AE Clark* and T Daniel

Forecasting South African house prices

1. INTRODUCTION

Property analysts are continuously speculating as to whether the current boom in the South African residential property market is, in essence, an impending bubble waiting to burst. A repeat of the crash that befell the market during the early 1980s is feared. Nevertheless, the general consensus is that a downward correction or, at the very least, a stabilization of the house prices is inevitable as the affordability of housing decreases. However, the exact timing of this correction is unknown, thereby increasing uncertainty.

Currently, research into the South African residential property market is severely limited. Property analysts have limited tools at their disposal to evaluate the state of the property market. Hence, analyses are generally based on similar events in international property markets.

The purpose of this study is to develop a suitable econometric model for forecasting South African house prices. This model is based on lagged values of the explanatory variables, i.e. lead relationships are established between the response and the explanatory variables, in order to generate short-term forecasts. The period of investigation is from the first quarter of 1980 until the first quarter of 2006. This study draws considerably on the research undertaken during an Honours project at the University of Cape Town (2005).

Standish, Lowther, Morgan-Grenville and Quick (2005) carried out a similar modelling exercise. The purpose of their study was to identify the key drivers of the South African residential property market. A regression model was developed; however, lagged values of the econometric variables were not incorporated in their model. Hence, forecasts are unattainable and the use of the model is limited to the use of scenarios.

This paper is set out as follows: In the following section, a brief history of the South African residential property market is presented. Thereafter, in section 3, the modelling methodology and the data are discussed. Section 4 follows with an economic justification of the explanatory variables under consideration. In Section 5 the forecasting model is developed. Section 6 presents the forecasting results and finally, in section 7, conclusions are drawn.

* Department of Statistical Sciences, University of Cape Town, Private Bag, Rondebosch 7701, Republic of South Africa. Email: allan@stats.uct.ac.za

2. A BRIEF HISTORY OF THE SOUTH AFRICAN RESIDENTIAL PROPERTY MARKET

The South African residential property market has not been subjected to uniform growth over the past 25 years. (See figure 1 below.) Growth patterns have fluctuated widely in direct response to exogenous events. For example, during the early 1980s, the boom in the residential property market was supported by negative real interest rates and a strong domestic currency in response to the escalating gold price. However, this was short lived as the property market endured a spectacular crash during 1984, due to the depreciation and subsequent crash of the Rand, and, in addition, political uncertainty. The prime lending rate rose from 11%, during the fourth quarter of 1980, to an average of 21,5%, during the second quarter of 1985. The depreciation of the Rand was instrumental in this interest rate hike, which, subsequently, influenced the property market negatively as loans became less affordable due to excessive mortgage repayments.

The market crash was followed by a three year period of decline. Thereafter, real house prices stabilized until the mid 1990s when high real interest rates depressed the property market. However, since the start of the millennium, house prices have experienced substantial growth. The current boom in the property market is aided by low interest rates, a strong domestic currency, a growing middle income sector and high investor confidence. In addition, low transfer duties on property and strong growth in the real disposable income of households support the property market.

3. MODELLING METHDOLOGY AND DATA

The quarterly South African house price series was supplied by *ABSA Group Economic Research*. These prices are based on the total purchase price of houses in the $80m^2$ - $400m^2$ size category, valued at less than R2,2 million, for which loan applications were approved. The prices are smoothed in an attempt to remove seasonal factors and outliers. All the house prices are converted into real terms by adjusting for inflation (base year = 2000).

As previously mentioned, the period of investigation is from the first quarter of 1980 until the first quarter of 2006. However, the data from the second quarter of 2005 until the first quarter of 2006 is used exclusively for evaluating the forecasting performance of the econometric model.

The following eleven economic and financial variables are considered for possible inclusion in the

econometric model: JSE/Actuaries All Share Index (ALSI), Number of Building Plans Passed, *Rand Merchant Bank/Bureau for Economic Research* (*RMB/BER*) Business Confidence Index, Ratio of Household Debt to Disposable Income, Real Gross Domestic Product (GDP), Real Gold Price, Number of Motor Vehicle Sales, Real Oil Price, Real Prime Rate of Interest, Real Rand/Dollar (R/$) Exchange Rate and Real Transfer Costs.

Contemporaneous relationships between the explanatory variables and the house price series are not established as only lagged explanatory variables are of interest. For example, referring to a simple linear model where y_t represents the house price series and x_t any explanatory variable, y_t is not regressed on x_t, but on a particular lag of x. (i.e. x_{t-i} for any non-negative integer and is denoted as x(-i) in the Estimation Results section). In the former model, a one-step ahead forecast of y_t requires a corresponding forecast of x_t which subsequently increases uncertainty. Thus the use of lagged explanatory variables reduces uncertainty as forecasts of y_t are based on *observed* values. For the econometric model constructed in this paper, only lagged values of the explanatory variables up to and including 8 quarters are deemed to be economically meaningful.

In order to identify potential model structures, and the subsequent suitable model for forecasting South African house prices, a procedure similar to all subsets regression[1], where all possible model structures are estimated, is employed. Considering that there are 8^{11} potential model structures for the full model, as there are 11 potential explanatory variables each with 8 lags, a simulation procedure is employed to reduce computation time. The Akaike Information Criterion (AIC)[2] is used to identify the competing models which are then further refined to establish the most suitable model. A stepwise model building procedure could also have been followed; however, this is an inefficient procedure as only a limited number of potential model structures are estimated.

[1]This procedure is illustrated as follows: Consider the following regression example where Y is the response variable and X_1 and X_2 are two potential explanatory variables. All subsets regression involves the estimation of all potential combinations of the relationship between Y and X_1 and X_2, i.e. $Y=a+bX_1$, $Y=a+bX_2$ and $Y=a+bX_1+cX_2$.

[2]The AIC is a model selection statistic that penalizes complicated models, e.g. models including many explanatory variables, and is thus a better measure than, say, R^2, the coefficient of determination, which increases as more explanatory variables are added to the regression model. Model selection based on the R^2 statistic always favours more complicated models which, generally, have poor forecasting ability in comparison to more parsimonious models.

4. ECONOMIC JUSTIFICATION

The eleven economic and financial variables under consideration for inclusion in the regression model are briefly justified. Lagged values of these variables are expected to capture economic changes prior to their impact on the South African residential property market.

4.1 All Share Index

The JSE/Actuaries All-Share Index traces the performance of the overall stock market. It consists of all ordinary securities whose movements are representative of the movements in the market. Thus, positive changes in these securities are indicative of confidence in the underlying companies and, subsequently, the economy. Hence, it is expected that the residential property market is influenced by the equity market.

The above idea is consistent with Borio and McGuire (2004). They investigated a sample of 13 industrial countries from 1970 and observed that a major equity price peak was often followed by a housing price peak (with an average lag of about two years). This suggests that the equity market and house prices have a positive relationship.

Currently, literature on the relationship between property returns (and thus property prices) and equity returns show conflicting results. Krainer and Furlong (2000) observed a positive relationship between stock prices of high-tech firms situated in San Francisco Bay and house price changes. However, they were unable to identify a similar relationship with high-tech firms situated in Los Angeles and San Diego. Catella (2002) argues the opposite, i.e. a negative relationship between property prices and the performance of the equity market. Intuitively, a negative relationship is plausible as the property market and the equity market can be seen as two competing markets. For example, a strong property market may induce investors to alter their investments in equities and invest in the property market in expectation of higher returns.

Similar studies have also been undertaken in order to identify the relationship between real estate returns and stock market returns. However, these results are also conflicting. Okunev, Wilson and Zurbruegg (2002) argue that this occurs as many of the studies investigate different data sources. Some use physical (direct) property market data while others use securitized (indirect) property data.

Examples of the above mentioned conflicting results are clearly seen in the studies undertaken by Miles, Cole and Guikey (1990) and Geltner (1990). The former found that real estate returns and stock market returns are cointegrated whilst the latter found the converse (both investigated the US market). Okunev et

al (2002) investigated the Australian property market and found bi-directional Granger causality between equity and real estate returns with their full sample. However, with a sub-sample of their data, they found that changes in stock market prices influence real estate returns.

Some authors have observed that certain economic variables are drivers in both the property and the real estate market. Liu and Mei (1992, 1994) found that government treasury bills and the long-term yield spread could be used to predict returns in both the real estate and the equity market. However, Ling and Naranjo (1997) found that the term structure of interest rates is not a key driver of the real estate market.

Liu and Mei (1992, 1994) and Quan and Titman (1999) also found that the real estate and the equity market moved in tandem. Quan and Titman (1999) however, observed that the strength of the relationship varied across time and was attributed to changes in the GDP levels of the countries investigated.

4.2 Prime rate of interest

In general, an increase in interest rates increases the cost of borrowing as loan repayments become more expensive. Thus a high prime rate results in high mortgage repayments, reducing the affordability and hence the demand for property. Hence interest rates and property prices are expected to have an inverse relationship.

Many researchers share the above generalization and note that interest rate related variables are key drivers of real estate returns: Chan, Hendershott and Sanders (1990) and Ling and Naranjo (1997) found that the term structure of interest rates is important when modelling real estate returns; McCue and Kling (1994) found that nominal interest rates is the most important determinant of real estate returns (a negative relationship was found); Lizieri and Satchell (1997) found that the ratio of the nominal interest rate to the inflation rate has an influence on property share prices; Brooks and Tsolacos (1999) investigated the impact of economic and financial factor on the UK property market and found that the interest rate term spread, as well as lagged values of the real estate series, were the most significant drivers of real estate returns. Finally, Sutton (2002) reports that real interest rates, GNP and equity prices are the most significant determinants of house prices.

4.3 Gross domestic product

GDP is a measure of overall economic activity in South Africa. Thus, a change in real GDP is an indication of real economic growth, which has a direct effect on the state of the property market. In addition, economic certainty results in high business confidence. Hence it is argued that an increase in economic growth will lead to an increase in the demand for property.

4.4 Building plans

In the long-term, the demand for and the supply of property are expected to be in equilibrium. However, if the supply of property fails to maintain an equilibrium relationship with the demand for property, property prices will adjust to clear the market. A key indicator of the supply of property is the number of building plans passed. It is a leading indicator for building activity. The number of building plans passed is affected by the current and expected future demand for property. Building activity would fall if demand for property is expected to fall in the near future. Thus, the number of building plans passed can be seen as an indicator of the general attitude towards investment into the residential property market, except when there is a market correction.

4.5 Business confidence

The RMB/BER Business Confidence Index is used as a proxy for business confidence in South Africa. Business confidence is a key factor of the demand for residential property. If business confidence is high, due to, for example, political and economic certainty, then more investment opportunities will be pursued by local and foreign investors. In turn, this will influence consumer spending as they too become more confident about the economy. Hence, business confidence indirectly influences consumer demand for property.

4.6 Motor vehicle sales

The number of motor vehicle sales is an indication of the state of the economy. In a recession, business confidence is low and savings generally exceed consumption, i.e. consumer spending is low. Hence, a large number of motor vehicle sales indicate that real economic growth and business confidence is high, which, in turn, may prompt an increase in the demand for property

4.7 Household debt/disposable income

The ratio of household debt to disposable income measures the percentage of the average households' disposable income that is used to repay debt. This ratio will increase if the interest rate increases, since, for example, mortgage repayments will increase, or as a result of the acceptance of additional debt. In addition, this ratio will also increase if the amount of disposable income decreases, due to, for example, an increase in the domestic fuel price which consequently increases the price of most goods. Hence this ratio is a direct measure of the average households' affordability and thus indicates their attitude towards spending.

4.8 Rand/dollar exchange rate

The real rand/dollar exchange rate has a direct and indirect effect on the residential property market. For example, a strong currency will deter foreign investors from local property investment. However, a depreciation of the rand will attract foreign investors to the local market. In addition, stability of the rand contributes to business confidence which also affects the demand for property.

4.9 Gold and oil

The price of gold has no direct impact on the property market. However gold does impact upon South Africa's economy. Hence changes in the gold price influence economic growth and subsequently the demand for property.

Similar to the price of gold, the price of oil has no direct impact on the property market. However, an increase in the price of oil will lead to an increase in the domestic price of fuel and consequently the price of most goods, reducing disposable income. In addition, an increase in the price of oil may have an inflationary impact on the economy, leading to an increase in interest rates, which reduces the demand for property as the cost of borrowing increases.

4.10 Transfer costs

Transfer costs directly influence the affordability of property as these costs increase the price of property. Hence a reduction in transfer costs will lead to an increase in the demand for property as the total purchase price falls.

5 ANALYSIS

5.1 Stationarity

Before incorporating the explanatory variables[3] in the modelling process, stationarity needs to be determined. Stationarity is a crucial assumption as non-stationary data leads to heteroskedasticity or non-constant variance, invalidating the standard errors of the parameter estimates in standard linear models.

Augmented Dicky Fuller (ADF) tests are used to determine whether the house price series and the explanatory variables are stationary.[4] Before proceeding with the tests, specification of any deterministic regressors and the appropriate lag length in the ADF regressions is needed. These were determined by following the procedure outlined by Enders (2004). A deterministic trend and an intercept term were included in the ADF tests for the All Share Index (ALSI), prime rate and transfer costs. For building plans, business confidence, the ratio of household debt to disposable income, gold, motor vehicle sales, oil and the rand/dollar exchange rate only an intercept term was included in the ADF tests. However no deterministic regressors were included for Gross Domestic Product (GDP) and the South African house price series. In addition, the Akaike Information Criterion is used to determine the appropriate lag length. The ADF test statistics are given in Table 1.

Table 1: ADF test statistics for the response and explanatory variables

Variable	Level	First Difference
South African house prices	0,551	**-2,347**
ALSI	-2,585,	**-6,031**
Building Plans	**-3,957**	
Business Confidence	**-4.017**	
Debt/Income	-2,899	**-11,311**
GDP	2,772	**-4,529**
Gold	-2,327	**-10,036**
Motor	**-3,430**	
Oil	-2,302	**-9,570**
Prime	-3,813	**-6,372**
R/$ Exchange	-2,431	**-4,686**
Transfer Costs	2,032	**-7,063**

Bold figures – Significance at the 5% level

From Table 1 it is clear that at the 5% significance level, business confidence, building plans and motor vehicle sales are stationary; hence, these variables do not require differencing. Thus, the first difference of the South African house price series and the remaining explanatory variables, ALSI, ratio of household debt to disposable income, GDP, gold, oil, prime rate, rand/dollar exchange rate and transfer costs, are all stationary at the 5% significance level.

Lastly, business confidence and motor vehicle sales exhibit a cyclical pattern. If the appropriate differencing operator is applied to these variables, then the sample size would reduce significantly. Hence, in order to sustain the validity of the analysis, these variables are excluded.

5.2 Estimation results

The results of the modelling process are presented below and briefly discussed.

[3] All the variables were converted to logs. The real prime rate was first transformed by adding 10 to each value, in order to eliminate negative values, and then converted to logs.

[4] See MacKinnon (1996) for the cut-off values for the ADF test statistics.

Table 2: Estimation results for South African house prices

Dependent Variable: D(log(South Africa(Real)))				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ALSI(-2)	0,034	0,01	3,548	0,001
GDP(-6)	0,367	0,177	2,079	0,04
Prime(-1)	-0,026	0,01	-2,659	0,009
R/$ Exchange(-2)	-0,04	0,02	-2,069	0,041
Transfer Costs(-2)	0,051	0,017	3,012	0,003
AR(1)	0,861	0,053	16,146	0,000
R-squared	**0,784**	Akaike Information Criterion		-5,524
Adjusted R-squared	0,772	Schwarz Information Criterion		-5,369
S.E. of Regression	0,015	**Durbin-Watson Statistic**		**1,775**

The following comments are made about the model for South Africa:

- The R^2 statistic is 0,784, indicating that the model explains a significant portion or 78,4% of the variability in the response variable. In addition, all the explanatory variables included in the model are significant, at the 5% significance level.
- The auto regressive term is included in the final model to account for positive serial autocorrelation.
- The model indicates that a **positive** relationship exists between the lagged stock market returns, GDP, transfer costs and house price growth rates; a **negative** relationship exists between interest rates, exchange rate movements and house price growth rates.
- The coefficients associated with the economic variables, that were differenced, can be interpreted as the percentage change in the quarterly property growth rate for a 1% change in the respective economic variable. e.g. The model indicates that a 1% increase in the lagged stock market returns leads to a 0,034% increase in the quarterly property growth rate. Similarly, a 1% increase in the growth of the rand/dollar exchange rate leads to a 0,040% decrease in the quarterly property growth rate.

6. FORECASTS

Figure 1 below displays the in-sample fitted values (section A) and the out-of-sample (quarterly one-step ahead forecasts - section B) forecasted values for the South African house price series. In addition, an approximate 95% confidence interval for the fitted values and the forecasted values are portrayed by the dotted lines. It can clearly be seen that the model traces the house price series and captures all of the salient features.

Table 3 displays the actual house price series and the forecasts of the house price series for 2005, excluding the first quarter, and the first quarter of 2006. Again, it can clearly be seen that the model captures the actual trend of the South African house prices, namely an upward trend. Notice that the forecasts are within one standard deviation of the actual house price series. This clearly indicates that the model is an adequate forecasting tool.

Table 3: Forecast results

Period	Actual	Forecast	Std. Error
2005 – Q2	541 753,74	541 123,41	8 242,99
2005 – Q3	552 497,21	556 746,27	8 403,04
2005 – Q4	569 299,79	562 492,13	8 498,63
2006 – Q1	581 510,18	588 193,74	8 868,21

7. CONCLUSIONS

The aim of this paper was to develop an econometric model for forecasting South African house prices for 2005/6. Quarterly data over the period 1980-2005 were used. Eleven economic variables were considered for possible inclusion into the econometric model. Unit root tests were performed on the house price series and the economic variables to determine their degree of stationarity. All the non-stationary variables were differenced in order to render them stationary. Thereafter the quarterly property growth rates were modelled and the fitted model used to generate short-term forecasts.

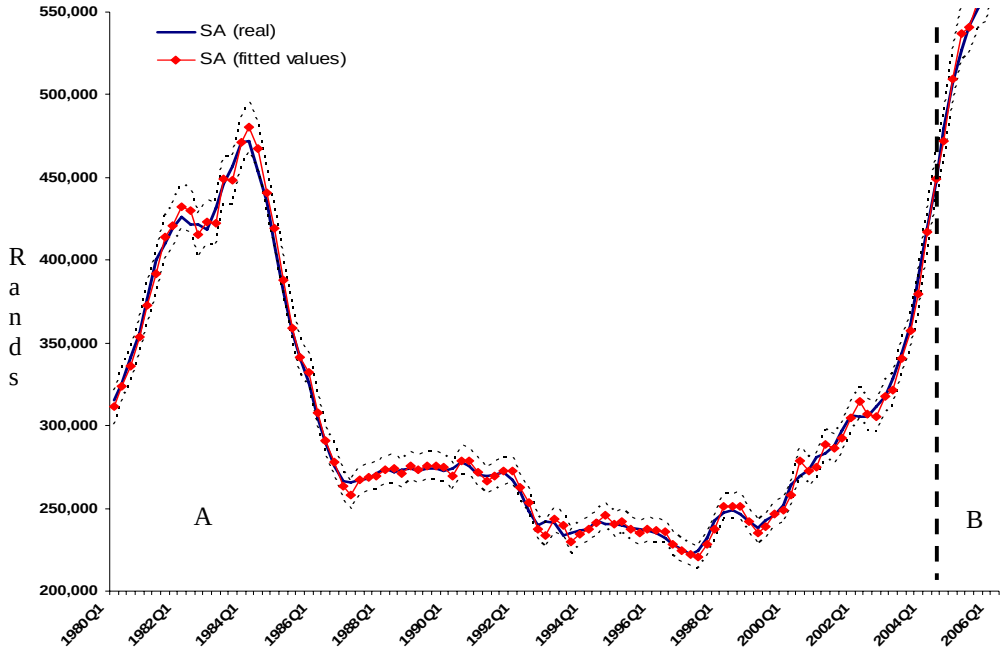

Figure 1: In-sample and out-of-sample quarterly one-step ahead forecasts for South Africa

The model explains 78,4% of the variation in the South African property growth rate series. All of the coefficients in the model are significant, at the 5% significance level, and the residual series does not display signs of serial autocorrelation. The integrated model accurately predicts the trend in the house prices for 2005, excluding the first quarter, and the first quarter of 2006, indicating that the model is a good forecasting tool.

In addition, it was observed that the following lagged economic variables are the main drivers of the South African residential property market: stock market returns, GDP, interest rates, the rand/dollar exchange rate and transfer costs. Movements in the equity market, exchange rate and transfer costs influence the property market within a period of two quarters whilst the property market responds more quickly to changes in interest rates.

In conclusion, the model developed in this paper can be used by property analysts to forecast South African house prices.

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