ON BUBBLES AND HOUSES: HOUSE PRICE INFLATION IN JOHANNESBURG

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Abstract: Economic commentators argue that the house price bubble is the central element in the current financial crisis. This means that income and the mortgage rate, the two key variables that a household considers when they assess whether or not they can afford a mortgage, should display a limited ability to explain house price movements. Given the role of real disposable income and the real mortgage rate, the paper first explores whether or not a long-run cointegrated relationship between these variables exists. It does so by estimating a Vector Error-Correction Model (VECM) that includes the real house price as measured by the ABSA median house price series, real disposable income and the real mortgage rate. The paper uses the ABSA median house price series as it is currently the most comprehensive and most used house price series in South Africa. Although one cointegrating vector exists the VECM estimation yields no satisfactory results. To consider whether or not the absence of this relationship is due to data limitations, a Hedonic model is estimated using data of real estate transactions in Johannesburg. A Hedonic model may capture pure house price inflation more accurately compared to a median house price series such as the ABSA series. However, the VECM estimation with the Hedonic house price inflation series still show no relationship between real house prices, real disposable income and the real mortgage rate. Subsequently, using both house price series in separate models, the paper considers whether or not the significant increase in house prices can be ascribed to liberal credit growth. It also considers whether or not growth in credit can, in turn, be ascribed to growth in income. The analysis highlights the rather significant role that credit extension played in the growth of the house prices over and above the impact of what many would consider to be the fundamental factors explaining house prices, such as disposable income and the mortgage rate. The analysis argues that the various macroeconomic relationships considered in this paper may be indicative of a collateral value-credit extension spiral, which in turn might be the mechanism underlying a house price bubble. It also highlights the need to let the mortgage rate play a bigger role in the allocation of mortgage credit.

JEL: D40; L85

1. Introduction

Like many other countries, South Africa experienced significant increases in house prices since the turn of the millennium. As in most of these countries, this increase came to a halt, and turned negative in real terms. This gave rise to the notion that house prices might have experienced a price bubble. Economic commentators argue that the house price bubble, particularly in the US, is one of the central causes of the 2008/9 global financial and

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economic crisis, and a reversal of the house price misalignment may hold serious repercussions for many economies. For most individuals their residential property is the primary component of their wealth and a rapid decrease in property value may cause banks to experience a fall in the value of the collateral to below the value of the loan. Households increasingly will have difficulty repaying debt (Riddle, 1999:273), while their incentive to repay debt that exceeds the value of the asset will decrease. The downturns in the property cycles not only affects consumption decisions but can also lead to bankruptcies in the financial and corporate sectors, along with macroeconomic recession and unemployment (Riddle, 1999:273; Weeken, 2004:1, Case, *et al* 2000:120, 148; Jacobsen, 2005:29).

According to literature disposable income is the key variable explaining house price movements, with the mortgage rate also playing an important role. (McQuinn O'Reilly 2006:4-5; Leishman 2003:137; ECB 2003:22; Case, *et al* 2000:142; Muellbauer and Murphy 1997:1705) However, when a house price bubble develops one would expect that the relationship between house prices, disposable income and the mortgage rate would break down. Stated in econometric terms, when no bubble exists and prices reflect their fundamentals, one would expect the presence of a long-run cointegrating relationship between a price and its fundamental (cf. Nunes and Da Silva 2007:3). If a bubble does exist, there will be no such cointegrating relationship.[2]

Using a cointegration approach, this paper considers whether or not such a bubble has been present in residential house prices in Johannesburg, the largest metropolitan area in South Africa. Given the role of real disposable income and the real mortgage rate, the paper first explores whether or not a long-run cointegrated relationship between these variables exists. It does so by attempting to estimate a Vector Error-Correction Model (VECM) that includes the real house price as measured by the ABSA median house price series, real disposable income and the real mortgage rate. The paper uses the ABSA median house price series as it is currently the most comprehensive and most used house price series in South Africa. The VECM estimation, though, shows no long-run relationship exists. Given that the ABSA series is a median house price series, while many papers argue that Hedonic house prices series are more accurate, the question arises as to whether or not the absence of a relationship results from the use of median house prices (Costello and Elkins, 2000:2; Flaherty, 2004:3). To address this question, the paper first distils a house price series from a Hedonic model and substitutes it for the ABSA series. A Hedonic model may capture pure house price inflation more accurately compared to a median house price series such as the ABSA series. Furthermore, using both house price series in separate models, the paper considers whether or not real mortgage credit extended by banks provides an explanation for house price movements. Thus, the question is whether or not the significant increase in house prices can be ascribed to liberal credit growth. It also considers whether or not this growth in credit can, in turn, be ascribed to growth in income.

2. On bubbles and long-run relationships

When defining a market bubble, researchers often focus on the concept of rapidly rising prices, unrealistic expectations of future prices and the departure from the fundamental

[2] The approach does have its sceptics, who argue that the approach is not infallible to test for market bubbles (see Evans, 1991:922).

value that precedes a significant price decline (Himmelber *et al*, 2005:1; Jacobson, 2005:29,37; Stevenson, 2005:16; Foley, 2004:16; Leishman, 2003:137; Stiglitz, 1990:13). According to Smith and Smith (2006:3) a house price bubble is "...a situation in which the market prices of certain assets rise far above the present value of the anticipated cash flow from the asset." These types of definitions imply that the price of an asset reflects its fundamental value before the market bubble arises (this is a reference point for the calculation of price changes). Thus, the asset price at any given point in time is then compared to a point where the asset price is assumed to be supported by its relevant fundamentals. However, it is possible that as part of a financial crisis or a recession, asset prices can decrease rapidly, reflecting lower expected earnings. In this case the prices might fall significantly even if no market bubble burst. It is also possible that asset prices are below their fundamental value and that asset prices can maintain that level for a period of time. If prices then rapidly increase from a point below their fundamental value it does not necessarily imply a market bubble.

Therefore, what the above suggest is that one should carefully distinguish between price movements that occur as a result of changes in fundamentals (and some of these price movements may be large), and price movements that are unrelated to the fundamentals (that might also be large). Furthermore, because the above definitions of a bubble are very sensitive to the reference point from which changes in prices are evaluated, there is need for a definition that is less sensitive. One possibility is to view it from within a cointegration framework (cf. Nunes and Da Silva 2007:3). Cointegration allows for a distinction between a long-run relationship and short-run deviations from the long-run relationship without the need to identify a reference point. It also allows for a distinction between price changes related to fundamentals (reflected by the long-run relationship) and those unrelated to the fundamentals (reflected by the absence of a long-run relationship).

3. Modelling

Modelling house prices and economic variables is often associated with problems of endogeneity of regressors leading to simultaneity among the variables in the system. In addition macroeconomic variables are aggregated and exhibit non-stationarity. The conventional wisdom was to difference all non-stationary variables used in a regression analysis. However, differencing variables to get them stationary eradicates the long-run relationship between the variables (Masih and Masih 1996:321). The application of cointegration techniques and developments in error-correction modelling serves, in part, as a solution to these modelling problems. Hence, this paper will use cointegration to assess whether a long-run relationship is present, or use its absence to establish the presence of a bubble.

House price volatility commonly reflects movements towards a new equilibrium price following a demand or a supply shock. Deviations from the market-clearing equilibrium price are accentuated by large transaction costs and inertia in the response of housing supply to shocks. If house prices are driven only by fundamental factors and deviations are regarded as rational and efficient, prices will tend to mean-revert and observed house price movements will reflect a combination of shocks and adjustment mechanisms. However, when fundamental factors fail to explain house prices, the failure can be interpreted as the presence of a bubble. This definition of a bubble as the absence of a long-run relationship is a broader definition than defining bubbles as large price increases, followed by large price decreases. It may also encompass cases where prices are merely unrelated to fundamentals, though they are not increasing or decreasing. Although this definition does not include the large increase/large decrease element of most bubble definitions, it is nevertheless free from the reference point problem. Thus, according to this definition, a bubble is merely price movements unrelated to fundamentals. Note however, that this paper also makes the point that a price that is unrelated to and is unexplained by its fundamentals, is not necessarily an unexplained price. Other factors (such as excessive credit growth in the case of this paper) may explain the price.

As mentioned above, the paper assumes that the fundamental value of housing is related to household disposable income and the real mortgage rate, thereby allowing the following empirical specification:

$$P_t = \beta_{0t} + \beta_{1t} RDY_t + \beta_{2t} RMOR_t + \varepsilon_t \tag{1}$$

where P denotes the log of real house prices, RDY is the log of real disposable income, and $RMOR$ denoting the real mortgage rate. Should no evidence be found in support for the presence of this relationship, the paper will consider two further possibilities. First, it will consider whether or not the ABSA median house price time series is appropriate. Secondly, it will consider whether or not mortgage credit extended by the banks does not provide a better explanation for house price movements.

Regarding the appropriateness of the ABSA median house price series, it should be noted that median house price indices are based on the assumption of homogeneity of housing units even though houses are heterogeneous in nature. As a result of the heterogeneity of houses, median house price indices are prone to yield biases because they are unable to distinguish between movements in prices and changes in the combination of dwellings sold from one period to the next. For example, although it is possible that the prices of many lower quality houses did not change, if the proportion of higher quality and hence, high-priced houses sold increase, a median measure will show an overall increase in house prices. Thus, the median value can be skewed by the sale of very high or very low-priced houses during a specific index period and the price movements recorded in the median index may not be representative of the price movements relevant to all houses in the economy (Hansen, 2006:5).

To incorporate the heterogeneous nature of housing in house price indices, the hedonic procedure is generally used to quantify the effect of various housing and neighbourhood characteristics on house prices. Hedonic price models focus on the utility derived from individual characteristics of a house. Empirically, the technique uses regression analysis to explain the variation in market values using property characteristics (Goodman and Thibodeau, 1995:25). The key advantage of the general hedonic formulation, and the reason why it is used in this paper, is that it provides direct estimates of pure price changes (house price inflation) and can, in principle, control for housing characteristics and changes in the composition and quality of houses sold in a dataset (Hansen, 2006:6). Thus, the Hedonic specification includes trend dummies that capture the effect of pure price changes over time after controlling for the heterogeneity of houses. This paper uses the parameters of these trend dummies to construct a pure price time series that is then substituted for the ABSA median house price series in the VECM estimations.

The general specification for a hedonic house price equation is

$$lnP_t = \beta_{0t} + S\beta_{1t} + L\beta_{2t} + N\beta_{3t} + T\beta_{4t}\; P_t = \beta_{0t} + \beta_{1t}S + \beta_{2t}L + \beta_{3t}N + \beta_{4t}T + \varepsilon_t \qquad (2)$$

where P is the natural log of the observed sale price of the property[3]; S denotes a class of variables describing structural characteristics (number of various rooms and bathrooms, number of storeys, number of garages and carports, the presence of a pool or not, etc.); L is a dummy variable that is 1 if the property is classified as a free-hold unit (full-title unit) and 0 if it is a sectional-title or cluster unit. N denotes a class of neighbourhood dummies; and T represents a three-month time trend in house prices. It should be noted that this is a pooled rather than panel data regression, as the number of observations and the specific housing units sold vary with each time period t.

The second question stated above, is whether or not mortgage credit extended by banks does not provide a better explanation for house price movements. Hence, in equation (3) real disposable income is replaced with real mortgage credit extended by banks:

$$P_t = \beta_{0t} + \beta_{1t}RCREDIT_t + \beta_{2t}RMOR_t + \varepsilon_t \qquad (3)$$

where $RCREDIT$ is real mortgage credit. Should real mortgage credit be a statistically significant variable, while real disposable income is not (or if a valid cointegrating relationship can be estimated with credit, but not with income), it serves as evidence that house prices might be driven by credit, and not so much by what one would consider its key fundamental variable, namely disposable income. As such, it may allow for a liberal credit extension policy to explain increasing house prices.

Following this, should credit provide a satisfactory explanation, the analysis also estimates a relationship between real disposable income and real mortgage credit extended by banks. This is done to consider the point made by banks that mortgage loans are primarily extended on the basis of a household's income. Thus, the analysis will perform a weak exogeneity test to establish whether or not causality runs from income to credit or *vice versa*. The relationship estimated will be:

$$RCREDIT_t = \beta_{0t} + \beta_{1t}RDY_t + \varepsilon_t \qquad (4)$$

Lastly, the analysis will estimate a relationship that includes house prices, disposable income, credit and the mortgage rate:

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[3] Refer to Malpezzi (2002:20) for a discussion of the reasons for estimating a semi-log hedonic function as opposed to other functional forms.

$$P_t = \beta_{0t} + \beta_{1t} RDY + \beta_{2t} RCREDIT_t + \beta_{3t} RMOR_t + \varepsilon_t \qquad (5)$$

If credit is the only explanatory variable, the estimation serves as evidence of the presence of a bubble that has been fed by liberal credit. However, if credit and fundamentals such as income and the mortgage rate are statistically significant, there is evidence that price movements do not only reflect a bubble, but also movements in the fundamentals (i.e. a hybrid case is possible).

3. Econometric methodology and data

(i) Econometric methodology

To estimate the long-run relationship this paper uses a Johansen vector error-correction framework (Johansen, 1991, 1992). The analysis examines the long run relationship between the variables specified in equations (1) to (5) above. Using the Johansen procedure, the vector error-correction model estimated is:

$$\Delta X_t = \Pi X_{t-1} + \sum_{t=i}^{k} \Gamma_i \Delta X_{t-i} + \varepsilon_{kt} \qquad (10)$$

where X_t = (containing respectively the variables specified in equations (1) to (5) above). Thus, X might be a 2x1, 3x1 or 4x1 vector that includes the I(1) variables, Γ_i are nxn short-run coefficient matrices (where n is the number of lags identified by the information criteria); ε_{kt} are normally and independently distributed error terms. The trace test is used to determine the number of cointegrated vectors.

(ii) Data

The house price time series is obtained from the ABSA residential property market database. According to the ABSA residential property market database the South African residential property market is categorised into three major segments: luxury houses, middle-segment houses (subdivided into large -, medium - and small houses) and affordable houses.[4] To model residential property prices in South Africa the paper employs house prices that are categorised in the middle segment of the Greater Johannesburg residential property market.

The data consists of quarterly observations for the period 1995 to 2009. Though this might seem a short sample, a precedent exists in Juselius and Toro (2005:515), who used sample splits ranging from 1977:4 to 1988:4 and 1989:1 to 1996:3 in their VECM estimation. Juselius and Toro (2005:512-3) argue that:

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[4] The luxury segment refer to houses valued between R2.6 million and R9.5 million; Middle segment housing refer to houses that are valued up to R2.6 million and are further divided into sub segments according to the size of the property. Small houses extend over an area of 80m^2 to 140m^2, medium houses 141m^2 to 220m^2 and large houses 221m^2 to 400m^2. Affordable housing refers to houses of 40m^2 to 79m^2 and priced at R193 000 or less. Due to the increase in house prices, the cut-off prices for the classification of houses were adjusted in 2006. Prior 2006 the price bracket for luxury housing was between R2.2 million and R8.2 million. Middle segment housing were priced up to R2.2 million and affordable housing were priced up to R193 000.

> "In the subsequent discussions we will use the concept of a "long-run relation" to mean a cointegrating relation between I(1) or I(2) variables and the notion of "short-run adjustment" when a stationary variable is significantly related to a cointegration relation or to another stationary variable. A necessary condition for a "long-run relation" to be empirically relevant in the model is significant "short-run adjustment" in at least one of the system equations."

Based on the literature reviewed above and the data available this paper uses the predominant rate of new mortgage loans extended by the banking sector for dwellings and disposable income of households to explain long-run house prices. For credit the paper uses the mortgage credit extended by banks.

For the estimation of the Hedonic model the study uses cross-sectional housing data from the Sold Property Guide database of Property 24. Property 24 is supported by the Property Association of South Africa, the MLS multi-listing organisation and a number of estate agency groupings. The data contain unit record information of sold housing units. This includes information of the sale price, location (street address, suburb), structural attributes (number of rooms, bathrooms, recreational areas, garages, carports etc) and whether or not the property is categorised as a free-hold unit or a sectional title unit.

Data generated by real estate agencies classify as transaction data that measure the market value of the property at the point of sale. Transaction data is based on the revealed preferences of producers and consumers in true market conditions and thus, records what willing buyers and sellers have done (Els and Von Fintel, 2008:8). However, transactions data typically require a moderate amount of "cleaning" that includes the removal of double entries and incomplete entries (Pollakowski, 1995:380).

The housing data used in the Hedonic modelling procedure covers residential properties located inside the Johannesburg municipal boundaries (based on the demarcation done by the Municipal Demarcation Board in 2000) and consists of 38 000 house sales from 1 January 1995 to 30 June 2009.

4. Estimation results and evaluation

(i) Univatiate Time series characteristics of the data

To test for the presence of unit roots the analysis employs the augmented Dickey-Fuller test (ADF) (Dickey and Fuller, 1979), the Phillips-Perron test (PP) (Phillips-Perron, 1988) as well as the Kwiatkowski-Phillips-Schmidt-Shin test (KPSS) (Kwiatkowski *et al* (1992). For the ADF test, the lag length was chosen using the Modified Schwartz information criterion and the PP test used the Newey-West Bandwidth for lag length determination. It should be noted that in particular the ADF and PP tests can suffer from lack of power as they tend to accept the null of a unit root too frequently against a stationary alternative (Masih and Masih, 1996: 321). Note that the null hypothesis for the ADF and PP tests is that the series is not stationary (i.e. a unit root is present), while the null of the KPSS is that the series is stationary. Table 2 shows the results for the ADF, PP and KPSS tests of the variables that were considered in the modelling process.

Table 1 – ADF and PP tests for unit roots and KPSS tests for mean stationarity.

	Augmented Dicky-Fuller			*Phillips-Perron*			*KPSS*		
Variable				***Z(ta)***	***Z(ta)***		***h(m)***	***h(m)***	
	I(0)	*I(1)*	*I(2)*	*I(0)*	*I(1)*	*I(2)*	*I(0)*	*I(1)*	*I(2)*
LJHBR	-0.334	-3.288**		0.010	3.291**		0.851***	0.263	
TRENDRL	-0.456	-4.274***		-0.054	-8.410***		0.874***	0.240	
LDYR	-0.349	-16.332***		-0.463	-27.201***		0.927***	0.198	
MORR	-2.586	-4.638***		-1.960	-4.638***		0.525**	0.159	
LCREDITR	-0.902	-1.540	-6.337***	1.555	-1.540	-6.303	0.780***	0.469**	0.180

*, **, *** indicates statistical significance at the 10%, 5% and 1% levels respectively

The stationary tests yield unanimous results (see Table 1), indicating that all the variables, with the exception of credit, are I(1), while credit is I(2). With credit being I(2), the analysis includes the change in credit (which is thus I(1)) as variable in the VECMs.

Following the stationarity tests, the paper estimates equation (1) above, which is a long-run relationship between the ABSA median house price series, disposable income and the mortgage rate, all in real terms. The trace test is used to test for cointegration (while the number of lags to include in the analysis has been established on the basis of information criteria). The trace test indicates the presence of one cointegrating relationship. However, when estimating the relationship the analysis finds no satisfactory results.[5] The error-correction term (i.e. the α-parameter) that measures the reaction of house prices to shocks in the long-run relationships is statistically insignificant and has the wrong sign. Normalising on the other variables does not yield better results.

To consider whether or not the absence of this relationship is due to data limitations, more specifically due to the manner in which the ABSA median house price series has been compiled, the paper subsequently develops a Hedonic house price model as specified in equation (2) above, using data from real estate transactions in Johannesburg. By controlling for housing characteristics,[6] the paper uses the parameters of the time dummies constituting

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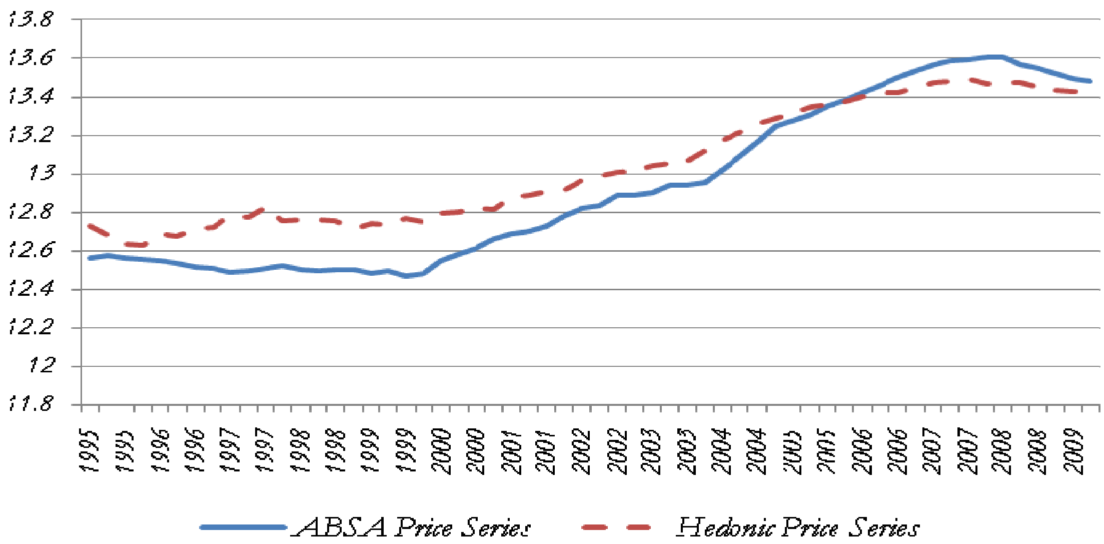
[5] Results are not reported here for reasons of brevity. They are, however, available on request from the authors.
[6] The control variables used were: Double-storey or not, sectional title or freehold, number of rooms, number of bathrooms, number of recreational areas, number of studies, number of domestic worker rooms, number of

the trend, of the Hedonic model to estimate a pure house price series. Figure 1 displays the pure house price series distilled from the Hedonic model, as well as the ABSA series (both in logarithm).

Figure 1 – Real Hedonic and ABSA median house prices for Johannesburg (in logarithm)



The pure house price series distilled from the Hedonic model is then substituted for the ABSA median house price series in the VECM to re-estimate the relationship between the real house price series, disposable income and the real mortgage rate. However, with the pure house price inflation series there still is no relationship between real house prices, real disposable income and the real mortgage rate.[7] This is taken as preliminary evidence in support of the presence of a bubble.

Subsequently, the paper considers whether or not credit market conditions contributed to the presence of the bubble. This is done by considering the relationship between house prices, real mortgage credit extended by banks and the real mortgage rate. The latter controls for price effects, while the former controls for quantity, i.e. non-price effects, such as credit rationing, or its opposite, liberal credit extension. The inclusion of credit is predicated on the notion that the interest rate does not necessarily serve as the price for mortgage credit that equilibrates the supply and demand for mortgages. Instead of using price, the allocation is done by administrative means on the part of the mortgage providers.

garages (and its square), number of carports, one or two houses on one property stand, flatlet present or not, pool present or not, as well as neighbourhood dummies.

[7] Again, the results are not reported here for reasons of brevity. They are, however, available on request from the authors.

Table 2 – VECM results

	Model 1 (A) TRENDLR	Model 1 (B) LJHBR	Model 2 LDYR	Model 3 (A) TRENDLR	Model 3 (B) LJHBR
Cointegrating Equation					
MORR	9.978	21.683		-0.054	3.241
	(5.606)	(4.314)		(-0.116)	(4.776)
D(LCREDIT)	-14.365	-28.565	-11.251	-4.101	-10.456
	(-7.783)	(-4.394)	(-3.818)	(-6.205)	(-10.456)
LDYR				-2.043	-2.248
				(-19.126)	(-15.564)
C	-13.622	-14.241		11.487	13.962
Error correction Equation					
α	-0.052	-0.003	-0.0462	-0.152	-0.022
	(-3.367)	(-0.449)	(-7.772)	(-1.694)	(-0.624)
TRENDLR χ^2*(Prob)*	0.000			0.099	
LJHBR χ^2*(Prob)*		0.674			0.543
MORR χ^2*(Prob)*	0.003	0.020		0.145	0.034
D(LCREDIT) χ^2*(Prob)*	0.002	0.001	0.305	0.035	0.004
LDYR χ^2*(Prob)*			0.000	0.852	0.103
LM(Prob)(2)	0.168	0.201	0.382	0.230	0.933
LM(Prob)(4)	0.347	0.071	0.466	0.144	0.779
Nr of lags	3	1	3	3	3

By using both the ABSA and the Hedonic pure house price series in a separate VECMs that include real house prices, real mortgage credit and the real mortgage rate, the analysis indicates that both real mortgage credit and the real mortgage rate explain house price movements (see Table 2, Models 1A and 1B). However, note that the model estimated with the ABSA median house price series does not performs satisfactory, given that its error-correction term (i.e. the α-parameter) is statistically insignificant and has the wrong sign. This leaves the model with the Hedonic price series as the only satisfactory model. According to the model estimated with the real Hedonic price series (see Table 2) an increase of one percentage point in the real mortgage credit extended, leads to an increase in the real house prices of approximately 14 percent. Furthermore, an increase of one percentage point in the real mortgage rate leads to a decrease of approximately ten percent in the real Hedonic price series. With regard to the error-correction term (i.e. the α-parameter), the value of -0.05

indicates that it will take approximately 20 quarters for a real house prices to return to their long-run equilibrium. The LM test for autocorrelation indicates the absence of autocorrelation.

The weak exogeneity test confirms the endogeneity of the Hedonic house price series, which indicates the legitimacy of normalising the regression on the house price series. This is further supported by the variance decomposition analysis contained in table 3 that indicates that house prices explain only 32% of their own variance, while credit explains 67% (while both credit and the mortgage rate explain 68% and 72% respectively of their own variances – which is an indication of their exogeneity in this model). Also note that in this model the real mortgage rate explains less than 5% of real house prices and 24% of real mortgage credit extended. The finding that credit explains house prices, while disposable income seems unable to do so, might be an indication that the changes in house prices observed were the result of credit extension policies of banks that did not take sufficient cognisance of the income of their clients. In short, the significant increases in house prices during the sample period might therefore be ascribed to liberal credit extension policies pursued by banks.

Table 3 – Variance decomposition after 20 quarters

	Variance explained by:		
Variance explained:	*TRENDRL*	*MORR*	*D(LCREDITR)*
TRENDRL	*32.7*	*0.3*	*67*
MORR	*4.6*	*71.7*	*23.7*
D(LCREDITR)	*8.7*	*23.5*	*67.9*

Note: Cholesky Ordering: *D(LCREDITR) MORR TRENDRL*

However, it is often considered common knowledge that banks use disposable household income as the main determinant in deciding the amount of credit to extend to households. For instance, the mortgage premium that a household has to repay, should, according to this common knowledge, not exceed one third of that household's disposable income. However, it has also been common knowledge that at times some households were for instance able to increase the amount of credit by extending the loan maturity (say from 25 to 30 years) without thereby increasing the monthly premium, or by simply registering a second mortgage. This would relax the constraint that disposable income places on the amount of mortgage credit extended. Furthermore, as house prices increased and the perceived collateral of their owners increased, some banks might have been willing to focus more on the perceived safety of the collateral (even though the collateral value might have been inflated by the very loans that the banks extend), than the actual ability of households to service their loans from their disposable income. Again this serves to relax the link and the direction of causality between disposable income and mortgage credit extended.

To consider this link between real mortgage credit extended and real disposable income, the analysis also shows, again using a VECM, that there is a long-run relationship between real disposable income and real mortgage credit (see Table 2, Model 2).[8] However, the weak exogeneity test indicates that causality in this relationship runs from credit to income and not

[8] Again the trace test indicates the presence of one cointegrating relationship (and the number of lags to include was determined using information criteria).

vice versa (again see Table 2, Model 2). This is further supported by the variance decomposition analysis (in Table 4) that indicates that real mortgage credit extended explains 82% of the variance of real disposable income and 99% of its own variance. Thus, whereas one would expect that income is an explanatory variable for mortgage credit extended, the reverse seems to be true. This might also be an indication that mortgage credit is often used to not only finance houses, but also household consumption, with household consumption being a driver of income, given its share in GDP. That is in line with findings that durable consumption expenditure by household is a leading indicator and possibly a driver of GDP (and hence disposable income) (cf. Burger 2008, 2010).

Table 4 – Variance decomposition after 20 quarters

	Variance explained by:	
Variance explained:	*LDYR*	*D(LCREDITR)*
LDYR	*17.9*	*82.1*
D(LCREDITR)	*0.6*	*99.4*

Note: Cholesky Ordering: *D(LCREDITR) LDYR*

Given the estimated relationship between real disposable income and real mortgage credit, the paper estimates a VECM that includes house prices, real mortgage credit extended by banks, disposable income and the real mortgage rate. Again, this model was estimated once with the ABSA median house price series and once with the Hedonic price series. But, once again, the ABSA price series does not yield a satisfactory model (see Table 2 Model 3B), while the Hedonic price model yields better results (see Table 2 Model 3A).[9] The estimation indicates that both income and credit are statistically significant, while the interest rate is statistically insignificant. The error-correction term (i.e. the α-parameter) is statistically significant at a five percent level. However, it is a borderline case, which indicates that this model should be interpreted with caution. This cautious attitude is further supported by the weak exogeneity test which indicates that the null hypothesis that the house price is a weakly exogenous variable that can only be rejected at the 10% level. The variance decomposition indicates that after 20 quarters credit explains 44% of the variance of the house price, while the latter explains 48% of its own variance. All the other variables explain the majority of their own variance after 20 quarters. Also note that in this model the real mortgage rate explains less than 5% of real house prices and real disposable income and a very small 11% of real mortgage credit extended. Furthermore, also note that while credit explains 52% of its own variance (confirming its rather exogenous nature), house prices nevertheless explain 35% of credit extended. This may be indicative of a collateral value-credit extension spiral.

Table 5 – Variance decomposition after 20 quarters

	Variance explained by:			
Variance	TRENDRL	LDYR	D(LCREDITR)	MORR

[9] The trace test indicates the presence of only one cointegrating relationship (with the number of lags to include was determined using information criteria).

explained:				
TRENDRL	47.9	5	44.1	3
LDYR	13.6	61.4	22.3	2.7
D(LCREDITR)	34.9	2.8	51.8	10.5
MORR	3.4	15.4	21.1	60.1

Note: Cholesky Ordering: D(LCREDITR) MORR LDYR TRENDRL

The significance of income and credit would not have been expected had income been the main criteria for the extension of mortgage credit by banks (the resulting multicollinearity would have caused the t-values of both to decrease, rendering them statistically insignificant – something that did not happen). Thus, given the failure of income and the success of mortgage credit on their own (together with the mortgage rate) to explain house prices, the statistical significance of both in a relationship that includes them both, indicate that credit played a role over and above income in explaining house prices. Therefore, whereas a standard expectation in the presence of a bubble would have been that income fails totally to explain house prices, the inclusion of disposable income and mortgage credit indicates that although there is a part of house prices that is explained by its most fundamental driver (i.e. disposable income), there is also a part of house price behaviour that can be explained by liberal credit extension. The latter might be interpreted as the driver of the bubble.

5. Conclusion

The above analysis indicates the rather significant role that credit extension played in the growth of the house price bubble in South Africa. Like the house price bubbles in the US and other countries, the South African house price bubble eventually burst amidst the worst economic turmoil since the Great Depression.

The one overarching conclusion that the above analysis yields is the importance of mortgage credit in explaining house price movements over and above the impact of what many would consider to be the fundamental factors explaining house prices, such as disposable income and the mortgage rate. Given the impact of household wealth on consumption and given that residential property constitutes the major component of that wealth, should highlight the role and importance of mortgage credit extension in the economy. Thus, it also highlights the harmful impact that a too liberal credit extension policy might have on the economy – a situation that seems to have been the case in South African (and elsewhere).

Given the relatively small role of real disposable income and the even smaller role of the real mortgage rate in explaining real house prices, indicates the institutional, non-price allocative mechanism at play in the housing market. The small role of the mortgage rate may also be indicative of the difficulty that monetary policy at times has to combat inflation by way of interest rate increases. Furthermore, as the full model containing house prices, income, the mortgage rate and mortgage credit indicates, while real mortgage credit explains 44% of real house prices, real house prices explain 35% of real mortgage credit extended. This is, as the analysis argues, indicative of a *collateral value-credit extension spiral*, which in turn might be the mechanism underlying a house price bubble. Therefore, the findings of this analysis indicate the need for banks to link the amount of mortgage credit that they extend more closely to the disposable income of their clients. It also highlights the need to let the mortgage rate play a bigger role in the allocation of mortgage credit.

Lastly, given that this paper compares models estimated with median house prices and Hedonic house prices, and given that the latter performed better, demonstrates the value of using Hedonic house prices. As such, the paper recommends that serious consideration should be given to estimate and use Hedonic house price series on a continuous basis.

6. Appendix

Table 3 – Cointegration based on the trace test

Vector (TRENDRL MORR LDYR)			
Lags 1 to 4			
Null	*Alternative*	*Trace Statistic*	*95% Critical Value*
r = 0	r ≥ 1	43.719*	42.915
r ≤ 1	r ≥ 2	18.284	25.872
r ≤ 2	r ≥ 3	3.992	12.518

Vector (LJHBR MORR LDYR)			
Lags 1 to 1			
Null	*Alternative*	*Trace Statistic*	*95% Critical Value*
r = 0	r ≥ 1	50.290*	42.915
r ≤ 1	r ≥ 2	18.320	25.872
r ≤ 2	r ≥ 3	3.646	12.518

*Vector (*TRENDRL MORR D(LCREDITR)			
Lags 1 to 3			
Null	*Alternative*	*Trace Statistic*	*95% Critical Value*
r = 0	r ≥ 1	39.17419*	29.79707
r ≤ 1	r ≥ 2	6.087555	15.49471
r ≤ 2	r ≥ 3	1.885405	3.841466

*Vector (*LJHBR MORR D(LCREDITR)*)*			
Lags 1 to 1			
Null	*Alternative*	*Trace Statistic*	*95% Critical Value*
r = 0	r ≥ 1	33.896*	29.79707
r ≤ 1	r ≥ 2	9.384	15.49471
r ≤ 2	r ≥ 3	1.334	3.841466

*Vector (*TRENDRL MORR D(LCREDITR) LDYR			
Lags 1 to 3			
Null	*Alternative*	*Trace Statistic*	*95% Critical Value*
r = 0	r ≥ 1	45.382	47.856
r ≤ 1	r ≥ 2	24.679	29.797
r ≤ 2	r ≥ 3	9.918	15.495

*Vector (*LJHBR MORR D(LCREDITR) LDYR			
Lags 1 to 3			
Null	*Alternative*	*Trace Statistic*	*95% Critical Value*
r = 0	r ≥ 1	61.524	47.856
r ≤ 1	r ≥ 2	27.414	29.797
r ≤ 2	r ≥ 3	9.291	15.495

Vector (LDYR LCREDITR)			
Lags 1 to 2			
Null	*Alternative*	*Trace Statistic*	*95% Critical*

			Value
r = 0	r ≥ 1	49.947*	20.262
r ≤ 1	r ≥ 2	2.526	9.165

* denotes rejection of the hypothesis at the 0.05 level

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