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Is the relationship between monetary policy and house prices asymmetric in South Africa? Evidence from a Markov-Switching Vector Autoregressive model

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ABSTRACT

This paper examines asymmetries in the impact of monetary policy on the middle segment of the South African housing market from 1966:M2 to 2011:M12. We use Markov-switching vector autoregressive (MS-VAR) in which parameters change according to the phase of the housing cycle. The results suggest that monetary policy is not neutral as house price growth decreases substantially with a contractionary monetary policy. We find that the impact of monetary policy is larger in bear regime than in bull regime; indicating the role of information asymmetry in reinforcing the financial constraint of economic agents. As expected, monetary policy reaction to a positive house price shock is found to be stronger in the bull regime. This suggests that central banker reacts more in bull regime in order to prevent potential crisis related to the subsequent bust in house prices bubbles which are more prominent in bull markets. These results substantiate important asymmetries in the dynamics of house prices in relation to monetary policy, vindicating the advantages of generating regime dependent impulse response functions.

Keywords: monetary policy, house prices, regime switching
JEL codes: C22, C32, E52, R31

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1. Introduction

The recent global economic downturn attributed to the sub-prime crisis in the US with rapid contagion worldwide has attracted the attention of academics and policymakers of both developed and developing countries, and South Africa is no exception to this. As observed from the “Great Recession”, the bust of the house price bubble is always followed by significant contractions in the real economy.¹ Over the last two decades, South Africa has witnessed a rapid appreciation in home values which has been shown to have affected the real economy, through consumption, at both aggregate and provincial levels (Das et al., 2011; Ncube and Ndou, 2011; Peretti et al., forthcoming; Simo-Kengne et al., 2012, forthcoming).² Further, Gupta and Hartley (forthcoming) point out that house price in South Africa, is a leading indicator for output and inflation, and hence, can provide important information as to where the real economy is heading. Given this, it is crucial for central banks to analyze thoroughly the effects of monetary policy on asset prices in general and real estate in particular, which in turn, would lead to the understanding of the effects of monetary policy on the economy at large.³

Against this backdrop, the main objective of this paper is not only to analyze the impact of interest rate on South African house prices, but also, to check if the effect is asymmetric depending on whether the housing market is in a bull or bear regime. Intuitively, an increase in the interest rates tends to increase the user cost of capital which translates into a decrease in housing activities and consequently a fall in real estate prices (Demary, 2010). Further, the class of models developed by Bernanke and Gertler (1989) and Kiyotaki and Moore (1997), in which there exist agency costs of financial intermediation (finance constraint) asserts that when there is information asymmetry in the financial market, agents may behave as if they are constrained financially. Moreover, the financial constraint is more likely to bind in bear markets. Hence, a monetary policy may have greater effects in bear markets. Further, recent studies by Ncube and Ndou (2011), Peretti et al., (forthcoming), Simo-Kengne et al., (forthcoming), highlight that the South African Reserve Bank (SARB) has systematically reacted to house price movements.⁴ Given the possibility of a feedback of house prices onto the interest rate setting behavior of the SARB, we use a Markov-switching vector autoregressive (MS-VAR) model comprising of the interest rate and house price, rather than the standard Markov switching regressions popularly used when analyzing the impact of monetary policy on asset returns (mainly stock returns),⁵ which in turn, assumes exogeneity of the monetary policy instrument.⁶ On one hand, the MS

¹ Recently, Leamer (2007) strongly argues that housing *is* the business cycle, indicating “any attempt to control the business cycle needs to focus especially on residential investment.” (p. 150). His main point relates to the dynamics of the construction of homes. To wit, a building boom over one time interval pushes the stock of new homes above trend and that necessitates with some lag another time interval with a building slump. Thus, monetary policy should focus on preventing booms from occurring to head off the eventual slump. Smets (2007) provides commentary on Leamer’s (2007) paper and argues that interest rates (and monetary policy) crucially determine the linkages between the housing cycle and the business cycle. Leamer (2007) responds that “in the context of my paper, ... the interest rate spread has its impact through housing, though it surely operates through other channels.” (p. 249).

² For a detailed international literature review on the impact of house prices on the real economy, the reader is referred to André et al., (2011), Peretti et al., (forthcoming), and Simo-Kengne et al., (forthcoming).

³ For a detailed international literature review on the impact of interest rate on house prices, the reader is referred to Vargas-Silva (2008), Gupta and Kabundi (2010), Gupta et al., (2012a, b).

⁴ Note that, Naraidoo and Ndahiriwe (forthcoming) and Naraidoo and Raputsoane (2010) using linear and non-linear Taylor rules had indicated that the SARB reacts to a financial conditions index, which included real house prices, besides, real effective exchange rate, real stock prices and credit spread. For a detailed international literature review on the response of monetary policy to asset prices the reader is referred to André et al., (2011) and Peretti et al., (forthcoming).

⁵ The reader is referred to Napolitano (2006) for a detailed literature review in this regard.

⁶ As far as the housing market is concerned, studies such as Garino and Sarno (2004), Xiao and Tan (2006) and Feng and Li (2011) have used univariate Markov-switching unit root tests to detect house price bubbles in the UK, Hong Kong and Seoul, and Beijing, respectively. Prior to that Hall et al., (1997) had used a univariate Markov-switching error correction approach to model housing cycle in the UK.

structure allows us to characterize the time series dynamics in different states, and on the other hand, the VAR structure allows for possible endogeneity in the relationship between monetary policy and house prices. To the best of our knowledge, the study by Chang et al., (2011) is the only other existing study that has utilized the MS-VAR approach to analyze the impact of monetary policy on housing returns (besides equity real estate investment trusts and stock returns) for the US. Though this paper does not provide a clear identification of the housing cycle in terms of bull and bear markets, the authors indicate that, following an innovation in Federal Funds rate, housing returns decline substantially more in low-volatility regime than in high-volatility regime. However, this paper did not analyze the possible feedback from housing returns to interest rate. More importantly, with no confidence intervals provided for the impulse response functions generated from the MS-VAR model, one cannot gauge whether the effects were significant or not.

Though there exists few studies, namely, Gupta and Ndahiriwe (2010), Gupta et al., (2010) and Ncube and Ndou (2011), indicating a negative impact of monetary policy on house prices in South Africa, none of these studies investigated the possible asymmetry in the nature of this effect. Further, studies, such as Ncube and Ndou (2011), Peretti et al., (forthcoming), Simo-Kengne et al., (forthcoming), which analyzes the plausibility of a feedback from housing prices onto interest rate, did not say anything about the nature of this relationship during bull and bear housing markets. The reason being that all these studies, barring Peretti et al., (forthcoming), used linear (structural and factor-augmented)VAR models, and hence, could not account for possible non-linearities in the relationship between interest rate and house prices that could exist under different states of the housing market. Peretti et al., (forthcoming) used a time-varying parameter VAR model, which accounted for non-linearities in the relationship between consumption, interest rate and house prices, and was able to depict the changes in the nature of this relationship over time. However, this paper, could not discuss how monetary policy reacted to house price movements during bear and bull markets, though it could have, had it identified the regimes.

South African housing market is categorized into luxury, middle and affordable segments based on the price of the properties, with the middle-segment being further divided into, large, medium and small based on sizes of the houses in the middle-segment.¹ In this paper, besides analyzing the entire middle-segment, we also look at the different size category of this segment as well, to capture possible heterogeneity in the relationship between house prices and interest rate. Given that a MS-VAR is parameter intensive, we use the maximum possible span of monthly data covering the period of 1966:1-2011:12, which is a point of departure from the quarterly data-based earlier studies related to house prices and interest rate in South Africa. In this regard, note that, with house price being identified as a leading indicator, Gupta (2012) emphasizes that one should carry out the analysis on housing markets at the highest possible frequency. Due to this, we had to rule out the luxury and affordable sections of the housing market, since data on these two segments are only available at quarterly frequency. However, with Gupta et al., (2010), Das et al., (2011) and Gupta and Inglesi-Lotz (forthcoming) indicating that policies does not significantly affect these two extreme ends of the market, we believe, that the compromise in the form of losing information on the luxury and affordable segments by using monthly frequency, is not a serious one. As in the existing literature on housing markets and interest rate in South Africa, the monetary policy instrument is chosen to be the three months Treasury bill rate.²

¹ See Section 3 on the data used for further details.

² It is believed that the housing market is unlikely to respond to policy actions that were already anticipated, given this, we utilized a measure of monetary policy surprise for our case, originally developed by Gupta and Reid (2012) to analyze its impact on stock returns in South Africa. The monetary policy surprise was constructed using the change in the three month Banker's Acceptance rate on the day after the Monetary Policy Committee announces the official repurchase rate decision. Monthly values for the surprises were obtained by taking averages of the event-

Ultimately, we look at four sets of bivariate MS-VAR models¹ comprising of real house price of the entire, large, medium and small middle-segments considered individually, along with the three months Treasury bill rate. The rest of the paper is structured as follow: Section 2 briefly presents the Markov switching framework and discusses the estimation and identification procedures, while Section 3 describes the data used. Section 4 reports the empirical results with regard to the potential asymmetric effects of monetary policy on house prices and vice versa. Finally, Section 5 concludes.

2. Methodology: Markov-Switching Vector Autoregressive (MS-VAR) Model

The use of Markov-switching approach has become popular for determining asymmetries. This methodology initially appeared in the form of switching regressions due to Golfeld and Quandt (1973), and underwent a number of extensions and refinements. Hamilton (1989) and Krolzig (1998) made important contributions by combining switching models with vector autoregression to develop a MS-VAR which is well equipped to characterise macroeconomic fluctuations in the presence of structural breaks or shifts. Applied to the housing market, the Markov-switching framework offers the possibility to model booms and contractions as switching regimes of the stochastic process that generates the growth rate of the housing prices. As discussed above, given our interest in studying the possible feedback from house prices to the interest rate behaviour of the SARB, besides analyzing the effect of the monetary policy on house prices, we look at a MS-VAR. The MS-VAR also allows us to analyze impulse response functions to tract the dynamic of the variables of our concern following shocks to the system.

A special case of the MS-VAR framework is the MSIAH(m)-VAR(p) model, in which all parameters of the autoregression including the intercept term and the variance are allowed to switch between regimes. Let Y_t be a bivariate VAR in monetary instrument (Tbill) and real house price growth (ghp) of either the entire middle-segment or its respective size categories, used individually. Based on all the standard unit root tests, namely, Augmented Dickey-Fuller (1981) (ADF), Phillips-Perron (1988) (PP), Dickey-Fuller test with generalized least squares detrending (DF-GLS), the Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) (1992) test; the Elliot, Rothenberg, and Stock (ERS) (1996) point optimal test, the Ng-Perron (2001) modified versions of the PP (NP-MZt) test and the ERS point optimal (NP-MPT) test, all the real house prices were found to be non-stationary, so the real house price measures were converted to their corresponding growth rates, and denoted ghp . The nominal interest rate was found to be stationary at the 10 percent level of significance using ADF, DF-GLS, ERS, NP-MZ_t and NP-

based data if there were multiple Monetary Policy Committee meetings in a month, and when there was no such meetings held in a particular month, the value of the surprise for that specific month was set to zero. The data covered the period of 2000:1-2011:12. Since, this measure is exogenous, we used a Markov-switching regression framework instead of a MS-VAR model. The results indicate that sudden adjustments occur contemporaneously in the dynamics of house prices due to unanticipated changes in monetary policy. House prices decrease with the increase in the monetary surprise, with the significant effect being reported in the bear regime. Moreover, the asymmetric effect of monetary policy emerges in all categories; the coefficients being different in size and or signs across the states. Additionally, the bear market appears to be the most affected for all categories except the small segment, which shows a significant effect in the bull regime. In the same vein, we carried out our analysis treating the three month Treasury bill rate as exogenous using Markov-switching regressions. However, given that the fit of the MS-VAR models were consistently better than the Markov-switching regressions, indicative of, perhaps, the endogeneity of the three months Treasury bill rate, these results were suppressed to save space. Moreover, the MS-VAR approach offers the possibility to analyze joint dynamics, which in turn, better characterizes the behavior of financial time series. The details of all these results are available upon request from the authors.

¹ The reason for not including all the house prices together in a MS-VAR is to avoid the possible multicollinearity between the house price index for the entire middle segment and the house price indices of its three sub-categories. Besides, it is not advisable to go beyond three-variable MS-VARs due to the problem of overparameterization leading to imprecise inferences (Perlin, 2011).

MP_T tests, and hence, was used in levels, and denoted as $Tbill$.¹ As in Ehrmann, Ellison and Valla (2003), the joint dynamics of $(Tbill, ghp)$ are given by the following MSIAH-VAR specification:

$$Y_t = \begin{cases} \mu_1 + B_{11}Y_{t-1} + \dots + B_{p1}Y_{t-p} + A_1\varepsilon_t & \text{if } s_t = 1 \\ \mu_2 + B_{12}Y_{t-1} + \dots + B_{p2}Y_{t-p} + A_2\varepsilon_t & \text{if } s_t = 2 \end{cases} \quad (1)$$

We identify the housing demand and the monetary policy shocks using a recursive or Choleski identification scheme. We order the variables as follows: $Tbill$ and ghp following Musso *et al.*, (2011) and André *et al.*, (2011). Note that the latent variable s_t which indicates bull or bear markets conventionally corresponds to “the high mean growth rate of house prices and stable state” and “low mean growth rate of house prices and volatile state” respectively. The fundamental residuals (ε_t) are assumed to be uncorrected at all leads and lags and their variance is set to unity so as to ensure the identity variance-covariance matrix. However, as each fundamental residual is pre-multiplied by a switching matrix A_i , the variance-covariance matrix Σ_i of the structural disturbances $A_i\varepsilon_t$ is subsequently regime-dependent as indicated by the following transformation:

$$\Sigma_i = E(A_i u_t u_t' A_i') = A_i E(u_t u_t') A_i' = A_i I_2 A_i' = A_i A_i' \quad (2)$$

The main characteristic of MS-VAR is that dynamics of variables are conditioned on the unobserved Markov process followed by the regime. Because the Markov chain is unobservable, Ehrmann *et al.*, (2003) emphasise on the recursive nature of the likelihood function which prevents standard estimation techniques from providing the maximised likelihood. One alternative suggested by Krolzig (1997) is the iterative maximum likelihood estimation technique known as *Expectation-Maximisation* (EM) algorithm which is designed for a general class of models where the observed time series depends on some hidden stochastic variables. This estimation technique consists of two steps whereby the *Expectation* step infers the hidden Markov chain conditioned on a given set of parameters and the *Maximisation* step re-estimates the parameters based on the inferred unobserved Markov process. These steps are repeated until convergence.

One major attraction of the MS-VAR is the possibility of regime-dependent Impulse Response Functions (IRFs), which helps to determine the cyclical variation in the responses of variables to a particular shock. Equation (3) gives the mathematical definition of the regime-dependent IRFs for regime i . It traces the expected path of the endogenous variables at time $t+h$ following a one standard deviation shock to the k -th initial disturbance at time t , conditional on regime i (Ehrmann *et al.*, 2003).

$$\theta_{ki,h} = \left. \frac{\partial E_t Y_{t+h}}{\partial u_{k,t}} \right|_{s_t = \dots = s_{t+h} = i} \quad \text{for } h \geq 0 \quad (3)$$

¹ These results are available upon request from the authors.

Recall that EM algorithm only provides estimates of the variance-covariance matrix Σ_1 and not the matrices A_1 . To make structural inferences from the data, the structural disturbances and hence A_1 must be identified. In other words, sufficient restrictions are imposed on the parameter estimates in order to derive a separate structural form for each regime, from which regime-dependent IRFs are then computed. As in a standard VAR measuring the housing effect of monetary policy, the house prices index is ordered last with the assumption that housing market reacts directly to changes in monetary policy. This is known as recursive identification scheme based on which the estimated variance-covariance matrix $\hat{\Sigma}_1$ obtained by Choleski decomposition is used to identify the matrix $\hat{A}_1$. Through the standard bootstrapping technique, $\hat{A}_1$ are combined with the parameter estimates of the Markov-switching unrestricted VAR¹ to derive the response vectors. The bootstrapping procedure consists of creating artificial histories for the variables based on which the distribution of the estimated parameters is approximated. This distribution shapes the confidence bands required for the impulse response analysis; the crucial step being the simulation of the hidden regimes s_t . As in Chib (1996), the states are simulated using Forward Filter-Backwards Sampling (FFBS) known as Multi-Move algorithm. The confidence bands are obtained by Markov Chain Monte Carlo (MCMC) simulation with Gibbs sampling of 5000 draws with a burn-in of 2000.

3. Data

The data sample covers the monthly house price indexes for the period of 1966:01 until 2011:12. Though the three-month Treasury bill rate data is available since 1957, we were constrained by the availability of the house price data, which in turn, determined the starting point of the analysis. The three-month seasonally adjusted Treasury bill rate data and the Consumer Price Index (CPI) data (used to convert nominal house prices into its real counterpart) are derived from the International Financial Statistics of the International Monetary Fund. Amalgamated Bank of South Africa (ABSA), one of the major private banks in South Africa, provides the seasonally adjusted house price index. As discussed earlier, ABSA categorizes housing into three price segments, namely luxury (ZAR 3.5 million – ZAR 12.8 million), middle (ZAR 480,000 – ZAR 3.5 million) and affordable (below ZAR 480,000 and area between 40 square metres - 79 square metres). The middle-segment is further categorized into three more segments based on sizes, namely large-middle (221 square metres – 400 square metres), medium-middle (141 square metres – 220 square metres) and small-middle (80 square meters – 140 square meters). The stable MS-VAR is estimated based on two lags, as was unanimously suggested by all the popular lag-length tests, namely, the sequential modified LR test statistic, the Akaike information criterion, the Schwarz information criterion, applied to a constant parameter VAR.² Accounting for stationarity and lags, our effective sample period start from 1966:04.

4. Empirical results

The MSIAH-VAR³ type of MS-VAR model is considered and the estimated coefficients are used to compute the IRFs. The choice of MSIAH type is motivated by the specification tests in Table

¹ Refer to Ehrmann *et al.*, (2003) for details on characteristics and computation of the regime-dependent impulse responses.

² The linear VAR is found to be stable as all roots were found to lie within the unit circle. The details of the lag-length test along with the results indicating the stability of the VAR, is available upon request from the authors.

³ MSIAH is also known as the heteroskedastic intercept switch model.

1 which clearly indicate a strong evidence of non-linearity, non-normality and heteroskedasticity for the four models corresponding to the entire middle segment and each of its subsequent categories. Given that, regime dependent IRFs are meaningfully applied with a small number of regimes, we set two regimes prior to the estimation of the model, which, in turn, is consistent to identifying bear and bull markets. As noted earlier, states are differentiated not only by their average growth rate but also by their variances. The results presented in Table 2 support the presence of two regimes. The growth rate of house prices is more volatile in regime 1 than in regime 2, and the intercept is also lower in regime 1 than regime 2. Thus, regime 1 is identified as a bear market and regime 2 corresponds to a bull market.

Table 1: Specification Tests and Regime Properties

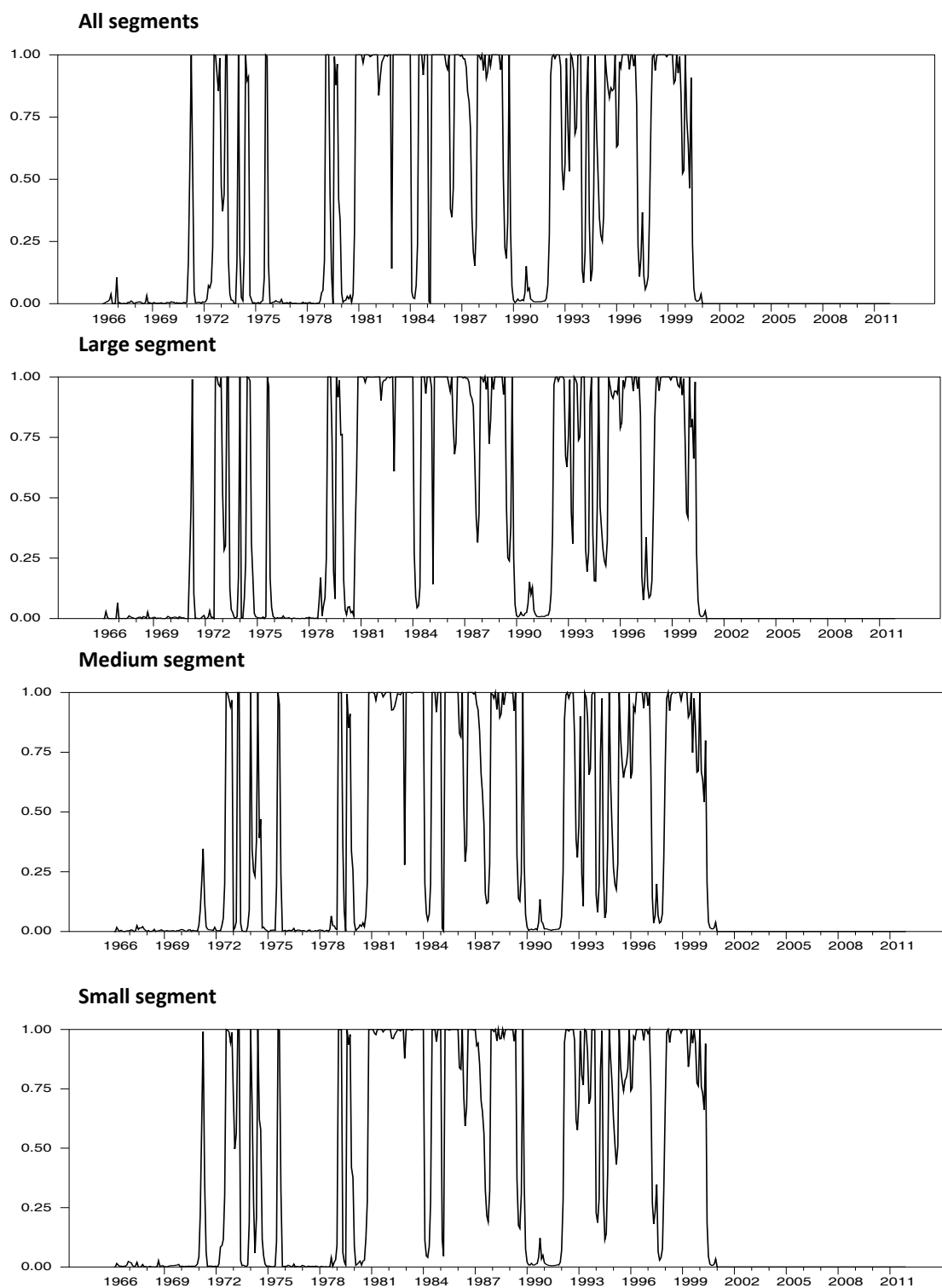
Specification tests	Linearity		Normality		Heteroskedasticity			
	LR	Davies	StdResid	VAR Error	StdResid		VAR Error	
					Hetero	Hetero-X	Hetero	Hetero-X
All segments	545.28**	0.00**	139.44**	787.44**	5.44**	4.35**	7.04**	5.56**
Large segment	578.9**	0.00**	124.28**	744.97**	7.31**	5.20**	11.85**	7.86**
Medium segment	519.53**	0.00**	107.92**	724.17**	4.85**	3.76**	7.34**	5.99**
Small segment	524.96**	0.00**	127.67**	723.85**	5.28**	3.85**	7.11**	5.02**
Regime properties	Transition probabilities		Duration		Observations			
	Bear regime	Bull regime	Bear regime	Bull regime	Bear regime	Bull regime		
All Segments	0.880	0.878	8.33	8.22	276.1	272.9		
Large segment	0.875	0.879	8.00	8.28	269.4	279.7		
Medium segment	0.877	0.868	8.13	7.60	283.3	265.7		
Small segment	0.886	0.887	8.83	8.88	273.3	275.7		

Notes: the first panel shows the specification tests; ** indicates significance at the conventional level (5%) of significance. The second panel displays the regime properties.

In general, the regimes are persistent with the transition probabilities lying between 0.87 and 0.89. The timing of the change is similar across regimes with an average expected duration of about 8 months for the first three models (All, Large and Medium segments) and 9 months for the fourth model (Small segment). The number of months for which the housing markets were under the two regimes, are very similar as well. Inferences regarding the turning points can be obtained from the smoothed probabilities of regime 2 (bull market), as depicted in Figure 1. It seems that the bear market is the prevailing regime between periods of 1966 to 1970, 1976 to 1979 and 2001 to 2011 in the middle sector of South African housing market. These periods coincide with some important economic features and socio-political conditions that prevailed in South Africa.

The first downswing period matches the residential segregation reinforced by the Group Areas Act 36 of 1966 which forced people of different races to live in separate residential areas (Prinsloo and Cloete, 2002) with huge consequences on property prices (Koetze, 1999). The second period coincides with the 1976 Soweto student uprising which had an adverse effect on confidence and economic performance, leading to a decline in real house prices by 22.4 percent between 1976 and 1979 (Luü, 2005). The last downswing is partly attributed to the effectiveness of the monetary policy in stabilising financial markets, especially given that the SARB moved to an inflation targeting regime starting in the February of 2000. Moreover as depicted by Naraidoo and Ndahiriwe (forthcoming) and Naraidoo and Raputsoane (2010) using linear and non-linear Taylor rules, the SARB had systematically been reacting to a financial conditions index, which included real house prices, during this period. It is also likely that the recent economic turmoil coupled with the Euro crisis, towards the end of the sample, have contributed in depressing real house prices due to the slowdown of the South African economy in general.

Figure 1: MSIAH-VAR- Smooth Probabilities of Regime 2 (Bull Market)



On the other hand, Figure 1 indicates two periods of bull markets (regime 2) in the housing market, namely 1970 to 1976 and 1980 to 2000. While the first period of housing boom can be associated with the global inflation due to oil price shock resulting in a hike of construction costs, we can infer that loose monetary policy contributed to the substantial run-up in house prices between 1980 and 2000. As discussed in Luü (2005), the upward trend of the property prices in the early 1980s was mainly due to the gold price boom and a reduction in tax rates which boosted the household net wealth and facilitated a reduction in the mortgage lending rate. However, the increasing political pressure and the decrease in gold price resulted in higher interest rates, and depressed the property market from 1984; but the effect was restrained by financial liberalisation which took place in 1985 following the recommendations of the De Kock Commission. The easy availability of credit following the liberalization led to a consumption boom, which, in turn, translated into sizable real estate appreciations. This trend slowed down in 1991 with the uncertainty about the future of the country. However, with the confidence restored in 1994 with of democracy, a recovery in the housing market was observed mainly due to higher economic growth and lower inflation and interest rates. However, the contagion effect from the Asian crisis in 1996-1997 led to the fall in the value of the rand with significant rise in interest rates, and thus discouraging housing activities but by late 1999, the house price boom resumed.

The empirical analysis focuses on IRFs as economic inference from the autoregressive coefficients might be difficult, if not misleading, given that the model is essentially an *atheoretical* representation of the dynamics between interest rate and house prices. As is obvious from Table 2, we, however, find that almost all the autoregressive coefficients are statistically significant, and the simple Wald test of asymmetry indicates that these coefficients are significantly different across regimes, barring the entire middle segment. Further, the coefficients on the two lags of the growth rate of house prices in the first equation (Tbill equation) of the system add up to 0.499, 0.571, 0.613, 0.635 (regime 1) and 0.811, 0.744, 0.799, 0.805 (regime 2) for the four models respectively. This suggests considerable interest rate smoothing by the SARB.

Figure 2 displays the IRFs of real house price inflation of the different models with the 16 percent and 84 percent quantiles for the impulse responses resulting from a 100 basis point shock to the Treasury bill rate over a period of thirty-six months. Regardless of the category, the Tbill rate reaches a peak of 1.5 percent (1.8 percent) in the bear regime (bull regime) and stays significant throughout the three-year period. The resulting response of the real house price growth rates, following a contractionary monetary policy, is negative in general for all the four categories. However, a few remarks are worth mentioning: First, in terms of magnitude and persistence, the responses of real house price inflation to a contractionary monetary policy differ considerably across regimes, hence, justifying the advantage of generating regime dependent impulse responses; Second, the initial rise of all and medium segment house prices observed in the bear regime following a monetary shock reflects the so-called *house price puzzle* often observed in the monetary policy and housing market literature that employs limited information sets contained in small-scale VARs based on a Choleski (recursive) decomposition for the identification of shocks.¹ However, the puzzling effect of a rise in real house price growth rates following a contractionary monetary policy is marginal and/or short-lived, as it lasts about two months; Finally, the impact of monetary policy appears stronger, but with short-lived significance in the bear regime, compared to the bull regime, in which the effect is of smaller magnitude but more persistent, with significance holding for the entire period of 3 years following the shock. The results are indicative of asymmetric effects across regimes for both the interest rate and house prices emanating from a monetary policy shock.

¹ The interested reader is referred to the paper by Vargas-Silva (2008), Gupta et al., (2010, 2012a, b) for a detailed literature review in this regard.

Table 2: EM Estimation for the MSIAH(2)-VAR(2), 1966:02-2011:12

	All Segments		Large segment		Medium segment		Small segment	
	Tbill	ghp	Tbill	ghp	Tbill	ghp	Tbill	ghp
Regime dependent intercept								
μ_1	0.02*	0.11*	0.03**	0.02	0.02*	0.08	0.03**	0.04
	(0.013)	(0.064)	(0.013)	(0.077)	(0.014)	(0.060)	(0.013)	(0.067)
μ_2	0.20	0.18**	0.22*	0.29***	0.20	0.19**	0.19	0.15**
	(0.121)	(0.062)	(0.113)	(0.062)	(0.056)	(0.064)	(0.119)	(0.072)
Standards errors								
σ_1	0.09	0.46	0.08	0.57	0.09	0.44	0.09	0.5
σ_2	0.61	0.28	0.60	0.30	0.61	0.28	0.60	0.31
Regime 1: Parameter estimates								
$\beta_{1,1}$	1.36**	-0.49**	1.40**	-0.19	1.35**	-0.36**	1.34**	-0.44*
	(0.043)	(0.164)	(0.038)	(0.192)	(0.053)	(0.163)	(0.123)	(0.253)
$\beta_{1,2}$	-0.36**	0.48**	-0.40**	0.18	-0.35**	0.35**	-0.35**	0.44*
	(0.044)	(0.164)	(0.037)	(0.192)	(0.053)	(0.163)	(0.123)	(0.251)
$\beta_{2,1}$	0.02	0.21**	0.01	0.66**	0.02*	0.25**	0.02	0.44**
	(0.012)	(0.061)	(0.010)	(0.064)	(0.013)	(0.060)	(0.012)	(0.062)
$\beta_{2,2}$	0.01	0.29**	-0.02**	-0.09	-0.002	0.37**	-0.01	0.19**
	(0.012)	(0.061)	(0.010)	(0.065)	(0.013)	(0.060)	(0.013)	(0.063)
Regime 2: Parameter estimates								
$\beta_{1,1}$	1.48**	-0.08**	1.48**	-0.09**	1.48**	-0.1**	1.49**	-0.08**
	(0.055)	(0.026)	(0.054)	(0.028)	(0.056)	(0.027)	(0.055)	(0.030)
$\beta_{1,2}$	-0.50**	0.07**	-0.50**	0.07**	-0.5**	0.08**	-0.50**	0.07**
	(0.055)	(0.026)	(0.054)	(0.028)	(0.056)	(0.027)	(0.055)	(0.030)
$\beta_{2,1}$	0.16	0.47**	0.14	0.48**	0.14	0.46**	0.16	0.59**
	(0.109)	(0.054)	(0.101)	(0.057)	(0.112)	(0.057)	(0.107)	(0.060)
$\beta_{2,2}$	-0.07	0.35**	-0.08	0.26**	-0.04	0.34**	-0.08	0.21**
	(0.108)	(0.052)	(0.097)	(0.054)	(0.111)	(0.056)	(0.105)	(0.058)
ω_{12_Tbill}	0.015	1.8x10 ⁻⁵	0.023	0.006	0.012	5.5x10 ⁻⁴	0.003	2.4x10 ⁻⁴
ω_{12_ghp}	0.167	7.54	0.219	2.065	0.262	2.601	0.265	1.954
Fitting	All segments		Large segment		Medium segment		Small segment	
	MSIAH- VAR	Linear VAR	MSIAH- VAR	Linear VAR	MSIAH- VAR	Linear VAR	MSIAH- VAR	Linear VAR
LogLik	-315.14	-587.78	-393.62	-683.07	-307.51	-567.28	-369.20	-631.68
AIC	1.25	2.18	1.54	2.54	1.22	2.11	1.45	2.35
HQ	1.33	2.23	1.62	2.58	1.31	2.15	1.53	2.39
SC	1.47	2.29	1.76	2.64	1.44	2.21	1.67	2.45

Note: Standard errors are in brackets. ***, ** and * indicate significance at 1%, 5% and 10% level of significance respectively.

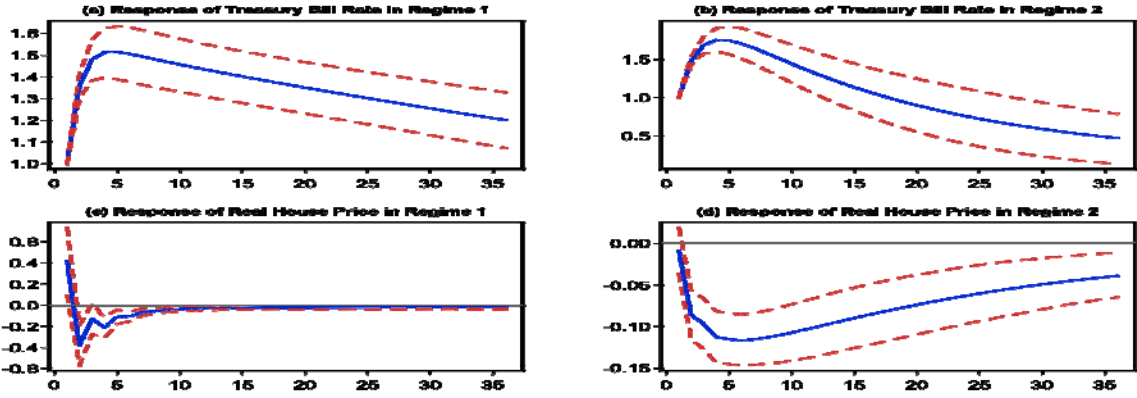
Terms ω_{12_Tbill} and ω_{12_ghp} are the Wald statistics for asymmetric effect (Equality of coefficients within regime 1 and regime 2):

$\beta_{1,j}(\text{regime1}) = \beta_{1,j}(\text{regime2})$ and $\beta_{2,j}(\text{regime1}) = \beta_{2,j}(\text{regime2})$ for asymmetric effect of monetary policy and asymmetric feedback from

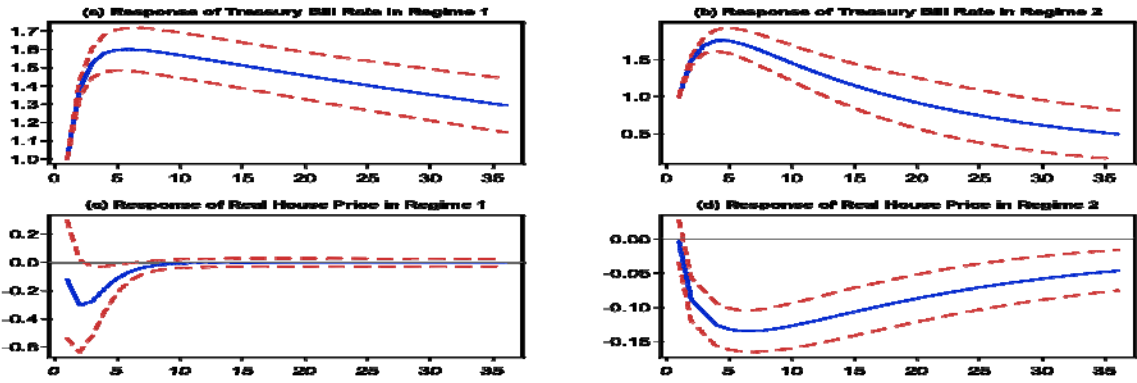
house price shock respectively. The test statistic is χ^2 with one degree of freedom under the null of symmetry. The critical values are 6.635, 3.841 and 2.706 at 1%, 5% and 10% respectively. AIC, SC and HQ are Akaike, Schwartz and Hannan-Quinn information criterion respectively.

Figure 2: Regime dependent IRFs following a contractionary monetary policy shock

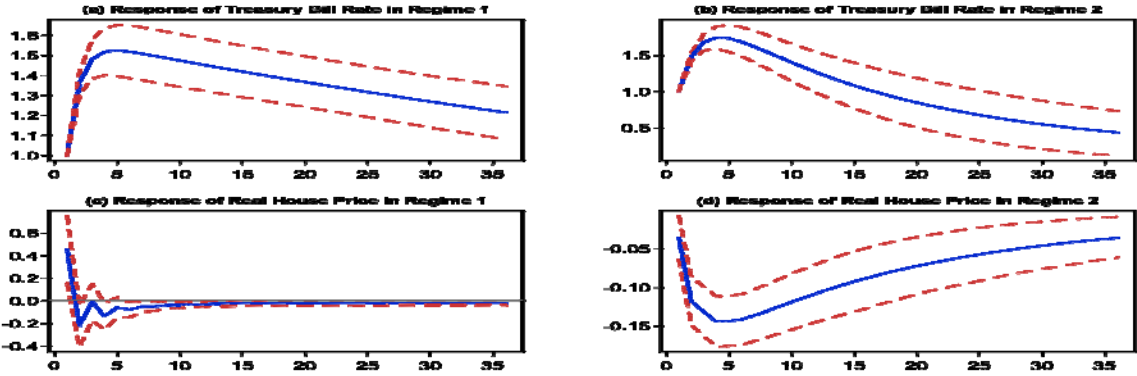
Response to Tbill rate shock: All Segments



Response to Tbill rate shock: Large Segment



Response to Tbill rate shock: Medium Segment



Response to Tbill rate shock: Small Segment

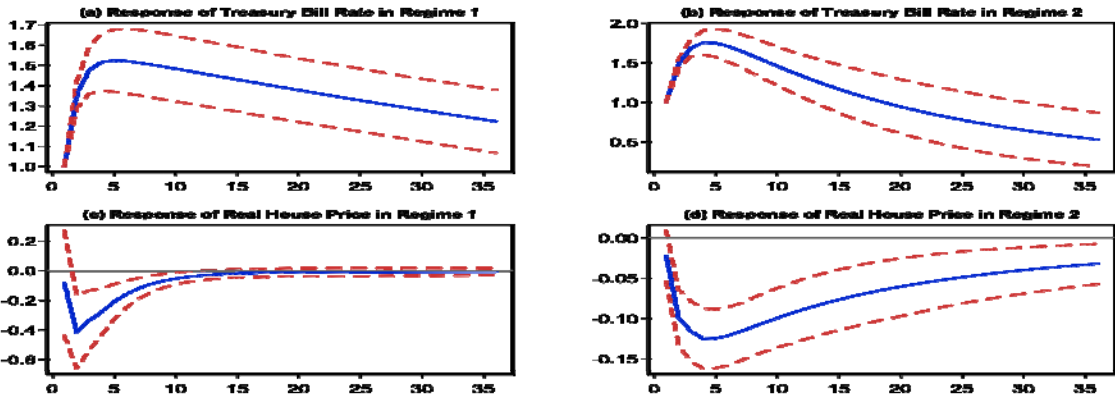
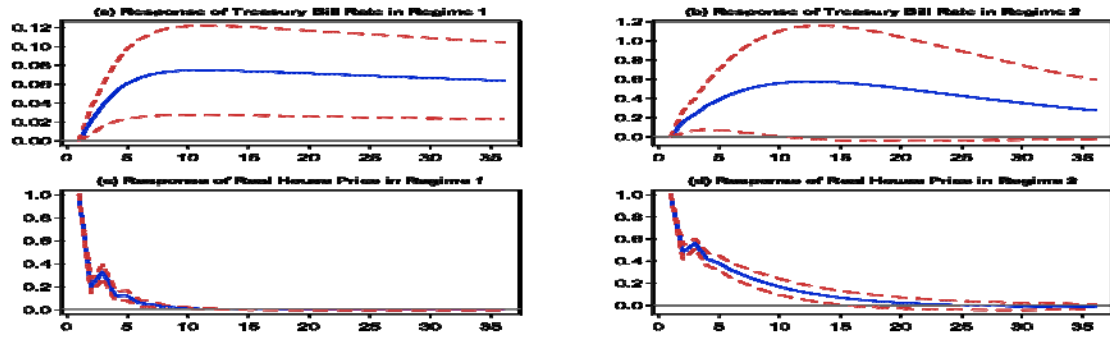
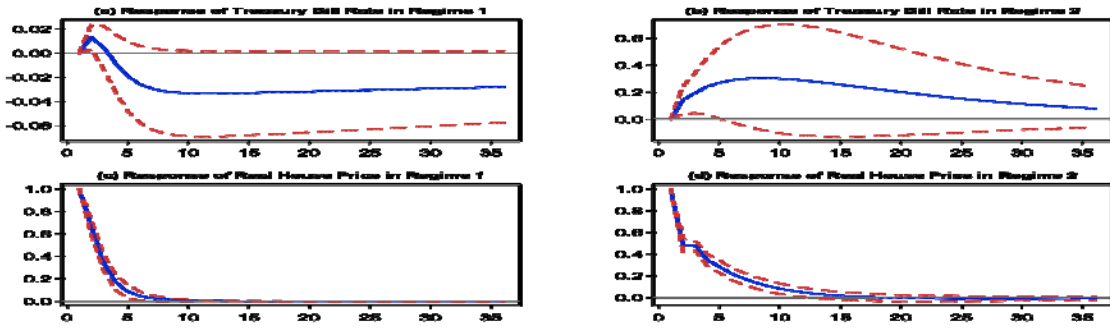


Figure 3: Regime dependent responses of interest rate to a positive house price shock

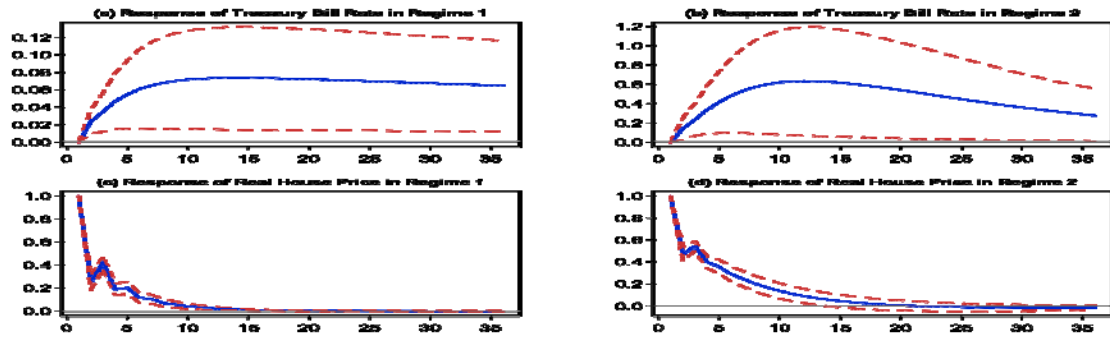
Reponses to House Price Shock: All segments



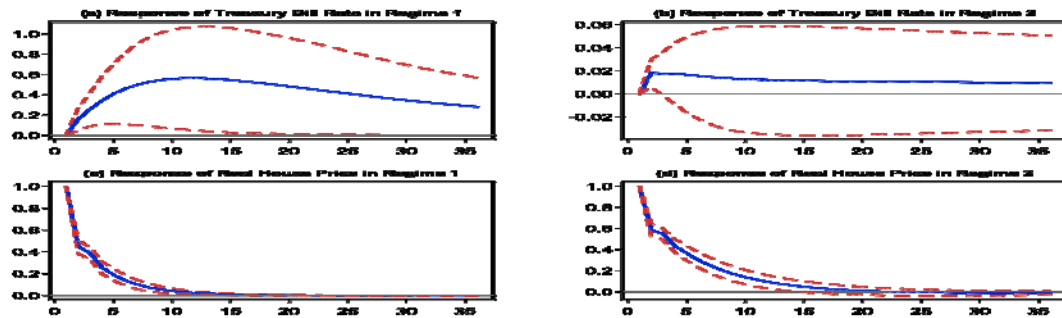
Reponses to House Price Shock: Large segment



Reponses to House Price Shock: Medium segment



Reponses to House Price Shock: Small segment



As argued by the theoretical models developed by Bernanke and Gertler (1989) and Kiyotaki and Moore (1997), economic agents are more likely to be optimistic (pessimistic) about future expectations of house price movements during the bear (bull) market. Although the prominence of financial constraints reinforces the impact of a contractionary monetary policy in the bear market, as suggested by Chen (2007) when analyzing stock markets, the response of house price inflation is likely to be short-lived due to the optimistic behaviour of economic agents which progressively outweighs the negative effect of a positive shock in the interest rate. On the other hand, the distinctive pessimistic behaviour of the bull regime tends to make the reaction of real house price growth rate prolonged but weaker to a positive monetary shock, since households are less financially constrained in this regime.

Fig 3 displays the feedback from a house prices shock to monetary policy based on the IRFs following a 100 basis point shock to real house price growth. The reaction of house prices, following a positive shock in real house prices, dies out within a year in the bear market, while in the bull regime, the reaction lasts for about 15 months. The effects are similar within regimes, and across the different housing categories. The effect also remains consistently significant before reverting back to its equilibrium value. Though the effects might seem asymmetric visually, the Wald tests carried out in Table 2 on the autocorrelation coefficient tends to suggest that the impact on house prices, following a house price shock, are not statistically different across the regimes within the individual housing categories. In general the results indicate a positive response of monetary policy to a house price shock across the two states. The responses of interest rate following a shock in the entire (All) middle segment indicate that the reaction of monetary policy is stronger in the bull market, but the effect is significant for only a short period. This is not surprising, since the bull market tends to be associated with house price bubbles (Helbling, 2005), and in order to prevent potential crisis related to the subsequent bust, the monetary authority might have a stronger reaction in this regime. Moreover, as economic agents are already pessimistic about future expectations in house price movements, the monetary policy reaction is likely to be big but quick one. Besides this, given that the movement in the house prices in South Africa is found to have a positive impact on the prices of non-housing goods and services (Gupta and Inglesi-Lotz, forthcoming), and which is likely to be bigger in magnitude during the bull market, the relatively stronger reaction of monetary policy to house price shock is justified in this regime to prevent inflationary pressures. Further, when the housing market is in the bear regime, causing the economy to be in recession via the wealth effect (Ncube and Ndou, 2011; Peretti et al., forthcoming; Simo-Kengne et al., 2012, forthcoming), the central bank is likely to be conservatively but more persistent in its response to house price increases.

However, diverse patterns emerge with respect to different models. In terms of magnitude, the reaction of monetary policy is stronger in the bull regime, relative to the bear regime, for the large and medium middle-segments, with the positive effect for the large segment under this regime lasting for a way shorter period when compared to the medium segment. These results, especially for the medium segment, are in line with the findings for the entire middle-segment, but are a contrast to the small segment, in which a stronger and more persistent reaction of monetary policy is obtained in the bear regime. The observed difference could be possibly attributed to the dual feature of housing as being both a consumption and investment good simultaneously. In effect, small segment houses are believed to act as an investment good for relatively richer households who reside in mainly the luxury segment of the market or the large middle-segment (Inglesi-Lotz and Gupta, forthcoming). Bear markets are more a buyer's market, in light of this, richer homeowners might want to spend some of their wealth to acquire property in the small segment as investment. The resulting increase in housing demand coupled with the typical optimism of the bear regime might lead to increase inflation risks, causing the monetary authority to respond more to a positive house price shock in the bear regime of small-segment housing. At this stage, it is perhaps worth noting that even though the SARB is likely to monitor

house prices of all the segments of the housing market, it is most likely that it would want to respond to an average price of the housing sector, which in our case happens to be the house price of the aggregate middle segment. Given this, the response of the monetary authority following a house price shock to the entire middle segment, could be depicting its typical response. However, having said this, our results do provide evidence that the interest rate responds significantly to the house price movements of the different segments of the market.

5. Conclusion

This paper investigates whether the impact of monetary policy shock on the entire middle-segment of the South African housing market, and its three categories based on sizes, is asymmetric using a MS-VAR approach spanning the period of 1966:M2 to 2011:M12. We find that monetary policy is non-neutral, as a contractionary monetary policy significantly depresses real house prices irrespective of house sizes. Furthermore, important asymmetries are found in the dynamics of house prices following a monetary policy shock in the bull and bear regimes identified for the housing market. Monetary policy is found to have larger effect on real house price inflation during the bear market-regime, thus supporting theoretical models that suggest the role of information asymmetry in reinforcing financial constraints of economic agents during this regime. This finding is robust to the aggregate and the various house sizes within the middle-segment.

Given that we used a MS-VAR to account for a possible feedback effect of house price movements on monetary policy setting, we also analyzed the impact on the interest rate following a house price shock. We found evidence of positive feedbacks from housing prices to the interest rate, which, in turn, confirmed that monetary policy in South Africa reacts to house price shocks, with the SARB found to respond more to a positive house price shock in the bull regime. This is not surprising, given that a bull market is possibly associated with house price bubbles, thus leading the monetary authority to react stronger in this regime in an attempt to prevent economic recession due the subsequent bust. Also, house price increases are likely to be more inflationary in the bull-regime than the bear regime, due to a bigger impact on the aggregate demand via the wealth effect of real house price increases. Finally, while the effect of monetary policy is consistent across house sizes in general, the reaction of the central banker to a house price shock in the small sized middle segment contrasts the remaining categories. In this segment, the reaction of monetary policy is found to be stronger in the bear regime; suggesting that houses in the small-segment are more likely to be investment goods and hence, are more attractive in the bear regime given the optimism of economic agents which, in turn, motivates a stronger response from the monetary authority to prevent possible inflationary pressures.

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