The lean versus clean debate and monetary policy in South Africa

Raputsoane, Leroi

30 November 2015

The lean versus clean debate and monetary policy in South Africa

By
Leroi Raputsoane[1]

December 2015

Abstract

This paper contributes to the lean versus clean debate by examining whether or not monetary policy in South Africa leans against the wind or cleans up after the bubble has bust. This is achieved by analysing the behaviour of asset prices during the different phases of monetary policy stance. The models that allow the behaviour of the asset prices to differ during periods of tight and easy monetary conditions as well as during periods of contractionary and expansionary monetary conditions are specified. The results provide evidence of an asymmetric behaviour between monetary policy interest rate and asset prices during the periods of easy and tight monetary conditions. The empirical results further provide evidence of symmetric behaviour between the monetary policy interest rate and asset prices during the periods of contractionary and expansionary monetary conditions. Thus monetary policy in South Africa supports the proposition of leaning against the wind as opposed to the proposition of cleaning up after the bubble has burst.

JEL Classification: C51, E52, E61, G01
Key Words: Lean versus clean debate, Monetary policy regimes, Financial distress

1. Introduction

The lean versus clean debate has taken centre stage among policy makers in the aftermath of the recent financial crises. According to Issing (2011), the prevailing orthodoxy during the tranquil macroeconomic conditions before the 2008 global financial crisis, a period that is sometimes referred to as the great moderation, embraced the “clean up after the bubble has burst” principle, also known as benign neglect or the Jackson Hole consensus. In this period, the consensus amongst policy makers was that monetary policy should ignore fluctuations in asset prices and potential bubbles, at least to the extent that they do not affect the inflation outlook, and clean up after the bubble has burst to restore macroeconomic stability. The defence of this view, including empirical support, is provided by Bernanke and Gertler (1999, 2001), Greenspan (2002), Bernanke (2002, 2009), Gilchrist and Leahy (2002) and Svensson (2010, 2011, 2012), among others. The reasons advanced for ignoring asset price developments are that they are difficult to identify or measure in real time, that monetary policy is too blunt an instrument to deal with asset price bubbles without detrimental costs to the economy and that targeting asset prices would introduce moral hazard and indeterminacy of inflation.

The recent global financial crisis has demonstrated that the consensus of benign neglect during the era of great moderation may no longer be valid as assert Gali and Gambertti (2013). It has strengthened the alternative viewpoint that central banks should “lean against the wind” which suggests that central banks should pay close attention and systematically react to asset price misalignments. According to Trichet (2005), leaning against the wind necessitates raising the monetary policy interest rate when asset price booms are identified and at times even beyond the level necessary to maintain price stability. Mishkin (2011) argues that the case for the leaning against the wind has become much stronger as opposed to benign neglect which is proposed by supporters of cleaning up after the bubble has burst. The defence of this view, including empirical support, is provided by Cecchetti et al. (2000, 2003), Borio and White (2004), Borio (2007, 2011, 2014), Taylor (2008), Trichet (2005, 2009), Curdia and Woodford (2009) and Woodford (2012) and Mishkin (2009, 2011), among others. The arguments for leaning against the wind are that output gaps, natural rates of unemployment and interest rates are unobservable and are measured with great uncertainty, that inflation and output stability does not ensure financial stability given that financial crises can manifest

[1] Pretoria, South Africa, Phone: +27733506406, Email: lraputsoane@yahoo.com

during periods of stable macroeconomic conditions and that unwinding financial crises can be unpredictable and costly.

The proposition that monetary policy should lean against the wind suggested by Trichet (2005), Woodford (2012), and Borio (2014), among others, where monetary policy is tightened during asset price booms and loosened during the asset price bursts implies symmetric behaviour between the monetary policy interest rate and asset price misalignments. The reason for the symmetric relationship between the monetary policy interest rate and asset price misalignments is that the monetary authorities react by systematically raising the monetary policy interest rate to help restrain the build up of financial imbalances and by adopting an accommodatory monetary policy stance during periods of bursts in asset prices. According to Trichet (2005), by reacting more symmetrically, increasing the monetary policy interest rate during periods of booming asset prices and decreasing the monetary policy interest rate during periods of asset prices bursts, the monetary authorities discourage excessive risk taking and over investment during the periods of asset price booms, while the opposite is true during the periods of asset prices bursts. Thus when monetary policy leans against the wind, the monetary authorities monitor and react to asset price misalignments consistently and systematically in periods of both asset price booms and bursts.

On the contrary, the proposition that monetary policy should clean up after the bubble has burst suggested by Greenspan (2002, 2010) and Yellen (2009), Bernanke (2009), among others, where monetary policy is restricted and passive to asset price misalignments during the build up phase of asset price bubbles and is loosened aggressively once the asset price bubble has burst implies asymmetric behaviour of monetary policy interest rates during the periods of asset price booms and bursts. The reason for the asymmetric relationship between the monetary policy interest rates and asset price misalignments is that the monetary authority ignores asset price misalignments during periods of booming asset prices and cleans up by reacting to asset price misalignments during the periods after the asset price bubble has burst. Furthermore, the suggestion that monetary policy should clean up after the asset price bubbles have burst suggests threshold behaviour by monetary authorities with regard to asset price misalignments in that the monetary authorities react to asset price misalignments only in their burst phase while no attention is paid to the booming phase of the asset price misalignments. The principle of cleaning up after the bubble has burst, including empirical support, is provided by Borio and Lowe (2004), De Graeve (2008), Stiglitz (2009), Mishkin (2009) and Goodhart et al. (2009), among others. In particular, Mishkin (2009) argues that nonlinearity best describes the clean up principle in that a negative interest rate shock is likely to have a larger effect on asset prices than a positive one.

This paper contributes to the lean versus clean debate by examining whether or not monetary policy in South Africa leans against the wind or cleans up after the bubble has bust. This is achieved by analysing the behaviour of asset prices during the different phases of monetary policy stance in South Africa. The asset price developments are captured using a composite indicator of financial distress that collects and synthesises information from the main segments of the South African financial market, including the bond and equity securities markets, the commodities market and the foreign exchange market. This indicator is constructed and described in detail in the next section. A similar indicator of financial distress has been constructed by Illing and Liu (2006), Balakrishnan et al. (2009), Cardarelli et al. (2009), Hakkio and Keeton (2009), Lo Duca and Peltonen (2011), Borio (2012) and Cevik et al. (2012), among others, while Kliesen et al. (2012) provides a survey of the similar indicator of financial distress.

To capture the asymmetric behaviour by monetary authorities with regard to asset price misalignments, the models with various regime switching behaviours suggested by Terasvirta (1994, 1998) and Van Dijk et al. (2002, 2003) are specified. These models allow for determination of the behaviour of the composite indicator of financial distress during periods of tight and easy monetary conditions, or the periods of high and low monetary policy interest rate, respectively. The models also allow for the determination of the behaviour of the composite indicator of financial distress during periods of contractionary and expansionary monetary conditions, or the periods of decreasing and increasing monetary policy interest rate, respectively. Consequently, this paper contributes to the clean versus clean debate by providing evidence of whether monetary policy in South Africa leans against the wind or cleans after the asset price bubbles have burst.

This paper is organised as follows. The next section is data description, followed by the specification of the empirical model. Then is the discussion of the empirical results and last is the conclusion.

2. Literature review

The global financial crisis has demonstrated that asset prices play an important role in macroeconomic fluctuations hence there is notable resurgence in the literature on the role of asset price misalignments in macroeconomic fluctuations. Notable contributions include Edwards and Vegh (1997), Kiyotaki and Moore (1997), Bernanke and Gertler (1999, 2001), Bernanke et al. (1999), Gertler and Karadi (2009), Gertler and Kiyotaki (2011), Christiano et al. (2010), Curdia and Woodford (2010, 2011) and Woodford (2012). This literature introduces financial fictions into the standard general equilibrium models. However, despite the significant advances in financial frictions literature, there is still no generally agreed framework to incorporate developments in financial markets into standard macroeconomic models. Additionally, Borio (2012) and Issing (2011), among others, contend that the literature on financial frictions mainly integrates individual financial market variables such as credit and house prices into standard macroeconomic models rather than a comprehensive measure that captures the financial market as a whole. In South Africa, the literature on financial fictions includes Liu and Seeiso (2012), while related contributions include Naraidoo and Raputsoane (2010), Kasai and Naraidoo (2012) as well as Naraidoo and Paya (2012) who find a statistically significant relationship between the monetary policy interest rate and the index of financial conditions in South Africa.

Borio and White (2004) and Gali and Gambetti (2014) contend that financial imbalances cannot build up without some form of excessive monetary accommodation and hence argue that understanding how monetary policy reacts to asset prices is imperative. Thus the severity of the recent global financial crisis has rekindled the debate of whether monetary policy should lean against the wind or clean up after the bubble has burst. The literature on the lean versus clean debate includes Cecchetti et al. (2000, 2003), Borio and Lowe (2004), Cecchetti and Li (2008), Drehmann et al. (2012), Baxa et al. (2013), Gali (2013) as well as Gali and Gambetti (2014). In particular, Cecchetti et al. (2000, 2003) provide evidence that incorporating asset prices directly into central banks' reaction function smoothens the path for output and inflation, while Borio and Lowe (2004) find an asymmetric response of monetary policy to the build up and unwinding of financial imbalances using data from 20 industrialised countries. Cecchetti and Li (2008) provide evidence that monetary policy at the Federal Reserve neutralises the procyclicality of bank capital requirements, while the opposite is true in Germany and Japan, while Baxa et al. (2013) find that central banks in developed economies asymmetrically decrease monetary policy rates during the periods of high financial distress. On the contrary, Gali (2013) and Gali and Gambetti (2014) provide evidence that the increase in stock prices is persistent following tightening of monetary policy conditions in the United States.

3. Data description

Monthly data spanning the period of January 2000 to December 2013 is used in estimation and it is sourced from the South African Reserve Bank database. The repurchase rate, also known as the repo rate, is the monetary policy rate in South Africa and it measures the nominal monetary policy interest rate. The indicator of financial distress is approximated using a composite measure that collects and synthesises information from the main segments of the South African financial market, including bond and equity securities markets, foreign exchange market as well as the money and commodity markets. The indicator of financial distress captures the interruption of the normal functioning of the financial markets. This interruption is characterised by increased uncertainty about the fundamental value of financial assets, increased information asymmetry and heightened aversion from holding risky and liquid assets resulting in liquidity shortages as well as significant shifts in asset prices. A similar indicator of financial distress has been constructed by Illing and Liu (2006), Balakrishnan et al. (2009), Cardarelli et al. (2009), Hakkio and Keeton (2009), Lo Duca and Peltonen (2011), Borio (2012) and Cevik et al. (2012), among others. Kliesen et al. (2012) provides a survey of the literature on indicators of financial distress and find that, although they are different in their construction, the correlation between them is high given that each of the indexes measure the same thing in principle.

The selection of the variables used to construct the indicator of financial distress relied heavily on existing literature and on their relevance and the availability of data. The variables and their descriptions are presented in Table 1. They comprise the interbank spread, Future spread, Sovereign bond spread, A rated bond spread, Corporate bond spread, stock market return, Financial sector return, Banking sector return, Financial sector beta, Banking sector beta, Nominal effective exchange rate return, Credit extension growth, Property market return, Commodity market return, Oil market return and VIX S&P500 volatility index. The financial distress variables were standardised and then aggregated using the principal components analysis weighting scheme. The standardisation involved demeaning all the variables by subtracting their means and then dividing them by their respective standard deviations. As such, a value of 1 in each one of these variables represents a 1 standard deviation difference from their mean value over the sample period.

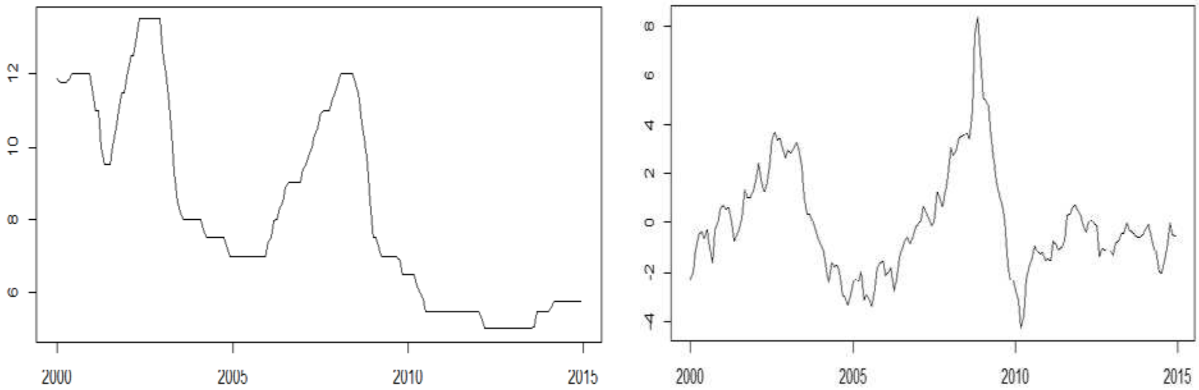
Table 1. Financial distress indicator variables

Variable	Description
Interbank spread	Spread between the 3 month Johannesburg Interbank Agreed Rate (JIBAR) rates and the 3 month Treasury bill rate
Future spread	Spread between the 3 month Forward Rate Agreements (FRAs) and the 3 month treasury bill rate
Government bond spread	Spread between the yield on 3 year government bond and the yield on 10 year government bond
A rated bond spread	Spread between the yield on A rated Eskom bond and the yield on 10 year government bond
Corporate bond spread	Spread between the FTSE/JSE All Bond yield and the yield on 10 year government bond
Stock market return	Annual change in the FTSE/JSE All Share stock market index
Financial sector return	Annual change in the FTSE/JSE Financials stock market index
Banking sector return	Annual change in the FTSE/JSE Banks stock market index
Financial sector beta	CAPM beta of the one year rolling window of the annual FTSE/JSE Financials stock market index returns
Banking sector beta	CAPM beta of the one year rolling window of the annual FTSE/JSE Banks stock market index returns
Nominal eff. exchange rate return	Annual change in nominal effective exchange rate
Credit extension growth	Annual change in total private credit extension
Property market return	Annual change in the average price of all houses compiled by the ABSA bank
Commodity market return	Annual change in the Economist's commodity price index
Oil market return	Annual change in the Brent crude oil price
VIX S&P500	Chicago Board's implied volatility of the S&P 500 index

Notes: Own calculation with data from the South African Reserve Bank database.

Figure 1 depicts the evolutions of the repurchase rate and the indicator of financial distress. The repurchase rate dropped somewhat at the beginning of 2001 but started to rise again later in the same year reaching a peak in late 2002. It then dropped dramatically from early 2003 reaching a low in early 2005. From early 2006, the repurchase rate increased steadily and peaked in the middle 2008 before it dropped again dramatically to late 2010 where it remained range bound to the end of the sample. The movements in the composite indicator of financial distress is comparable to those constructed in the literature by Illing and Liu (2006), Balakrishnan et al. (2009), Cardarelli et al. (2009), Hakkio and Keeton (2009), Lo Duca and Peltonen (2011), Borio (2012) and Cevik et al. (2012), among others. The only notable exception is that the indicators of financial distress for developed countries show relatively heightened financial distress that peak in late 2011 as a result of the sovereign debt crisis. This observation is supported by Kliesen et al. (2012) who survey the literature on financial stress indexes by comparing the datasets from which they are constructed and provide evidence that these indexes are highly correlated since they approximate a similar principle.

Figure 1. Evolution of the main variables



(i) Repurchase rate (ii) Financial distress indicator

Notes: Own calculation with data from the South African Reserve Bank database.

The movements in repurchase rate are closely mirrored by the movements in the indicator of financial distress where there are two distinct peaks in the indicator of financial distress in 2003 and 2008. The 2003 peak in the indicator of financial distress is associated with the sustained increase in financial distress since 2000 following the tech bubble, the Enron scandals, the rand rapid depreciation and the 9/11 attacks in 2001. These events were followed by the war on terror and the South American economic crisis in 2002 as well as the market jitters as a result of the war in Iraq in 2003. The 2008 peak in the indicator of financial distress is preceded by the sustained increase in this indicator from 2006 as a result of turn in US's housing market that resulted in chain of events that exposed fragilities in the financial system resulting in the subprime crisis in late 2007. These events were followed by the subsequent dramatic fall in the indicator from late 2008 as mortgage companies Fannie Mae and Freddie Mac as well as the world biggest banks Merrill Lynch and Lehman Brothers filed for bankruptcy, resulting in the worst economic crisis since the Great Depression of the 1930s. The indicator of financial distress then remained range bound to the end of the sample. Table 2 shows the descriptive statistics of the repurchase rate and the indicator of financial distress.

Table 2. Descriptive statistics of the main variables

	Financial distress indicator	**Repurchase rate**
Mean	0.000000	8.266671
Maximum	8.331240	13.500000
Minimum	-4.284230	5.000000
Std. Dev.	2.163317	2.677406
Skewness	1.041061	0.449726
Kurtosis	4.500744	1.837512
Jarque-Bera	49.405960	16.202940
Probability	0.000000	0.000303

Notes: Own calculation with data from the South African Reserve Bank database.

4. Empirical model

Many macroeconomic variables tend to behave differently during the periods of expansions and upturns as opposed to the periods of contractions and downturns. The evidence of this salient behaviour of macroeconomic variables is provided by Sims and Zha (2004), Davig (2004), Hamilton (2005), Hamilton (2008) and Borio (2012) who observe that the expansions and upturns in many macroeconomic variables are normally gradual and protracted and are often followed by abrupt and dramatic contractions and downturns. The variants of the Logistic smooth transition autoregressive

(LSTAR) model are used to capture the behaviour of the indicator of financial distress during the different monetary policy regimes. The LSTAR model was proposed by Terasvirta (1994,1998) and Van Dijk et al. (2002, 2003) and is specified as follows

$$Y_t = \begin{cases} \beta_L + \beta_{L1} Y_{t-d} + \ldots + \beta_{Lm} Y_{t-(m-1)d} \left(1 - G\left(Z_t, \gamma, \theta\right)\right) + \varepsilon_t, & Z_t \le \theta \\ \beta_H + \beta_{H1} Y_{t-d} + \ldots + \beta_{Hm} Y_{t-(m-1)d} \left(G\left(Z_t, \gamma, \theta\right)\right) + \varepsilon_t, & \theta < Z_t \end{cases} \quad (1)$$

where

$$G = P(Z_t, \gamma, \theta) = \left(1 + \exp - \gamma\left(Z_t - \theta\right)\right)^{-1} \quad (2)$$

and

$$Z_t = \phi_1 X_t + \phi_2 X_{t-1} + \ldots + \phi_m X_{t-(m-1)d} \quad (3)$$

Y_t is the regime switching variable, X_t is the transition or threshold variable, while $G(\bullet)$ is the monotonic transition function that is bounded between 0 and 1, specified as a logistic function with a threshold variable, Z_t is the threshold variable, γ is the smoothing parameter that determines the speed and smoothness of transition between regimes and θ measures the threshold location. β are the model parameters, while the threshold parameters are ϕ. m is the embedding dimension, d is the time delay and the 'low' and 'high' regimes are L and H, respectively.

More specifically, the LSTAR model is specified as follows in this instance

$$FDI_t = \begin{cases} \beta_L + \beta_{L1} FDI_{t-d} + \ldots + \beta_{Lm} FDI_{t-(m-1)d} \left(1 - G\left(Z_t, \gamma, \theta\right)\right) + \varepsilon_t, & Z_t \le \theta \\ \\ \beta_H + \beta_{H1} FDI_{t-d} + \ldots + \beta_{Hm} FDI_{t-(m-1)d} \left(G\left(Z_t, \gamma, \theta\right)\right) + \varepsilon_t, & \theta < Z_t \end{cases} \quad (4)$$

where

$$G = P(Z_t, \gamma, \theta) = \left(1 + \exp - \gamma\left(Z_t - \theta\right)\right)^{-1} \quad (5)$$

and

$$Z_t = \begin{cases} \phi_1 RPR_t + \phi_2 RPR_{t-1} + \ldots + \phi_m RPR_{t-(m-1)d} \\ \\ \phi_1 \Delta RPR_t + \phi_2 \Delta RPR_{t-1} + \ldots + \phi_m \Delta RPR_{t-(m-1)d} \end{cases} \quad (6)$$

FDI_t is the indicator of financial distress, which is the regime switching variable. G is the monotonic logistic transition function with a threshold or threshold variable Z_t and is bounded between 0 and 1. RPR_t and ΔRPR_t are the repurchase rate and the change in the repurchase rate, respectively. The different types of regime switching behaviours can be specified depending on how the logistic function $G\left(Z_t, \gamma, \theta\right)$ is specified. As such, the LSTAR model can take different forms. In the event that the transition variable is in levels $Z_t = X_{t-d}$, the model distinguishes between periods of high and low levels in the transition variable. Enders and Granger (1998) also suggest that the model can distinguish between periods of upturns and downturns in the transition variable when the transition variable is first differences $Z_t = \Delta X_{t-d}$ hence the model behaves differently when the transition variable is increasing and when it is decreasing.

In this particular instance, the model distinguishes between the periods of tight and easy monetary policy conditions when the transition variable is specified as

$$G = \left(1 + \exp - \gamma\left(RPR_t - \theta\right)\right)^{-1} \tag{7}$$

The tight monetary policy stance describes the periods of high interest rates and easy monetary policy stance describe the periods of low interest rates. The transition variable in this instance is the level of the repurchase rate RPR_t. This model is referred to as the model with RPR_t transition variable hereafter. The model also distinguishes between contractionary and expansionary phases of monetary policy when the transition function is specified as

$$G = \left(1 + \exp - \gamma\left(\Delta RPR_t - \theta\right)\right)^{-1} \tag{8}$$

The contractionary and expansionary phases of monetary policy describe the periods of increasing and decreasing interest rates, respectively. The transition variable in this instance is the change in the repurchase rate ΔRPR_t. This model is referred to as the model with ΔRPR_t transition variable hereafter. Thus the study will establish how the indicator of financial distress behaves during the periods of high and low monetary policy interest rate as well as during the periods of increasing and decreasing monetary policy interest rate. For a more detailed discussion on specification and the various forms of Threshold Autoregressive models, see Terasvirta (1994,1998), van Dijk et al. (2002, 2003).

5. Empirical results

The specified variants of the LSTAR model were estimated using the algorithm by Aznarte et al. (2013). The first step in estimation involved carrying out the linearity test of full order LSTAR model against full order autoregressive (AR) model at different values of the time delay parameter. According to Terasvirta (1994) and van Dijk and Terasvirta (2002), in the event that the null hypothesis of linearity is rejected, the next step involves performing additional tests to choose between the LSTAR model and the Exponential Smooth Transition Autoregressive (ESTAR) model. The choice between the LSTAR model and the ESTAR model can also be done as a post estimation exercise through the use of model evaluation criteria. The detailed steps to choose between the LSTAR model and the ESTAR model are detailed in Terasvirta (1994) and van Dijk and Terasvirta (2002). The results for the test of linearity of the full order AR model at different values of the time delay parameter are presented in Table 3. Linearity in the full order LSTAR model is rejected most significant when the time delay parameter is 2 for both the model with RPR_t transition variable, which distinguishes between periods of tight and the easy monetary policy, and the model with ΔRPR_t transition variable, which distinguishes between periods of contractionary and the expansionary monetary policy.

Additional tests to choose between the LSTAR model and the ESTAR model were not performed in this study given that the transition functions for the two models adjust differently to the deviations of the regime switching variable around the threshold level. The study aims to analyse how asset prices behave during the different phases of monetary policy stance. The logistic transition function adjusts asymmetrically, or at different speeds, above and below the threshold level. The exponential transition function adjusts symmetrically, or the same speed, above and below threshold level. Therefore the transition function that adjusts asymmetrically above and below the threshold level is more appropriate. The estimation results also show statistically significant asymmetries in the behaviour of financial stress during the different phases of monetary policy stance, which favours the use of the LSTAR model as opposed to the ESTAR model.

Table 3. Nonlinearity test and the optimal time delay parameter

	(i) Model with RPR_t transition variable		**(ii) Model with ΔRPR_t transition variable**	
	$Spec\_test$	$P-Value$	$Spec\_test$	$P-Value$
$d=1$	5.39284	0.018952	0.10622	0.238072
$d=2$	6.56306	0.008918	0.309752	0.182584
$d=3$	6.34839	0.03472	0.267620	0.269037
$d=4$	4.36960	0.112515	0.11019	0. 417264

Notes: $Spec\_test$ is the test for nonlinearity of the full order LSTAR model against full order AR model, which is the F-test with associated p-values, under the null hypothesis of linearity. This test also doubles as the test for the optimal time delay parameter, $d=1,2,..,n$, determined where the test for linearity is rejected most significantly. More details on conducting these tests can be found in Terasvirta (1994) and van Dijk and Terasvirta (2002).

The empirical results and measures of model adequacy for the estimated variants of the LSTAR model are presented in Table 4. Given that the LSTAR model is specified in an autoregressive manner, this necessitates determining the lag order of the estimated models. The determination of the lag order involved using the Akaike information criterion, the Bayesian information criterion and the Hannan Quin information criterion. These criteria pointed to the lag order of 1. In addition, to assess the robustness of the estimated LSTAR models, the residual variance, the Akaike information criterion and the mean absolute percentage error, which is the forecasting accuracy measure, were implemented. The grid search, which involves estimating the model for a grid of different values of the threshold variable and selecting the best fit as the threshold estimate, was also implemented to determine the threshold values for both models. The Akaike information criterion, the mean absolute percentage error and the residual variance all point to the model with ΔRPR_t transition variable as the preferred model.

The null hypothesis of no remaining nonlinearity and parameter constancy are accepted for the model with RPR_t transition variable. However, this hypothesis is rejected for the model with ΔRPR_t transition variable. In addition, the null hypothesis of parameter constancy is accepted for both models with RPR_t transition variable and ΔRPR_t transition variable. The parameter that measures the speed and smoothness of transition between the low and high regimes in the transition variable is 10.59 for the model with RPR_t transition variable, while it is 23.85 for the model with ΔRPR_t transition variable. This implies a relatively smooth and slow speed of adjustment for the model with RPR_t transition variable compared to the model with ΔRPR_t transition variable between the high and the low regimes. The transition between regimes in the model with ΔRPR_t transition variable is relatively abrupt given the relatively high parameter that measures the speed and smoothness of transition between the low and high regimes. The transition function for the model with ΔRPR_t transition variable is statistically insignificant. However, it is important to note that the statistical significance of the transition functions is often not a concern and is seldom reported. Thus, the parameter measuring the speed and smoothness of transition is often allowed to be dimension free as suggested by Terasvirta (1994), given that its size points to the various forms of the transition function.

Table 4. Logistic smooth transition autoregressive model results

	(i) Model with RPR_t transition variable		(ii) Model with RPR_t transition variable	
	Coefficient	Standard error	Coefficient	Standard error
β_L	0.441991	0.119410***	-0.501185	0.183475***
β_{L1}	1.064361	0.063335***	0.933720	0.055681***
β_H	-0.547978	0.241799**	0.880628	0.348681**
β_{H1}	-0.778892	0.117233***	-0.220190	0.108352 **
γ	10.589489	4.073608**	23.845582	27.78862
θ	9.34830	0.062852***	0.057952	0.078907
AIC	96.00000		14.00000	
$Mape$	257.100		182.4000	
Rsd_Var	1.59400		0.864700	
Rm_Lin	9.581232	(0.325157)	2.106685	(0.00123)
Pr_Cnst	2.9154589	(0.2755115)	5.812323	(0.447052)

Notes: Statistical significance codes: *** = 1%, ** = 5%, * = 10%. AIC is the Akaike Information criterion, $Mape$ is the mean absolute percentage error, Rsd_Var is the variance of the residuals, Rm_Lin and Pr_Cnst are the tests for no remaining nonlinearity and parameter constancy, respectively, with associated p-values in parentheses. More details on conducting these tests can be found in Terasvirta (1994) and van Dijk and Terasvirta (2002).

The results of the model with RPR_t transition variable are reported in Table 3, panel (i). This model distinguishes between the periods of tight and easy monetary conditions. The grid search finds a statistically significant threshold at 9.34 percent. The statistical significance in this threshold level means that the indicator of financial distress behaves differently when the repurchase rate is above this threshold level as opposed to when it is below or equal to this threshold level. This means that the values of the repurchase rate above this threshold level describe tight monetary conditions, while the values of the repurchase rate below or equal to this threshold describe easy monetary conditions. The results further show that the indicator of financial distress increases by a statistically significant 1.06 percent relative to its recent past during the periods of easy monetary conditions, while it decreases by a statistically significant 0.79 percent relative to its recent past during the periods of tight monetary conditions. This means that the indicator of financial distress increases at a relatively faster pace in periods of easy monetary conditions and decreases at a relatively slower pace in periods of tight monetary conditions.

The results of the model with ΔRPR_t transition variable are reported in Table 3, panel (ii). This model distinguishes between the periods of contractionary and expansionary monetary conditions. The grid search finds a threshold at 0.06 percent. This means that the values of the change in repurchase rate above this threshold describe tight monetary conditions, while the values of the change in the repurchase rate below or equal this threshold describe easy monetary conditions. However, this threshold is not statistically significant. The statistical insignificance in this threshold level means that there is no discernible difference in the behaviour of the indicator of financial distress when the repurchase rate is above this threshold level as opposed to when it is below or equal to this threshold level. The results further show that the indicator of financial distress increase by a statistically significant 0.93 percent relative to its recent past during the periods of contractionary monetary conditions, while it decreases by a statistically significant 0.22 percent relative to its recent past during the periods of expansionary monetary conditions. This result means that the indicator of financial distress increases at a marginally faster pace in periods of contractionary monetary conditions and decreases at a relatively slower pace in periods of expansionary monetary conditions.

In summary, the empirical results of the model with RPR_t transition variable have provided evidence that the indicator of financial distress decreases in periods of tight monetary conditions and increases in periods of easy monetary conditions. The positive growth in the indicator of financial distress during the periods of easy monetary conditions supports the view that accommodative monetary policy lays the foundation for financial crises to manifest as argue Borio and White (2004) and Taylor (2008), among others. The empirical results of the model with ΔRPR_t transition variable have provided evidence that the indicator of financial distress increases in periods of contractionary monetary policy conditions and decreases in periods of expansionary monetary conditions. Of particular interest is the statistical insignificance of the threshold level in the results of the model with ΔRPR_t transition variable, which is the model that distinguishes between the periods of contractionary and expansionary monetary conditions. The implication of this finding for the lean versus clean debate is that monetary policy in South Africa supports the proposition of leaning against the wind as opposed to cleaning up after the bubble has burst. This is contrary to the findings by Borio and Lowe (2004) and Baxa et al. (2013) who provide evidence of asymmetric response of monetary policy to the build-up and unwinding of financial imbalances in developed economies.

6. Conclusion

This paper has contributed to the lean versus clean debate by examining whether or not monetary policy in South Africa leans against the wind or cleans up after the bubble has bust. The behaviour of asset prices were analysed over the different phases of monetary policy stance in South Africa. The asset price developments were captured using a composite indicator of financial distress that collects and synthesises information from the main segments of the South African financial market, including bond and equity securities markets, the commodities market and the foreign exchange market. The models with different regime switching that allow for the determination of the behaviour of asset prices during periods of tight and easy monetary conditions as well as during periods of contractionary and expansionary monetary conditions, were specified.

The empirical results have provided evidence of asymmetric behaviour of asset prices misalignments in periods of tight and easy monetary conditions. In particular, the empirical results have shown that the indicator of financial distress decreases in periods of tight monetary conditions and increases in periods of easy monetary conditions. The empirical results further provide evidence of symmetric behaviour of asset price misalignments during periods of contractionary and expansionary monetary conditions. In particular, the indicator of financial distress increases in periods of contractionary monetary policy conditions and decreases in periods of expansionary monetary conditions. The results have also provided evidence of statistical insignificant threshold level in the model that distinguishes between the periods of contractionary and expansionary monetary conditions. The implications of the results for the lean versus clean debate is that monetary policy in south Africa supports the proposition of leaning against the wind as opposed to the proposition of cleaning up after the bubble has burst.

References

Aznarte, A. L., Di Narzo, A. F. and Stigler, M. (2013). "tsDyn: Nonlinear Time Series Models with Regime Switching," R package, Version 0.9-32, March

Balakrishnan, R., Danninger, S., Elekdag, S. and Tytell, I. (2009). "The Transmission of Financial Stress from Advanced to Emerging Economies," Working Paper, 09/133, Washington DC: International Monetary Fund, June

Baxa, J., Horvath, R. and Vasicek, B. (2013). "Time-varying monetary-policy rules and financial stress: Does financial instability matter for monetary policy?" Journal of Financial Stability, 9(1), 117-138, April

Bernanke, B. and Gertler, M. (1999). “Monetary Policy and Asset Price Volatility,” Federal Reserve Bank of Kansas City Economic Review, 17-51, Quarter IV

Bernanke, B. Gertler, M. and Gilchrist, S. (1999). “The Financial Accelerator in a Quantitative Business Cycle Framework,” in J. Taylor and M. Woodford (eds.). (1999). Handbook of Macroeconomics, 1: 1341-1393

Bernanke, B. and Gertler, M. (2001). “Should Central Banks Respond to Movements in Asset Prices?” American Economic Review, 91(2): 253-257, May

Bernanke, B. (2002). “Asset-Price “Bubbles” and Monetary Policy,” Remarks before the New York Chapter of the National Association for Business Economics, New York, October 15

Bernanke, B. (2009). “The Crisis and the Policy Response,” Lecture at the Stamp, London School of Economics, London, January 13

Borio, C. and Lowe, P. (2004). “Securing sustainable price stability: should credit come back from the wilderness?” Working Paper, 157, Basel: Bank of International Settlements, July

Borio, C. and White, W. (2004). “Whither Monetary and Financial Stability? The Implications of Evolving Policy Regimes,” Working Paper: 147, Basel: Bank of International Settlements, February

Borio, C. (2007). "Change and constancy in the financial system: implications for financial distress and policy," Working Paper: 237, Basel: Bank for International Settlements, October

Borio, C. and Drehmann, M. (2009). “Assessing the risk of banking crises – revisited,” Bank for International Settlements Quarterly Review, 29-46, March

Borio, C. (2011). “Rediscovering the Macroeconomic Roots of Financial Stability Policy: Journey, Challenges, and a Way Forward,” Annual Review of Financial Economics, 3(1): 87-117, December

Borio, C. (2012). “The financial cycle and macroeconomics: What have we learnt?” Bank for International Settlements Working Paper, 395, December

Borio, C. (2014). “Monetary Policy and Financial Stability: What Role in Prevention And Recovery?” Working Paper: 440, Basel: Bank for International Settlements

Cardarelli, R., Elekdag, S. and Lall, S. (2011). “Financial stress and economic contractions,” Journal of Financial Stability, 7(2): 78-97, June

Cecchetti, S, H Genberg, J Lipsky and S Wadhwani (2000). “Asset Prices and Monetary Policy”, The Geneva Report on the World Economy: 2, Geneva: International Centre for Monetary and Banking Studies, May

Cecchetti, S.G. (2003). “What the FOMC Says and Does When the Stock Market Booms”, in Richards, A. and Robinson, T. (eds.), Asset Prices and Monetary Policy, Proceedings of the Research Conference of the Reserve Bank of Australia, 77-96, November

Cecchetti, S., Genberg, H. and Wadhwani, S. (2003). “Asset Prices in a Flexible Inflation Targeting Framework”, in Hunter, W., Kaufman, G. and Pomerleano, M. (eds), Asset Price Bubbles: The Implications for Monetary, Regulatory, and International Policies, MIT press, 427-44, January

Cecchetti, S.G., and L. Li (2008). “Do Capital Adequacy Requirements Matter for Monetary Policy? “Economic Inquiry, 46(4): 643-659, October

Cevik, I., Dibooglu, S. and Kutan, A, (2013). “Measuring financial stress in transition economies,” Journal of Financial Stability, 9(4): 597-611, 597-611

Christiano, L. Motto, R. and Rostagno, M. (2010). “Financial Factors in Economic Fluctuations,” European Central Bank Working Paper, 1192, May

Curdia, V. and Woodford, M. (2010). “Credit Spreads and Monetary Policy,” Journal of Money, Credit and Banking, 42(S1): 3–35, September

Curdia, V. and Woodford, M. (2011). “The Central Bank Balance Sheet as an Instrument of Monetary Policy,” Journal of Monetary Economics, 58(1): 54-79, January

Davig, T. (2004). “Regime-Switching Debt and Taxation, Journal of Monetary Economics,” 51(4): 837-859, May

De Graeve, F., Kick, T. and Koetter, M. (2008). “Monetary policy and financial (in)stability: An integrated micro-macro approach,” Journal of Financial Stability, 4(3): 205-231, September

Edwards, S. and Vegh, C. (1997). “Banks and macroeconomic disturbances under predetermined exchange rates,” Journal of Monetary Economics, 40(2): 239-278, October

Gali, J. (2013). “Monetary Policy and Rational Asset Price Bubbles,” National Bureau of Economic Research Working Paper, 18806, February

Gali, J. and Gambetti, L. (2014). “The Effects of Monetary Policy on Stock Market Bubbles: Some Evidence,” National Bureau of Economic Research Working Paper, 19981, March

Gertler, M. and Karadi, P. (2011). “A model of unconventional monetary policy,” Journal of Monetary Economics, 58(1): 17-34, January

Gertler, M. and Kiyotaki, N. (2010). “Financial Intermediation and Credit Policy in Business Cycle Analysis,” in Friedman, B. M. and Woodford, M. (eds.), Handbook of Monetary Economics, 3: 601-650

Gilchrist, S. and Leahy, J. (2002), “Monetary policy and asset prices,” Journal of Monetary Economics, 49(1): 75-97, January

Goodhart, C. and Segoviano, M. (2009). “Banking Stability Measures,” Discussion Paper, 627, London: Financial Markets Group, January

Greenspan, A. (2002). “Economic volatility,” Speech at a symposium sat Jackson Hole, Wyoming, August 30

Greenspan, A. (2010). “The Crisis,” Brookings Papers on Economic Activity, Spring

Hakkio, C. and Keeton, W. (2009). “Financial stress: what is it, how can it be measured, and why does it matter?” Federal Reserve Bank of Kansas City Economic Review, 5-50, Quarter II

Hamilton, J. D. (2005). “What's Real About the Business Cycle?” Federal Reserve Bank of St. Louis Review, 87(4): 435-452, July/August

Hamilton, J. D. (2008). “Regime-Switching Models,” in Durlauf, S. and Blume, L. (eds.), New Palgrave Dictionary of Economics, May

Issing, O. (2011). “Lessons for monetary policy: what should the consensus be?” Globalization and Monetary Policy Institute Working Paper, 81, April

Liu, G. and Seeiso, N. (2012). “Business Cycle and Bank Capital Regulation: Basel II Procyclicality,” Economic Modelling, 29(3): 848-857, June

Lo Duca, M. and Peltonen, T. (2011). “Macro-Financial Vulnerabilities and Future Financial Stress - Assessing Systemic Risks and Predicting Systemic Events,” Working Paper, 1311, Frankfurt: European Central bank, March

Illing, M. and Liu, Y. (2006). “Measuring financial stress in a developed country: An application to Canada,” Journal of Financial Stability, 2(3): 243-265, October

Kasai, N. and Naraidoo, R. (2012). “Financial assets, linear and nonlinear policy rules: An in-sample assessment of the reaction function of the South African Reserve Bank,” Journal of Economic Studies, Vol. 39(2): 161-177, May

Kiyotaki, N. and Moore, J. (1997). “Credit Cycles,”: Journal of Political Economy, 105(2): 211-48, April

Kliesen, K., Owyang, M. and Vermann, K. (2012). “Disentangling Diverse Measures: A Survey of Financial Stress Indexes,” Federal Reserve Bank of St. Louis Review, 94:5: 369-398, September/October

Mishkin, F. S. (2009). “Is Monetary Policy Effective during Financial Crises?” American Economic Review, 99(2): 573-77, May

Mishkin, F. S. (2011). “Monetary Policy Strategy: Lessons from the Crisis,” Working Papers: 16755, Massachusetts: National Bureau of Economic Research

Naraidoo, R. and Paya, I. 2012. "Forecasting monetary policy rules in South Africa," International Journal of Forecasting, 28(2): 446-455, April-June

Naraidoo, R. and Raputsoane, L. (2010). “Zone-Targeting Monetary Policy Preferences And Financial Market Conditions: A Flexible Non-Linear Policy Reaction Function Of The SARB Monetary Policy,” South African Journal of Economics, 78(4): 400-417, December

Sims, C. A. and Zha, T. (2004). “Were There Regime Switches in U.S. Monetary Policy?” American Economic Review, 96(1): 54-81, March

Stiglitz, J. E. (2009), “Interpreting the causes of the great recession of 2008,” Lecture at BIS Annual Conference, Basel: Bank of International Settlements, June 25-26

Taylor, J. (2008). “The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong,” Working Paper: 14631, Massachusetts: National Bureau of Economic Research, January

Terasvirta, T. (1994). “Specification, Estimation and Evaluation of Smooth Transition Autoregressive Models,” Journal of the American Statistical Association, 89(425): 208-218, March

Terasvirta, T. (1998). “Modelling Economic Relationships with Smooth Transition Regressions,” in A. Ullah and D.E.A. Giles (eds.), Handbook of Applied Economic Statistics. New York: Marcel Dekker, 507-52, February

Trichet, J-C. (2005). “Asset price bubbles and monetary policy,” Lecture, Monetary Authority of Singapore, June 8

Trichet, J-C. (2009). “Credible Alertness Revisited,” Speech at Jackson Hole, Wyoming, August 22

Van Dijk, D., Terasvirta, T. and Franses, P. (2002). “Smooth Transition Autoregressive Models: A Survey of Recent Developments,” Econometric Reviews, 21(1): 1-47, August

Van Dijk, D., Terasvirta, T., Stefan, L. and Lundbergh, S. (2003). “Time-Varying Smooth Transition Autoregressive Models,” Journal of Business & Economic Statistics, 21(1): 104-121, January

Woodford, M. (2012). “Inflation Targeting and Financial Stability,” National Bureau of Economic Research Working Paper, 17967, April

Yellen J. (2009) “A Minsky meltdown: Lessons for central bankers” Presentation to the 18th Annual H. P. Minsky Conference on the State of the US and World Economy 16 April New York