DETERMINANTS OF THE UPSWING PHASE IN THE SOUTH AFRICAN REAL ESTATE GROWTH CYCLE

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Abstract

Understanding and predicting cycles in real estate prices would allow investors to maximise their investment in real estate. This paper builds on the work of a previous study and includes a regression analysis of the upswing phase of the residential real estate growth cycle, which is intended to identify potential leading indicators of an upswing phase in the residential real estate cycle. The results for the upswing phase indicate that house prices, interest rates, growth in household consumption, growth in the South African All Share Index and growth in the Rand-Dollar exchange rate, all lagged by one quarter could be considered to predict the upswing phase of house prices.

Keywords: Growth Cycle, Upswing Phase

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1. Introduction

The global market cycle has many components, all of which ebb and flow together to form and influence the world economy. Part of this broader economic cycle is the residential real estate cycle, which in turn has its own unique cyclical patterns. Over the past seven years we have seen a global surge in real estate prices coinciding with strong worldwide economic growth, followed by a dramatic collapse of prices in countries such as the United States of America. Within the real estate market residential real estate cycle also reacts different to stimuli than the other real estate classes such as offices, hotels and shopping malls (Guttentag, 1961). Residential real estate, however, has not been researched as thoroughly as other real estate classes, leaving some uncertainty globally about the predictive power of the various economic factors affecting this sector of the real estate market, be it during periods of growth or contraction (Newell, McAllister & Worzala. 2004).

Various economic variables in the South African environment that can be associated with a directional change in the real estate growth cycle have been identified by Franken, Bloom and Erasmus (2011). The question remains as to which variables allow for the prediction of the different phases in the cycle? The focus of this study is the identification of variables that are used to develop regression models for an upswing phase of the residential real estate cycle.

Empirical house price data in a market upswing phase is used in this study to test whether different macro determinants and performance measures of the real estate cycle are active during an upturn of the cycle. A model is developed to test whether it is possible to predict the growth of residential real estate values. This paper firstly discusses the literature related to market cycles and indicators that influence and predict changes in the real estate market and then proceeds with a description and implementation of the methodology adopted for the preparation and development of the model. The paper concludes by assessing the results and the practical implementation thereof for market participants and decision makers.

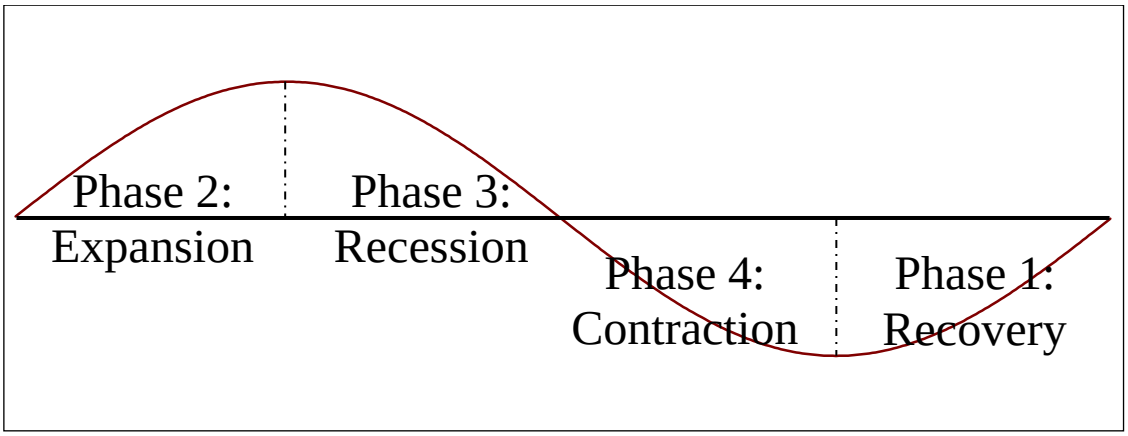
Some constraining factors are that the residential real estate cycles for the South African market, residential real estate price determinants have not previously been extensively studied in the available literature. The relevant literature is aimed at the international environment and is thus based on foreign economies which may not necessarily be relevant to the South African situation.

2. Literature review

A residential real estate cycle consists of four phases: a recovery, expansion, recession and contraction phase, as shown in Figure 1. The economic indicators influencing the changes in house prices differ between the four phases of the growth cycle (Trass, 2004:26). Since it is almost impossible to determine the exact point where a recovery merges into an expansion and

where a recession merges into a contraction phase, the recovery and expansion phases are grouped together as an upswing phase, and the recession and contraction phases as a downswing phase (Cloete, 1990:11-12 and Estey, 1956:84).

Figure 1. The phases of the residential real estate cycle



Source: Adapted from Mueller (2002)

In South African the residential real estate market recorded 17 percent annual nominal growth and 11 percent annual real growth in house prices from 2000 to 2004 (Du Toit, 2004a). This period of growth was the first continuous four year period of sustained growth since 1984. The nominal growth has subsequently decreased and house prices are currently showing negative real growth. Average real house prices increased from R240 000 in the fourth quarter of 1999 to R488 000 in the first quarter of 2004, which was slightly above the previous high of R472 100 reached in 1984 (Du Toit, 2004b). At the end of the 2000 to 2004 growth cycle the Economist ranked South Africa second only to Hong Kong (Economist, 2004). South African real estate has last seen such pronounced growth in residential prices in the early 1980s when house prices increased for four consecutive years. Unfortunately, those years were followed by plummeting house prices from 1984 to 1986, referred to as a bust (Loos, 2004).

The last strong house price growth cycle was preceded and supported by a number of factors or economic variables, such as personal tax relief, strong growth in disposable income, a decline in the ratio of household debt to disposable income, greater affordability of housing, the improved political situation, growth in the gross domestic product (GDP), relatively low inflation and interest rates, a strong domestic demand for housing and strong foreign demand for residential properties (Du Toit, 2004c and Loos, 2004).

The abovementioned factors are seen as key drivers of the real estate market and research indicates that the drivers tend to follow a regular pattern (Trass, 2004:18). The pattern is reflected in the real estate market and is called a real estate cycle. It is possible to determine in which phase of the cycle the market finds itself at any given time, but to forecast the timing of movement between phases in the cycle presents a dilemma (Trass, 2004:17-19).

The variables that influence a real estate cycle may be divided into macro and micro variables. A country's overall real estate cycle is affected by macro variables whereas micro variables are only applicable to real estate cycles for provinces, cities, towns or suburbs (Trass, 2004:36-37). This research focuses on the macro real estate cycle and all reference to cycles should be construed as macro real estate cycles. The real estate cycle could be assessed through the use of economic variables or performance measures.

The rent cycle, construction cycle, vacancy cycle and numerous other real estate related cycles are seen as economic variable indicators of the real estate cycle. These cycles, as well as the macro real estate cycle, are each in turn influenced by certain indicators, such as rental rates, construction prices, inflation and real income. These are only some of the determinants that act as indicators of the real estate cycle, and serve as early warning signs of changes in the real estate cycle and consequently in the state of the real estate market. Changes in the real estate cycle accordingly determine the long-term direction of real estate prices and have historically been a significant alert of successes and failures of the real estate market.

Furthermore, it is important to acknowledge that the real estate market is not a uniform sector within the economy. For example: residential real estate appears to react more to downturns in cycles when compared to commercial real estate (Dokko, Edelstein, Lacayo and Lee, 1999). Extensive research in the commercial, industrial and office real estate sectors has been performed to develop an approach to predict real estate prices. Interest in the residential class has however lagged, leaving a gap in the

research required to make an informed decision on price predictions of the residential class.

2.1 Factors affecting the house price growth cycle

Residential real estate price levels are ultimately determined by the market forces related to macro demand and macro supply. Franken, Bloom and Erasmus (2011) classified the predictive variables for the South African residential prices cycle into macro demand indicators, ranging from inflation and changes in interest rates to employment and population growth, and secondly into macro supply indicators, such as construction cost, rental price levels and occupancy rates.

After collecting and assessing of the relevant variables as determinants of the residential real estate growth cycle, Franken *et al.* (2011) used a regression model to assess their relationship with the house price cycle. This analysis used time series data from 1974 to 2004. However, variables such as income tax were not considered since they were not relevant to an assessment of the growth cycle of South African house prices. Variables were also eliminated due to the unavailability of data, such as sales volumes and the number of mortgage loans approved (mortgage availability). Other variables were not further considered as they were not available in the appropriate format, e.g. monthly versus annual (Franken *et al.*, 2011).

The variables finally defined and considered by Franken *et al.* (2011) for the least squares regression model are indicated in Table 1, with an indication of whether they were included or excluded from the analysis.

Table 1. Independent variables available as indicators of the real estate cycle regression analysis

Variables Included	Variables Excluded
Affordability Index	Employment Growth
Building Cost Index	Income Tax and Capital Gains Tax
Building Plans passed	Mortgage Availability
Consumer Price Inflation	Population Growth
Disposable Income	Real estate Sales Volume
Gross Domestic Product	Rent Price Level
Household Consumption	Rent-Price Relationship
Household Debt to disposable income	
Household Savings	
JSE All Share Index	
Interest Rate	
Interest Rate Growth	
One-quarter Lagged House Prices	
Rand-Dollar Exchange Rate	

Source: Franken *et al.* (2011:20)

The indicators stated in Table 1 were used to develop a linear regression model to determine which variables could be useful for the development of a model and to reduce the number of variables for an application of a best subset regression analysis. In addition, the variables considered would not always start moving in tandem as economic conditions change. To overcome this timing problem some of the dependent variable can be related to previous values of the independent variables (Dielman 1996: 180-181), known as lagging the variables. The regression analysis variables, as identified by Franken *et al.* (2011), were used in this paper to develop the final model for the prediction of the house price growth cycle.

A best subset regression analysis produces a multitude of models based on the various combinations of the independent variables. The coefficient of determination (R^2) derived for each model is considered for the assessment and evaluation of the model. The R^2 refers to the level of variation in the dependant variable that could be explained by the independent variable (Keller & Warrack 2000:644). The coefficient of determination (R^2) can be artificially high because of relationships between the independent variables (correlation) included in the model, which is caused by high levels of multi-colinearity.

3. Methodology

The methodology used to isolate the predictors to inform the upswing phase in the real estate residential cycle firstly considered the applicable period that represented an upswing phase in real estate prices, where-after an assessment of the variables identified by Franken *et al.* (2011) was conducted for the period of the upswing. The best subset regression was performed on the one-quarter lagged variables and the model with the highest R^2 was identified as the best

predictive model for the upswing phase. The assumptions of a typical multiple regression model were tested on the residuals and discrepancies analysed before a discussion of the findings.

3.1 Data sources

ABSA Bank, the Johannesburg Stock Exchange (JSE), the South African Reserve Bank (SARB) and the Bureau of Economic Research (BER) provided the data for this analysis. ABSA Bank provided the ABSA House Price Index and the Affordability Index, while the Building Cost Index and JSE All Share Index (ALSI) were provided by the BER and JSE respectively. The information for Household Debt to Disposable Income, Building Plans Passed, Household Consumption, Disposable Income, Gross Domestic Product, the Real prime overdraft rate and Year-on-year growth thereof, Household Savings, Consumer Price Inflation and the Rand-Dollar Exchange Rate where all provided by the South African Reserve Bank.

3.2 Lagging of variables

Dielman (1996: 180-181) postulated that the lagging of variables is an effective method to relate a dependant variable to previous values of the independent variables. The previous values of the independent variables are called lagged variables. Even though Quigley (1999) and Rosenthal (1999) lagged variables for up to four periods in studies of the real estate cycle, Rosenthal (1999) discovered that variables lagging more than two periods did not contribute to the prediction of changes in house prices. Consequently the variables included in the regression model were not lagged for more than two periods.

3.3 Period of assessment

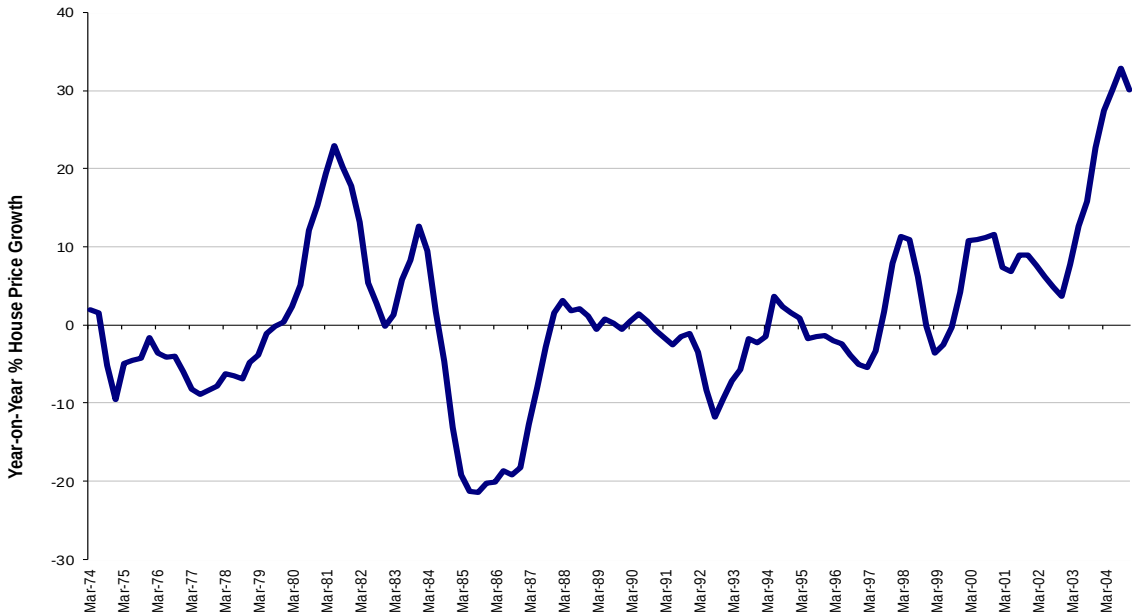
The timeframe covered in the analysis was from the first quarter of 1974 to the fourth quarter of 2004. This period includes 124 quarterly observations, with one and two of these quarters lost for lagging data one period and two periods respectively.

4. Results

4.1 Identifying the upswing and downswing phases

The identified one-quarter lagged variables were divided into two groups, each representing the upswing and downswing growth of house prices. An upswing or downswing phase is defined by Franken (2007:147) as two consecutive periods of growth in the same direction. Therefore an upswing phase in the cycle is defined as two consecutive periods of growth in the same direction, or 6 months of positive growth. The house price growth cycle illustrated in Figure 2 was separated into 11 upswing phases and 12 complete downswing phases. The upswing data for the whole period consisted of 65 observations, 11 upswing cycles, with an average length of 5.91 quarters or 17.73 months.

Figure 2. House price growth cycles in quarterly values from 1974 to 2004



Source: Adapted from data provided by Absa

4.2 Assessment of variables

After the classification of the data into an upswing and downswing data set an assessment of the time series data was performed, testing for normality and multi-colinearity. Thereafter the best subset regression analysis was used to develop the models for the upswing phase.

The upswing time series data were assessed using two tests. Firstly the variables were tested for normality. Secondly the strength of the relationship between the variables during the upswing period was tested. The upswing data were tested for normality with the use of histograms and the Shapiro Wilk test (Ott & Longnecker, 2001). For the Shapiro Wilk test a p-value below 0.05 means that the assumption of a normal distribution cannot be accepted at 95% confidence level (Polhemus, 2005). The results of the Shapiro Wilk test suggested that affordability, GDP, the dependent house price variable, one-quarter lagged house prices, interest rate growth and the JSE-ALSI index were normally distributed for the upswing period at the 5% significance level. A visual assessment of the variables confirmed the findings of the Shapiro Wilk test. The results of the Shapiro Wilk tests are shown in Table 2.

Table 2. Shapiro Wilk test for normality

Variable	Shapiro-Wilk W	P-Value
Affordability	0.976	0.230
Building Plans passed	0.941	0.004
Construction Cost	0.906	0.0001
Consumption	0.931	0.001
Debt/Income	0.941	0.004
Disposable Income	0.933	0.002
GDP	0.979	0.349
House Prices (dependent)	0.969	0.103
House Prices (lagged)	0.971	0.138
Household Savings	0.887	0.000
Inflation	0.950	0.010
Interest Rates	0.948	0.009
Interest Rates Growth	0.965	0.060
JSE-ALSI index	0.978	0.284
Rand/Dollar	0.936	0.002

The data relevant to the upswing phase was further tested for multi-colinearity that may exist between the independent variables, as high correlation between the independent variables results in disproportionately large standard errors and unstable regression coefficients (Dielman, 1996:316-318).

The multi-colinearity was tested by using a correlation matrix of the one-quarter lagged variables for the upswing phase. House prices and affordability showed the highest correlation of 0.94. This was expected, since the affordability ratio was calculated using the house price variable. Consumption showed a correlation above 0.7 with GDP, construction cost and building plans passed. Inflation and house prices, and disposable income and construction cost were correlated at a level of more than 0.6. House prices, interest rates and affordability had correlation with consumption of more than 0.5. Correlation between house prices and building plans passed, disposable income and household savings, disposable income and the debt-income relationship, household savings and the debt-income relationship, as well as construction cost and interest rate growth indicated correlation levels of more than 0.5.

Of the pairwise combinations that showed significant correlation, only consumption and house prices, and consumption and interest rates, appeared in the regression model that offered the best predictive ability. The colinearity between these pairs was still below 0.60 and did not present a problem when the t-statistics of the individual variables were evaluated.

4.3 Best Subset Regression

The best subset regression was applied to 65 observations, thus using a combination of the upswing cycles from 1974 to 2000 and it was tested on the remaining 9 observations from 2001 to 2004. The regression was based on the 90 percent training sample and a 10 percent test sample. The statistics of the model are depicted in Table 3. The best subset regression analysis produced a multitude of models and the model with the highest coefficient of determination (R^2) was chosen as the model, which explained the most variation in house price growth (Dielman, 1996:414-415, 105). The model specified in Table 3 produced the highest R^2 of 0.97 with a RMSE of 1.6392. This means that the combination of variables explained 97 percent of the variation in house price growth during the upswing cycle (Dielman, 1996:105-106). The R^2 was obtained when

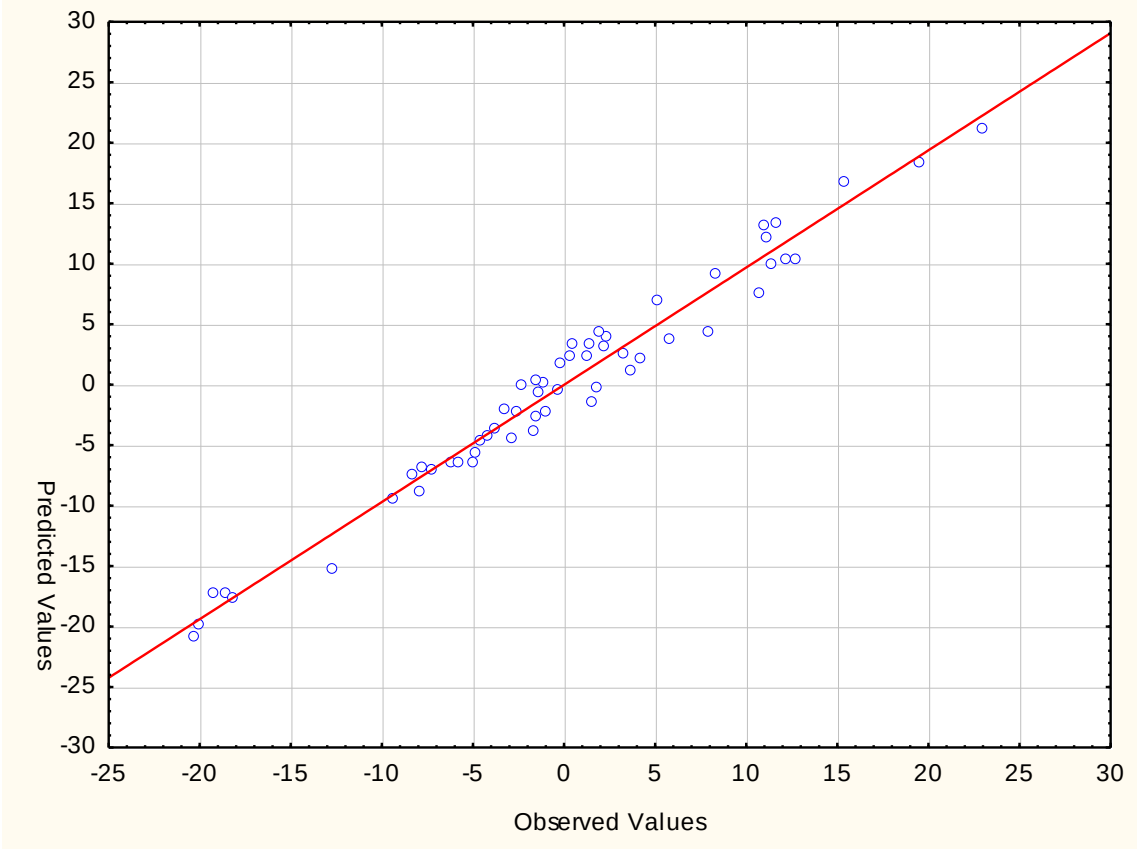
the model was tested on the period from the first quarter of 2001 to the final quarter of 2004. The following variables are excluded from the regression model: construction cost, building plans passed, CPI, disposable income, GDP, debt-to-income ratio and interest rate growth.

Table 3. Best subset regression model for the upswing cycle producing the highest R^2

One-quarter Lagged Variables	House Prices Beta Coefficients	House Prices Standard Error B	House Prices t-statistic	House Prices p-value
House Prices	0.941	0.034	28.074	0.000
Interest Rates	0.074	0.033	2.272	0.028
Household Savings	0.063	0.027	2.301	0.026
Consumption	0.091	0.039	2.353	0.023
JSE-ALSI index	0.052	0.028	1.885	0.065
Rand-Dollar Exchange Rate	0.048	0.027	1.812	0.076
	R-Squared	0.969	RMSE	1.639
	Adjusted R^2	0.965	F-Test	256.417
			h-test	1.46

A scatter plot of the predicted values of house price growth versus the actual values for the period from 1974 to 2000 is depicted in Figure 3. In the scatter plot the values produced by the model for the period 1974 to 2000 were tested against the actual values. It showed that 97 percent (R^2 of 0.97) of the predicted growth during upswing phases for the period 1974 to 2000 corresponded with the actual growth in house prices. The root mean square error (RMSE) of 1.6435 suggested that the deviation from the actual values was relatively small.

Figure 3. Scatter plot of the observed values of house price growth versus the best subset model for the upswing phases from 1974 to 2000



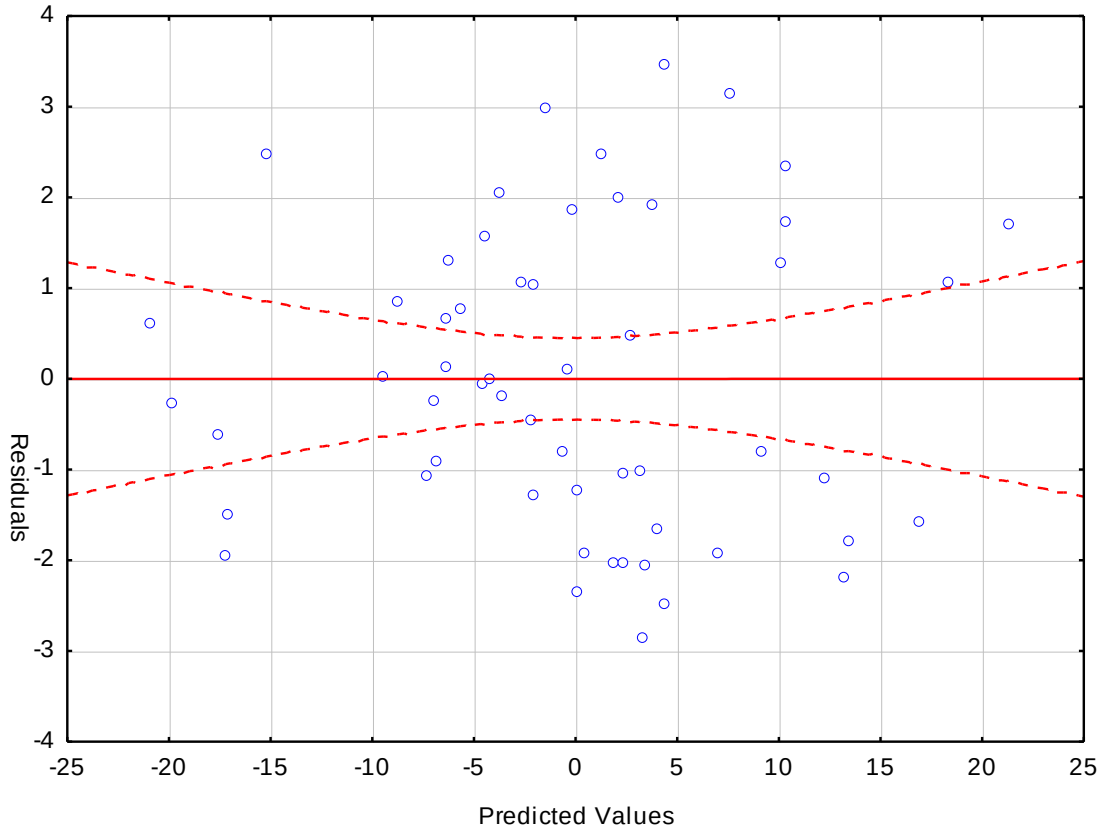
In order to confirm the value of the R^2 an additional test was performed, namely the F-test, which determines whether or not the overall model is useful for predicting growth in residential prices (McClave, Benson & Sincich, 1998:523). The F-test for this model produced a value of 256.4, with a p-value of 0.000. This was well outside the boundary of 1.84 for the 95 percent confidence level and 2.35 for the 99 percent confidence level, which confirmed that the model could be useful for predicting house prices (Dielman, 1996:105, 526).

4.4 Testing the assumptions of the model

A multiple linear regression model has four assumptions applicable to its residuals which offer the 'ideal' conditions for estimating and deducing conclusions about the predictive ability of the model. The four assumptions of homoskedasticity, linearity, independence and normality may be confirmed through scatter plots of the residuals versus the regression line (Dielman, 1996:217-218).

In order to determine whether the residuals conformed to the assumption of homoskedasticity a scatter plot of the residuals versus the predicted values shown in Figure 4 was assessed. The scatter plot showed that the residuals were randomly distributed, which suggests that heteroskedasticity was not present during the development of the model. The assumption of homoskedasticity would be violated if the residuals formed any form of discernable pattern (Ott and Longnecker, 2001:761-762).

Figure 4. Scatter plot of residuals versus predicted values



In linear multiple regression the relationship between the dependent variable and the explanatory variables should be linear. This relationship could be assessed through a scatter plot of the residuals versus the predicted values. If the residuals are randomly distributed there is evidence of a linear relationship. It is evident in Figure 4 that the residuals were randomly distributed and thus it suggests that the relationship between house prices and the explanatory variables is linear (Dielman, 1996:222-226).

The assumption of independence refers to the absence of serial correlation (autocorrelation) between the residuals (Dielman, 1996:306-307). When lagged dependent variables are used as explanatory variables, Durbin's *h*-test is used to test for serial correlation. There was no serial correlation between the residuals when the *h*-test indicates a value of between -1.96 and +1.96 at the 95 percent confidence level (Dielman, 1996:312-313). The *h*-test for the upswing model was 1.46 suggesting that there was no serial correlation between the residuals. Figure 5 depicts the normal probability plot of the residuals versus their expected value.

Non-normality may be detected through a normal probability plot of the residuals. The probability plot shows that the residuals were slightly skewed to the left (Ott and Longnecker 2001:765-766). Neter, Kutner and Nachtsheim (1996) stated that small departures from normality of residuals do not invalidate the regression analysis, and the residuals' slight skewness to the left is therefore not a concern.

4.5 Interpretation of results

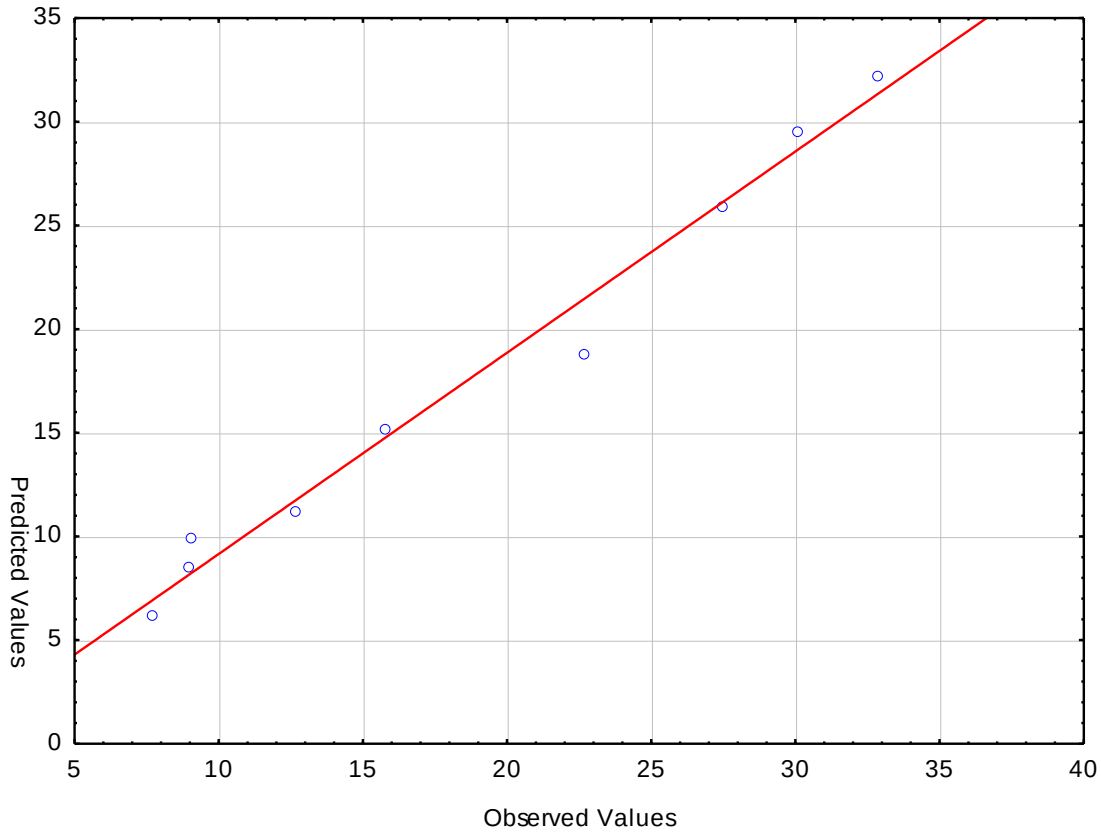
The results of the best subset regression model indicated in Table 3 suggest that the one-quarter lagged house price variable, one-quarter lagged interest rates, one-quarter lagged household savings, one-quarter lagged consumption, one-quarter lagged JSE-ALSI index and the one-quarter lagged Rand-Dollar exchange rate as the combination of variables to predict the growth in house prices during an upswing cycle.

The beta coefficients in Table 3 infer the value that each variable contributed to growth in house prices for every one percent change in the variable, with the other variables remaining constant. One-quarter lagged house prices contributed the most to the prediction with 0.941190, followed by consumption with 0.090703 and interest rates with 0.074297. Household savings, the JSE-ALSI and the Rand-Dollar exchange rate contributed 0.063171, 0.052416 and 0.048399 respectively. The JSE-ALSI and the Rand-Dollar exchange rate was significant at the 90% confidence level.

The t-statistics indicate whether or not the relationship between the independent variables and the dependent variable was linear (Franken, 2007:156). To determine, with 95 percent confidence, whether the relationship is linear, the t-statistic should be outside the upper boundary of +1.96 and the lower boundary of -1.96 and the p-value should be less than 0.05 (Steyn, Smit, Du Toit and Strasheim, 2003:419). House prices, interest rates, consumption and household savings conformed to both the requirements. The JSE-ALSI and the Rand-Dollar exchange rate had p-values between 0.05 and 0.1 suggesting that the t-statistics was significant at the 90 percent confidence level (Dielman 1996:152).

A scatter plot of the observed values of house price growth versus the predicted values for the period from 2001 to 2004, as displayed in Figure 5, showed that there were only minor deviations from the regression line. The RMSE of 1.692, shown in Table 3, confirmed that the deviations from the regression line were relatively small which showed that the model was useful for prediction of house price growth (Dielman 1996:105).

Figure 5. Scatter plot of the observed values of house price growth versus the values predicted by the best subset model for the upswing phases over the period 2001 to 2004



The statistically significant t-statistics suggested that multi-colinearity was not a problem. A correlation test showed that only consumption had a significant relationship with house prices (0.59) and with interest rates (-0.51).

5. Conclusion

This study investigated whether specific variables could predict successive period of growth in prices over the South African residential real estate cycle, referred to as the upswing phases. Several of these variables were identified in the literature study, and it is noticeable that the variables shown by the regression analysis to collectively have the best predictive power were all lagged by one quarter. Lagging the best subset variables in the regression model furthermore implies that a practitioner who regularly tests for directional changes within these variables will have an early signal that there might be an increase of residential real estate prices in the offing. Therefore, if an upward trend is exhibited by the independent variables, it is probable that residential prices could follow the tendency.

The movements in prices over the period 1974 to 2004 indicated no discernable trend or cyclicality, further implying that the high predictive power of the regression model is a strong indication of the relationship between residential prices and the independent variables, and that the price changes are not subject to a normal predictable economic cycle that repeats after a fixed period in time.

The variables which had a statistically significant predictive power for the upswing phases of growth in the South African residential real estate market were a combination of household savings, the consumption levels of households, positive changes in house prices, the Rand-Dollar exchange rate, the Johannesburg Securities Exchange All-share Index and changes in the mortgage market measured by either interest rates or mortgage activity.

6. Practical and Managerial Implications

The analysis that was performed can be applied by active participants to understand and predict the house price growth cycle, understanding that it is different from the house price *classical* cycle. The variables that are active during the phases of the cycle are useful for determining whether the market is in an upswing phase, and may be employed to predict changes in the direction of growth in house prices.

Estate agents might have sufficient time to prepare for an upswing by, for example, appointing and training new staff, opening new branches and actively acquiring new properties. Development companies can plan new developments earlier and release them during an upswing phase of the house price growth cycle. Consequently a development company could provide housing, or plans for housing, when demand for housing is high. Fund managers can also be assisted in the allocation of investments between commercial, industrial and residential real estate and between real estate and other investment vehicles. Lastly, construction companies who allow discounts when demand for construction is low can add premiums earlier in the upswing phase and minimising unnecessary discounts.

7. Future Research

Where this study focused on the upswing phase of the residential real estate market, a similar study is proposed for the downswing phases of the real estate cycle. The omission of some variables from the regression analysis due to insufficient or unavailable data poses a limitation to the study, and could be overcome by obtaining the relevant information. This study will be greatly improved if those variables were included in the regression analysis, and even more so if monthly data was available for all the indicators. Serial correlation between the residuals of the regression analysis can also only be ruled out conclusively if all the variables are present.

By analysing monthly data the recovery and expansion phase in the upswing cycle and the hypersupply and recession phase during the downswing phase could also be distinguished more clearly. This would allow for empirical studies to be conducted on all four phases, which would in turn contribute to the accuracy of prediction of directionality and timing of changes in house price growth. It is possible that one of the sectors could consistently act as a leading indicator for the others, thereby enabling some early identification of changes in the sectors.

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