thus significantly influenced by episodes of high inflation and subsequent disinflation during the testing period.

Since the variables employed in the error-correction models are all integrated of the same order it is possible to proceed with testing for cointegration (i.e. to examine whether the respective house-price series and RGDP, RISK and RMRATE are cointegrated in a long-run equilibrium relationship). Testing for cointegration is performed in EVIEWS employing the methodology developed in Johansen. In applying the tests, it is assumed that the level data have no deterministic trends and the cointegrating equations have intercepts. Results from cointegration testing are displayed in Table 3 and confirm that the small-, medium-, and large-sized house-price series are cointegrated with the RGDP, RISK and MRATE series in long-run equilibrium relationships. The house-price series for affordable and luxury homes are not, however, cointegrated with the exogenous variables examined; hence, these series are precluded from estimation in the error-correction model.

Table 4: Johansen cointegration tests (1979:Q1 – 2005:Q4)

Hypothesised number of cointegrating vectors	Eigenvalue	Likelihood ratio	5% critical value	1% critical value
Model with RHP_S				
None **	0.324748	67.92313	53.12	60.16
At most 1	0.124843	25.51488	34.91	41.07
At most 2	0.067400	11.11292	19.96	24.60
Model with RHP_M				
None *	0.25408	56.1628	53.12	60.16
At most 1	0.11867	24.5041	34.91	41.07
At most 2	0.06836	10.8614	19.96	24.60
Model with RHP_L				
None *	0.239753	57.53830	53.12	60.16
At most 1	0.118935	27.93422	34.91	41.07
At most 2	0.097832	14.25887	19.96	24.60
Model with RHP_AFF				
None	0.147479	38.73403	53.12	60.16
At most 1	0.108355	21.50189	34.91	41.07
At most 2	0.056088	9.115693	19.96	24.60
Model with RHP_LUX				
None	0.182402	46.81613	53.12	60.16
At most 1	0.131114	25.06662	34.91	41.07
At most 2	0.060763	9.887943	19.96	24.60

*(**) Denotes rejection of the null hypothesis at the 5% (1%) levels of significance.

D. Error-correction models estimation and results

For the sample period spanning 1980:Q1 (coinciding with the onset of the 1980s boom) and 2005:Q4, the model given by equations [9] to [11] is estimated using EVIEWS in two stages for each of the applicable house-price series. In the first stage, equation [9] is estimated using Ordinary Least Squares to determine the long run equilibrium price of homes. Estimation results for the small-, medium-, large-sized house-price long run equations are presented in Table 5, Table 6 and Table 7 respectively. For each of the equations, parameter coefficients of the explanatory variables are of the expected sign and are highly significant. Further, the residuals taken from the estimated equations are all stationary.

Table 5: Estimation output: Long-run equilibrium relation (1980:Q1 – 2005:Q4)

Dependent variable: Log (RHP S)

Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG (RGDP)	0.940608	0.002569	366.1477	0.0000
RISK	-1.176124	0.408729	-2.877517	0.0049
RMRATE	-0.060633	0.005497	-11.03021	0.0000
R-squared:	**0.602135**	**Schwarz criterion:**		**-0.752385**
Adjusted R-squared:	**0.594257**	**Durbin-Watson stat:**		**0.135175**

Table 6: Estimation output: Long-run equilibrium relation (1980:Q1 – 2005:Q4)

Dependent variable: Log (RHP M)

Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG (RGDP)	0.959319	0.002324	412.7378	0.0000
RISK	-0.061068	0.004970	-12.28728	0.0000
RMRATE	1.236591	0.377019	-3.279918	0.0014
R-squared:	**0.658919**	**Schwarz criterion:**		**-0.919224**
Adjusted R-squared:	**0.652165**	**Durbin-Watson stat:**		**0.152922**

Table 7: Estimation output: Long-run equilibrium relation (1980:Q1 – 2005:Q4)

Dependent variable: Log (RHP_L)

Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG (RGDP)	0.984926	0.002436	404.3524	0.0000
RISK	-1.410934	0.387549	-3.640663	0.0004
RMRATE	-0.053666	0.005212	10.29628	0.0000
R-squared:	**0.592407**	**Schwarz criterion:**		**0.592407**
Adjusted R-squared:	**0.584336**	**Durbin-Watson stat:**		**0.584336**

The residuals (ERROR_S, ERROR M, ERROR L) taken from estimation of the long run-equilibrium relations are each lagged by one period and included in equation [10], which is then estimated using Ordinary Least Squares. Estimation results for the small-, medium- and large-sized house-price error-correction models are presented in Table 8, Table 9 and Table 10 respectively. The residuals taken from the estimated equations are stationary, as illustrated in Figure 13, Figure 14 and Figure 15, which plot actual, fitted, and residual values for the small-, medium- and large-sized house price equations respectively.

Table 8: Estimation output: ECM model (1980:Q1 – 2005:Q4)

Dependent variable: Δ Log (RHP_S)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Δ LOG (RGDP, (2))	0.256123	0.106139	2.413086	0.0177
Δ RISK	-0.006675	0.002278	-2.929794	0.0042
Δ LOG (RHP_S, (-1))	0.879576	0.031396	28.01532	0.0000
ERROR_S (-1)	-0.053818	0.024321	-2.212822	0.0293
R-squared:	**0.918516**	**Schwarz criterion:**		**-3.860761**
Adjusted R-squared:	**0.915996**	**Durbin-Watson stat:**		**0.804547**

Table 9: Estimation output: ECM model (1980:Q1 – 2005:Q4)				
Dependent variable: Δ Log (RHP_M)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Δ LOG (RGDP, (1))	0.201676	0.098961	2.037920	0.0443
Δ RISK (-1)	-0.006042	0.002067	-2.922425	0.0043
Δ MRATE (-2)	-0.225494	0.102822	-2.193045	0.0307
Δ LOG (RHP_M, (-1))	0.896500	0.030934	28.98140	0.0000
ERROR_M (-1)	-0.053592	0.024407	-2.195736	0.0305
R-squared:	**0.933998**	**Schwarz criterion:**	**-4.029244**	
Adjusted R-squared:	**0.931277**	**Durbin-Watson stat:**	**0.848624**	

Table 10: Estimation output: ECM model (1980:Q1 – 2005:Q4)				
Dependent variable: Δ Log (RHP_L)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Δ LOG (RGDP, (1))	0.220216	0.087694	2.511177	0.0137
Δ RISK (-1)	-0.006480	0.001922	-3.371991	0.0011
Δ MRATE (-2)	-0.175738	0.092130	-1.907502	0.0594
Δ LOG (RHP_L, (-1))	0.893516	0.029055	30.75212	0.0000
ERROR_L (-1)	-0.036933	0.022957	-1.608825	0.1109
R-squared:	**0.942952**	**Schwarz criterion:**	**-4.314489**	
Adjusted R-squared:	**0.940599**	**Durbin-Watson stat:**	**1.210797**	

Fig. 13: Actual, fitted and residual values for RHP_S model

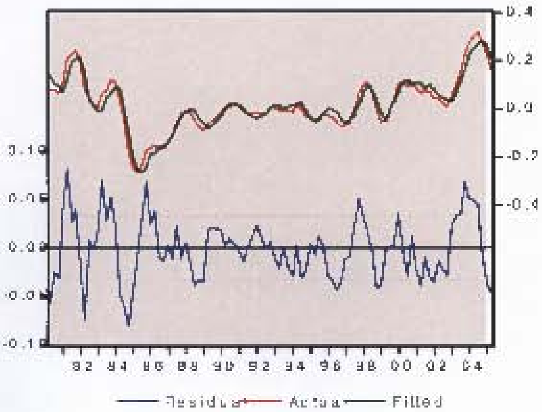


Fig. 14: Actual, fitted and residual values for RHP_M model

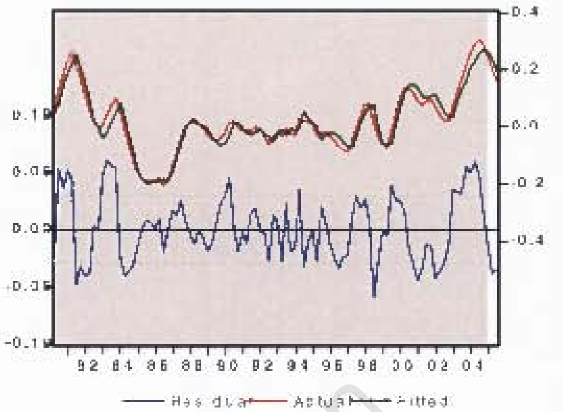
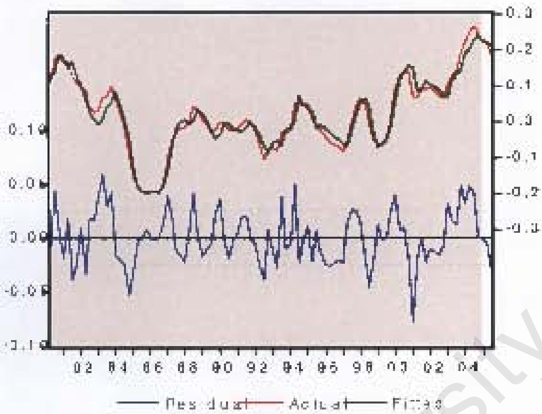


Fig. 15: Actual, fitted and residual values for RHP_L model



Combining the results from the two-stage estimation procedure yields the following relations for the final error correction models:

$$\Delta Log(RHP\_S) = -0.0538*[0.9406*LOG(RGDP) - 1.1761*RISK - 0.0606*RMRATE - LOG(RHP\_S(-1))] + 0.2561*\Delta LOG(RGDP,(2)) - 0.0067*\Delta RISK + 0.8796*\Delta LOG(RHP\_S(-1)).$$

$$\Delta Log(RHP\_M) = -0.0535*[0.9593*LOG(RGDP) - 0.0616*RISK - 1.2367*RMRATE - LOG(RHP\_M(-1))] + 0.2017*\Delta LOG(RGDP, (1)) - 0.0060*\Delta RISK(-1) - 0.2255*\Delta MRATE(-2) + 0.8965*\Delta LOG(RHP\_M(-1)).$$

$$\Delta Log\ (RHP\_L) = -0.0369*[0.9849*LOG(RGDP) - 1.4109*RISK - 0.0536*RMRATE - LOG(RHP\_L(-1))] + 0.2202*\Delta LOG(RGDP,\ (1)) - 0.0065*\Delta RISK(-1) - 0.1757*\Delta MRATE(-2) + 0.8935*\Delta LOG(RHP\_L(-1)).$$

Each of the estimated models performs is highly successful in explaining variations in South African house-price changes. The exogenous variables explain around 92% of the variation in small-sized home price changes, 93% of the variation in medium-sized home price changes and 94% of the variation in large-sized home price changes.

The parameter coefficients of the RGDP series are significant in the long and short run and of the expected sign for the three house-price models. Accordingly, real changes in the prices of homes are contemporaneously positively related to real GDP growth. Further, in view of the aggregated measure of income employed in testing, it could be inferred that rising numbers of households in South Africa (and the emergence of the black middle class) has supported house prices during the current housing boom.

For all the models, the parameter coefficients of the RMRATE series are of the expected sign. In addition, the parameter coefficients were significant (albeit less so in the RHP_L model) for the both the RHP_M and RHP_L models. The short-run RMRATE parameter coefficient was not, however, significant in the RHP_S model. This finding possibly stems from the fact that lower segments of the housing market (including first-time buyers) have limited access to housing finance, irrespective of short-run movements in interest rates. In the short run, the parameter coefficient of the RMRATE series is higher in the RHP_M model than in the RHP_L model. Since the review period has been characterised by large swings in the RMRATE series (relative to the RGDP series for which the short-run parameter coefficient is marginally higher in the RHP_L model), this result would appear to be in discord with the notion - as suggested by Luüs (2003) - that householders "upscale" during boom periods and "downscale" during periods when the housing market is under pressure. However, owing to the fact that buyers of large-sized homes will in many instances require less financing to purchase homes (owing to greater personal wealth), buyers in the upper segment of the housing market are likely to be less sensitive to short-run changes in interest rates when making home buying decisions.

The parameter coefficients of the RISK series are significant in the long and short run and of the expected sign for all three house-price models. In view of the motivation underpinning the inclusion of a sovereign risk variable in estimating house prices, this finding indicates that house-price changes are not only influenced by favourable macroeconomic conditions, but also the *sustainability* of favourable fundamentals.

For all the models, the short-run parameter coefficients enter the models at a lag or lead of two periods at most. This finding suggests relatively quick pass-through from the exogenous variables to property prices.

The parameter coefficient of the error correction term is negative and significant for all the models (although only very weakly significant for the RHP_L model). This finding is consistent with the housing-literature consensus that house prices exhibit mean reversion in the long run. The relatively small parameter terms on the error coefficients suggest that adjustment to housing-market equilibrium is slow.

For each of the models, changes in real house prices are highly autocorrelated. This result is in accordance with the consensus in the literature that housing markets are not informationally efficient. In addition, the high level of persistence in short-run house-price dynamics partially explains the slow rate of housing-market adjustment towards long-run equilibrium. Further, the evidenced inertia in house-price changes suggests that there is potential for South African house prices to overshoot, which is consistent with the possibility of bubble formation.

V. CONCLUDING REMARKS

This paper has examined South African house-price dynamics over a three-decade period spanning 1976 to 2005. Estimation of error-correction models for a sample period spanning 1980:Q1 to 2005:Q4 revealed that real changes in the prices of medium- and large-sized South African homes are associated with short-run changes in economic growth, real mortgage rates and sovereign risk. Empirical analysis suggested that the real prices of small-sized homes are not associated with real mortgage rates in the short run. Estimation of the house-price models also revealed that house-prices exhibit mean reversion in the long run, although adjustment to long-run equilibrium (governed by economic growth, real mortgage rates and sovereign risk) is slow. The slow rate of adjustment to long-run equilibrium is partly a function of the presence of substantial inertia in house-price changes. This finding is consistent with the possibility that the South African housing-market may be subject to speculative bubbles.

This possibility is lent credence when considering the dramatic boom-to-bust cycle followed by house prices in the mid-1980s. In evaluating the present position of the housing market, however, due consideration must be taken of the fact that economic conditions are widely divergent from those experienced in the mid-1980s, when a sharp deterioration in fundamentals led into a housing market crash. With the establishment of credible monetary and fiscal policy frameworks (which together with improved economic growth prospects and a substantially strengthened external position have helped narrow South Africa's sovereign risk spreads substantially), interest rates in South Africa are likely to remain at structurally lower levels in a context of reasonable growth performance for at least the medium term. In this light, while favourable fundamentals have supported the recent boom in house prices, they are expected to support house prices in the near term. This contention is supported by house-price developments post-2005, which suggest that the housing market is set for a "soft-landing".

Risks to the housing-market outlook are, however, apparent. A key risk derives from the strong presence of buy-to-let investors in the current market, which provide the market with momentum and can fuel house-price growth trends, since investors are more likely than homeowner-occupants to buy/sell properties when they expect or see a rise/drop in property prices (Mbeleki and Nel, 2005). Hence, a simultaneous selling-off by investors to avoid or limit capital losses can exacerbate a potential decline in house prices. A more robust examination of this topic represents a possible area for future research, whereby the housing market would be disaggregated into homeowner-occupant and buy-to-let investor segments.

VI. REFERENCES

Abraham, J.M., and Hendershott, P.H., (1996). Bubbles in Metropolitan Housing Markets. *Journal of Housing Research* 7(2):191-207.

ABSA, (2004). Residential Property Market, in *Economic Perspectives*, various editions.

Aron, J., Muellbauer, J.N.J., Smit, B.W., (2003). Modeling the Inflation Process in South Africa. Keynote Address Eight Annual Conference on Econometric Modeling for Africa, Stellenbosch University, 1-4th July 2003 (unpublished manuscript)

Baker, D., (2002a). The Run Up in Home Prices: Is it Real or is it Another Bubble? *Centre for Economic Policy and Research*, Briefing Paper.
<http://www.cepr.net/documents/publications/housing_2002_08.pdf> accessed July, 2004.

Baker, D., (2002b). The Housing Affordability Index: A Case of Economic Malpractice. *Centre for Economic and Policy Research*, December.
<http://www.cepr.net/documents/publications/housing_2002_12.pdf> accessed July, 2004.

Bernanke, B.S., and Lown, C.S., (1991). The Credit Crunch, *Brookings Papers on Economic Activity*, No. 2.

Barr, G., and Kantor, B., 2002. The South African Economy and Its Asset Markets – An Integrated Approach. *The South African Journal of Economics* 70 (1):53–78.

Capozza, D.R., Hendershott, P.H., Mack, C., and Mayer, C.J. (2002). Determinants of Real House Price Dynamics, *National Bureau of Economic Research Working Paper No. 9262*.

Case, K.E., and Shiller, R.J., (1989). The Efficiency of the Market for Single Family Homes. *American Economic Review* 79(1):125-137.

Case, K.E., and Shiller, R.J., (1990). Forecasting Prices and Excess Returns in the Housing Market. *AREUEA Journal* 18:253-273.

Case, K.E., and Shiller, R.J., (2003). Is There a Bubble in the Housing Market? An Analysis. *Brookings Papers on Economic Activity,* Vol. 2, pp. 299–342.

Cho, M., 1996. House Price Dynamics: A Survey of Theoretical and Empirical Issues. *Journal of Housing Research* 7(2):145-172.

Clapp, J.M., and Giacotto, C., (1994). The Influence of Economic Variables on Local House Price Dynamics. *Journal of Urban Economics*, 36(2):161-183.

Fama, E.F., (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance*, 25:383-420.

Flood, R.P., and R.J. Hodrick, 1990. On Testing for Speculative Bubbles. *Journal of Economic Perspectives*, 4(2):85-101.

Gallin, J., (2003). The Long Run Relationship between House Prices and Income: Evidence from Local Housing Markets. *Manuscript, Federal Reserve Board*.

Gatzlaff, D.H., and Tirtiroglu, D., (1995). Real Estate Market Efficiency: Issues and Evidence. *Journal of Real Estate Literature*, 3:157-192.

Harris, J.C. (1989). The effect of real rates of interest on housing prices. *Journal of Real Estate Finance and Economics*, 2(1), 47-60.

Herring, R., and Wachter, S., (2002). Bubbles in Real Estate Markets. *Zell/Lurie Real Estate Center*, Working Paper No. 402.

Hoffman, D., (2005). House prices in the Netherlands. *International Monetary Fund Country Report No. 05/225*.

Hosios, A.J., and Pesando, J.E., (1991). Measuring Prices in Resale Housing Markets in Canada: Evidence and Implications. *Journal of Housing Economics*, 1(4):303-317.

International Monetary Fund, (2004). World Economic Outlook Chapter 2: When Bubbles Burst. September.

Ito, T., and Hirono, K.N. (1993). Efficiency of the Tokyo Housing Market. *Bank of Japan Monetary end Economic Studies*, 11(1)1-32.

Kalra, S, Mihaljek, D., and Duenwald, C., (2000). Property Prices and Speculative Bubbles: Evidence from Hong Kong SAR. *IMF Working Paper*, WP/00/2.

Krainer, J., (2003). House Price Bubbles. *FRBSF Economic Letter 2003-06* (March 7). <http://www.frbsf.org/publications/economics/letter/2003/2003-06.html>accessed June, 2004

Luüs, C., (2005). "The ABSA Residential Property Market Database for South Africa: Key Data Trends and Implications", taken from "Real Estate Indicators and Financial Stability". *BIS Paper No 21*.

Mankiw, N.G., and D.N. Weil, 1989. The Baby Boom, the Baby Bust, and the Housing Market. *Regional Science and Urban Economics* 19:235-58.

Martin, C.H. 1989. Behuisingfinansierings-Vraagstukke Met Spesifieke Verwysing Na Die Republiek Van Suid-Afrika. *PhD Dissertation, University of Stellenbosch*.

Mbeleki, T., and Nel, H.F., (2005), Asset Prices and Monetary Stability - The Impact of a Housing Market Bubble. *Working Paper, Financial Stability Department of the South African Reserve Bank, Pretoria.*

Meen, 1998, "Modeling Regional House Prices: A Review of the Literature". University of Reading for the Department of the Environment, Transport and the Regions, ISBN 0 7049 1305 4, 1998.

Meese, R.A., and Wallace, N., (1993). Residential Housing Prices in the San Francisco Bay Area: New Tests of the Explanatory Power of Economic Fundamentals. *Working Paper, University of California at Berkeley*.

Meese, R.A., and Wallace, N., (1993). Testing the Present Value Relation for House Prices: Should I Leave My House in San Francisco? *Journal of Urban Economics,* 22:27-59.

Nakamura, R., and Morita, M., (2002). The Effect of Expectations on House-Price Changes: A Case of Tokyo Metropolitan Area. *Prepared for the ASRES and AREUEA Joint International Conference*, July 4-6.

Poterba, J.M., (1991). House Price Dynamics: The Role of Tax Policy and Demography. *Brookings Paper on Economic Activity*, No.2:143-203.

Shiller, R.J. (2000). Irrational Exuberance. *Princeton University Press*.

Stiglitz, Joseph E. (1990). "Symposium on Bubbles," *Journal of Economic Perspectives* 4(2), Spring, pp. 13-18.

The Economist, (2003a), "Property Survey: Castles in Hot Air", *The Economist*, 29 May 2003.

The Economist, (2003b), "Property Survey: Design Flaws", *The Economist*, 29 May 2003.

The Economist, (2005), The Global Housing Boom – Special Report. *The Economist*, 18 June 2005.

Tse, R.Y.C., and Webb, J.R., (1999). Dynamic Equilibrium of the Housing Market. *Urban Studies* Vol 36 No. 13, 2361-2373.

Youngblood, M.D., (2003). Is There a Bubble in Housing? New Evidence from 123 Housing Markets. *The Market Pulse*, Vol. VIII, Issue 4.