Monetary Policy Transmission Channels in Lesotho[1]

Selloane Khoabane[*]

Abstract

PRICE STABILITY is the primary objective of monetary policy in Lesotho. It is pursued through maintenance of the fixed exchange rate regime. For policy design and improvement, it is important to understand how monetary policy decisions affect the real economy. Hence why the objective of this paper is to investigate the channels of monetary policy transmission for Lesotho. Due to data constraints, only three channels (exchange rate, interest rate and credit channels) are investigated using the standard VAR approach. The results show that monetary policy decisions by the South African Reserve Bank are transmitted to interest rates in Lesotho. In addition, the three channels of monetary policy transmission are ineffective in Lesotho.

Keywords: monetary policy, output effect, price effect
JEL classification: E31, E32, E52

---

[1] The views and opinions expressed in this paper are those of the authors and should not be attributed to the Central Bank of Lesotho (CBL).

[*] Principal Economist – Studies and Analysis Division, Department of Research,
Email: skhoabane@centralbank.org.ls, Tel: (+266) 2223 2062. Tel: (+266) 2223 2138.

1 INTRODUCTION

1.1 Background

IN LESOTHO, monetary policy is pursued with the primary objective of price stability. At the core of Lesotho's monetary policy is the fixed exchange rate regime, which is characterised by the one-to-one peg of the local currency, the Loti, to the South African currency, the Rand, under the Common Monetary Area (CMA) Agreement. The peg is sustained by maintaining the international reserves at a level that ensures a one to one exchange of the Loti for Rand at all times. That is, for every Loti issued, an equivalent amount of foreign currency reserves is maintained to underwrite the peg. Theoretically, Lesotho has surrendered monetary policy autonomy and borrows monetary policy from SA.

By achieving and maintaining price stability, monetary policy promotes economic growth, high employment and financial stability (Poole and Wheelock, 2008). The process through which monetary policy decisions affect the economy in general, and the price level in particular, is referred to as the transmission mechanism. Understanding the monetary policy transmission mechanism and channels is important for the design and implementation of monetary policy (Chuku, 2009). Effectiveness of monetary policy transmission is determined by factors such as financial sector development, liquidity conditions, asset quality, financial market activity and competition, regulatory environment, inflation, exchange rate flexibility, amongst others (Saborowski and Weber, 2013). These factors can change overtime within economies, thus altering monetary policy to be effective or weak depending on their direction and offsetting effects. For example, Mwabutwa *et al.,* (2016) showed that monetary policy transmission improved in Malawi following financial sector and structural reforms. This means that research in this area needs to be undertaken time and again to assess any changes from the previous research findings.

This notwithstanding, research on monetary policy transmission in Lesotho is scarce and focuses more on the effect of SA's monetary policy on other Southern African Customs Union (SACU) or Common Monetary Area (CMA) countries as with Ikhide and Uanguta (2010)

[1] The views and opinions expressed in this paper are those of the authors and should not be attributed to the Central Bank of Lesotho (CBL).

and Sander and Kleimeier (2006). Thus the objective of this paper is to investigate the effect of SA's monetary policy decisions on Lesotho's interest rates and the channels through which monetary policy decisions are transmitted to the real economy in Lesotho. There is limited, if not lack of literature that is specific to Lesotho on the subject matter and this study is intended to contribute to filling that gap with the purpose of informing formulation of country specific policies. The paper is organized as follows. This introduction is followed by the literature review. Then the methodology is discussed in Section 3 followed by a description of the data in Section 4. Section 5 analyses the results while the conclusion and policy recommendations are provided in Section 6.

2 LITERATURE REVIEW

There are a number of empirical studies on monetary policy transmission mechanisms in advanced economies, emerging market economies and Low Income Countries (LICs). The focus of this paper is on an LIC in Sub-Saharan Africa (SSA), Lesotho. Thus the selection of the empirical literature as reviewed in this Section is biased towards similar countries. All the economies in SSA are LICs, except South Africa (SA), which is an emerging market economy. Nonetheless, studies on SA are reviewed because of its link with Lesotho that emanates from the latter's fixed exchange rate monetary policy regime as explained in the Introduction. Majority of studies on monetary policy transmission mechanisms take a country-specific approach. Consequently, most of the papers included in this Literature Review relate to specific countries. These studies analyse the effect of monetary policy on aggregate demand and/or trace the channels through which the effect of monetary policy action is transmitted.

Mabulango and Boboy (2016) analysed the monetary policy transmission mechanism for the Democratic Republic of Congo (DRC) using the restricted Bayesian Vector Autoregression (BVAR). Their results showed that the effect of the change in the policy rate on output is not statistically significant. In addition, the effect was not always in line with a priori expectations. The latter observation also applied to the effect on inflation. The conclusion therefore was that monetary policy transmission is weak for the DRC. Nyumuah (2018) found similar results on Ghana using recursive and structural VAR approaches. A shock to the policy rate had no effect on neither output nor the price level. He went a step further to test the effect of a shock on money supply, credit to the private sector and the exchange rate and found that they all had no effect on neither output nor the price level until the 70th quarter, after which they began to have a very small influence. For Kenya, Cheng (2006) found that policy-driven interest rates had a significant and persistent impact on the price level, but not on real output. These results were obtained using both recursive and structural VAR.

Mwabutwa *et al.,* (2016) used a time varying parameter vector autoregressive (TVP-VAR) model with stochastic volatility to assess how the responses of output and the price level to shocks to the bank rate, exchange rate and credit have evolved, in Malawi, from 1981 to 2010. Their findings revealed that responses of output and inflation to monetary policy shocks have changed over the years. Monetary policy transmission was weak and inconsistent with theory before the year 2000, after which it strengthened and conformed with theoretical postulations following the financial and structural reforms that fostered macroeconomic stability. Tsangarides (2010) applied both the recursive and structural VAR to investigate the monetary policy transmission mechanism on output and inflation (headline and core CPI) in Mauritius. He found out that the shock to the repo rate, the exchange rate and money supply had a consistently statistically significant effect on the headline CPI but was not always statistically significant for output.

Two papers studied the monetary policy transmission mechanism for Namibia in different periods using different methodologies. Uanguta and Ikhide (2002) used dynamic forecasting analysis to assess the behaviour of selected key macroeconomic variables following episodes of changes in South Africa's (SA's) repo rate from 1990 to 1999. They noticed that tightening episodes tended to be followed by higher interest rates and lower private investment. They also estimated a VAR with private investment, consumer prices, lending rates, SA's repo rate and money supply. Its results showed that changes in the SA's policy rate are transmitted to Namibia's lending rates and private investment. Sheefeni (2017) considered the period 2000 to 2016 using a BVAR approach to study the responses of output and inflation to a positive shock to the interest rate, exchange rate, credit to the private sector and asset prices. His findings showed that a rise in interest rates reduces the growth rate of output and inflation for up to 8 quarters after which the effect dies off. Appreciation of the exchange rate initially results in a rise in output growth that is followed by a decline after 3 quarters. The effect on inflation is positive but wears off after 5 quarters. A shock to credit results in a decline in both output and inflation that wears off after the 4th quarter. Output responds negatively to a positive shock to housing prices while inflation responds positively.

Gumata et al (2013) used a large BVAR model comprising 165 quarterly variables, to investigate channels of transmission of monetary policy shocks in SA from the first quarter of 1990 to the second quarter of 2012. Their findings are that a 1.0 per cent increase in the repo rate results in a decline in GDP, which reaches a trough after a year. The effect of the shock lasts for close to two years. In the same way, inflation also declines in response to a positive monetary policy shock. The effect on inflation reaches its peak after a year and lasts for more than two years. The interest rate channel is important in SA. A rise in the repo rate is directly translated to the increase in the three-month Treasury bill rate and the prime overdraft rate. A rise in the short-term rate is followed by a decline in stock prices and house prices, signalling the asset price channel at work. The business and consumer confidence decline in response to contractionary monetary policy while inflation expectations rise, confirming effectiveness of the expectations channel. The real effective exchange rate increases slightly in response to a rise in the interest rate. However, the increase in the interest rate does not result in an inflow of funds into SA but curtails their outflow. With regards to the lending channel, a percentage increase in the repo rate reduces mortgage advances, total loans and advances and credit extended to the private sector. The equity and liabilities of banks rise shortly after the shock and then fall until they reach their lowest level two years after the shock. The household balance sheet channel is also important as demonstrated by the decline in household disposable income and total assets. Bonga-Bonga (2017) used the structural vector error correction model (SVECM) to assess how inflation responds to monetary policy shocks in SA during the inflation targeting period (2000 to 2016). According to his findings, a positive monetary policy shock reduces inflation slightly but this effect is not statistically significant. The effect on manufacturing production (proxy for output) is negative and statistically significant.

This literature seems to provide an indication that monetary policy transmission is weak in LICs in Africa. Although the findings on the responses of aggregate demand indicators to monetary policy shocks vary from one study to another, even in the case of studies about the same country, majority of the studies reviewed here give out statistically non-significant results for one or both indicators of aggregate demand. In addition, in a number of cases, the findings do not conform with theoretical expectations, at least not consistently throughout the study periods. Namibia is the only exception in that two studies have found statistically significant results confirming effectiveness of its monetary policy transmission. Uanguta and Ikhide (2002) revealed the importance of the bank lending channel. Sheefeni (2017) confirmed the importance of the bank lending channel and three additional channels that play a significant role in Namibia's monetary policy transmission mechanism. The findings by Mwabutwa et al (2016) on Malawi are also interesting. The transmission was weak and out of line with theory in the period before the financial and structural reforms but strengthened and aligned with theory after the reforms. In the case of SA, the results of the study by Gumata et al (2013) are statistically significant and indicate that all monetary policy transmission channels are at play in SA and that a positive shock on interest rates results in a decline in GDP and inflation. Similarly, Bonga-Bonga (2017) found out that a positive monetary policy shock reduces inflation and manufacturing production but the effect on inflation is not statistically significant.

Monetary policy transmission, as conventionally described, requires a highly developed and competitive financial system, characterised by an institutional setup in which loan contracts are protected, financial intermediation takes place through formal institutions and markets, the central bank is independent, the interbank market for reserves, the secondary market for government securities and the markets for equities and real estate are liquid and well-functioning; and where there is a reasonably high level of international capital mobility and the exchange rate is floating (Mishra et al, 2010). These are lacking in LICs in Africa. Christensen (2011) points out that structural weaknesses, including fiscal dominance, excess liquidity in the banking system, and low financial sector development indicated by limited competition in the banking system, less developed financial markets and a few non-bank financial institutions characterise financial systems in Africa. Effiong et al (2017) report that monetary policy may have short lived impact or even be ineffective in less developed countries with underdeveloped financial systems. Carranza *et al.,* (2010) also provides empirical evidence to the effect that monetary policy effectiveness is higher, the bigger and more active the stock market.

In addition, the potency of monetary policy transmission depends on the demand side factors that determine private sector credit. Examples of demand side factors are level of indebtedness of the private sector, level of unemployment, Catão (1997), the size of the business sector and the size and number of firms that produce capital goods and durable consumer goods, Otero (2017), inability to meet qualification requirements such as collateral, borrowing firm's capital and creditworthiness.

3 METHODOLOGY

This study employs the Vector Autoregression (VAR) framework, in particular, the standard (unrestricted) VAR to assess the monetary policy transmission mechanisms in Lesotho. This is in line with Cheng (2006), Chuku (2009) and Uanguta and Ikhide (2002), who studied the monetary policy transmission mechanism for Kenya, Nigeria and Namibia, respectively.

Considering a VAR(p) model of the form;

$$y_t = k + A(L)\, y_{t-1} + \varepsilon_t \qquad (1)$$

Where y_t is a vector of $t = 1,\ldots\ldots\ldots,T$ endogenous variables, k is a vector of constants, and A and B are coefficients matrices, L is the lag operator. ε_t is the vector of serially uncorrelated disturbances, $\varepsilon_t \sim N(0,\Sigma)$.

The vectors of endogenous variables used to estimate the effect of SA's monetary policy decisions on Lesotho's interest rates, and assess the effectiveness of the interest rate channel, the credit channel and the exchange rate channel, respectively, are specified as follows:

$$y_t' = (SARRE_t, TBR_t) \quad (2)$$
$$y_t' = (L\_RGDP_t, CPIR_t, TBR_t) \quad (3)$$
$$y_t' = (L\_RGDP_t, CPIR_t, L\_BLOANS_t) \quad (4)$$
$$y_t' = (L\_RGDP_t, CPIR_t, LREED_t) \quad (5)$$

where the variables are as defined in Table 1 below. The analysis is carried out in separate vectors because of the limited span of data and the limited degrees of freedom that is inherent in VAR modelling.

The standard VAR approach that imposes a recursive Cholesky decomposition structure is followed in this paper, with the ordering of the variables as specified in (2) to (5). This ordering is based on the "slow moving", "fast moving" variables categorization by Bernanke et al (2004). Fast moving variables are highly sensitive to contemporaneous economic news or shocks. Slow moving variables are ordered first. The SA repo rate is ordered first in (2) because it is not affected by the domestic variables. Another set of VAR models as specified in (6) to (9) below, with variables ordered differently from the set above ((2) to (5)) was estimated for robustness checks.

$$y_t' = (TBR_t, SARRE_t) \quad (6)$$
$$y_t' = (L\_RGDP_t, TBR_t, CPIR_t) \quad (7)$$
$$y_t' = (L\_RGDP_t, L\_BLOANS_t, CPIR_t) \quad (8)$$
$$y_t' = (L\_RGDP_t, LREED_t, CPIR_t) \quad (9)$$

The advantages of the VAR models include that they "allow historical data to tell their own story" while the unrestricted lag structure minimises common econometric problems such as spurious correlation and cointegration (Uanguta and Ikhide, 2002). However, it is criticized on the grounds that, to reasonably approximate the world representation, it should have long lags. This over-parameterization requires very large data sets, otherwise it results in imprecise and unreliable estimates of the VAR coefficients and forecasts that have large standard errors due to limited degrees of freedom. Hence the emergence of alternative approaches such as the

Bayesian VAR, which addresses these shortcomings by using informative priors to shrink the VAR model, thereby reducing parameter uncertainty and improving forecast accuracy (Bańbura *et al.,* 2008). Nonetheless, every methodology has its weaknesses. The BVAR is criticised on a number of grounds including the choice of priors, which could be done to adjust the results to match the researcher's hypotheses by assuming priors that are consistent with such hypotheses, while choosing which prior distribution to use might be difficult and time consuming because there are too many distributions to choose amongst (van de Schoot *et al.,* 2014).

4 DATA

The paper assesses three monetary policy transmission channels, the interest rate channel, the credit channel and the exchange rate channel. Other channels such as the asset price channel and the expectations channel could not be included due to unavailability of data on asset prices and consumer and investor confidence. In assessing the interest rate channel, Lesotho's 91-day Treasury bill rate (TBR) and the prime lending rate (LBR) are used. However, theoretically, interest rates in Lesotho should closely follow South Africa's interest rates because of the fixed exchange rate regime. Thus the effect of South Africa's repo rate (SARRE) on interest rates in Lesotho is also assessed. The credit extended to the private sector (BLOANS) and the real effective exchange rate index (REER) are used to assess the credit channel and the exchange rate channel, respectively. The study uses quarterly data covering the period from the first quarter of 2007 to the fourth quarter of 2017. The variables included in the study are described in Table 1 below. All the variables are included in the VAR without any transformation except private sector credit, real GDP and real effective exchange rate index, which are expressed in natural logarithms.

Table 1	Data Description and Sources	
Variable	Descriptor	Source
91-day Treasury Bill Rate	TBR	CBL
Prime Lending Rate	LBR	CBL
South African Repo Rate	SARRE	South African Reserve Bank
Real Effective Exchange Rate Index	REER	IMF International Financial Statistics
Private Sector Credit	BLOANS	CBL
Inflation Rate	CPIR	Bureau of Statistics
Real Gross Domestic Product	RGDP	Bureau of Statistics
Source	Central Bank of Lesotho	

5 RESULTS

5.1 Stationarity Tests

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were used to test for stationarity of all the variables considered in this paper. According to both the ADF and PP tests, performed with intercept and with trend and intercept, all the variables except the inflation rate (CPIR) and the natural log of private sector credit (L-BLOANS) have a unit root. The results of the L_BLOANS are mixed because they show that it is stationary in levels under both tests when the intercept is included but is non-stationary under both tests when both the trend and intercept are included. The CPIR also gives out mixed results with the ADF test showing that it is stationary in levels while the PP test indicates that it has a unit root. All the variables become stationary after being differenced once, according to both the ADF and PP tests. The paper presents the VAR models with all the variables in levels. This is in line with Sims (1980), Sims *et al.,* (1990) and Brooks (2014) who point out that for purposes of VAR estimation, which is purely for examining the relationship between the variables, differencing to achieve stationarity should be avoided because it throws away information on any long-run relationships between the series. Spurious regression is not a concern here because the interest is on impulse response functions and not on regression coefficients or any inference.

Table 2	Stationarity Tests (Critical Values)			
	ADF Test		PP Test	
	LEVELS			
Variable	Intercept	Trend & Intercept	Intercept	Trend & Intercept
SARRE	-2.0327	-0.7644	-1.4466	-1.3207
TBR	-1.1908	-1.1983	-1.5257	-1.6459
LBR	-1.1889	-1.1948	-1.5242	-1.6431
L_REER	-1.2642	-1.7451	-1.2558	-1.9437
L_BLOANS	-4.2353***	-0.1647	-4.2353***	-0.1920
CPIR	-3.1266**	-3.3373*	-2.0586	-2.4551
L_RGDP	-1.9466	-1.7016	-2.4352	-1.7016
	1ST DIFFERENCES			
Variable	Intercept	Trend & Intercept	Intercept	Trend & Intercept
SARRE	-3.4735***	-3.5437***	-3.3754***	-3.2885*
TBR	-4.2183***	-4.1778**	-4.2183***	-4.1778**
LBR	-4.2132***	-4.1729***	-4.2132***	-4.1729**
L_REER	-5.6675***	-5.6098***	-5.6762***	-5.6200***
L_BLOANS	-3.3214***	-5.9301***	-4.6877*	-5.9183***
CPIR	-3.8543***	-3.8084***	-3.8707***	-3.7989*
L_RGDP	-6.5525***	-5.6697***	-6.5931***	-7.5361***

Notes: *, **, *** are the 10%, 5% and 1% levels of significance, respectively.

Source Central Bank of Lesotho

5.2 Lag length Selection and Diagnostic Tests

Lag Length Selection and Models' Diagnostic Tests

Each model is estimated with the optimal lag length that was selected by the highest number of information criteria. All the models have no autocorrelation and their residuals are normally distributed. Model (2) has heteroscedasticity while the rest are characterised by homoscedasticity. All the models are stable as no root lies outside the unit circle. As such the data generating processes of these models can be trusted.

Table 3 Results of the Lag Length Selection and Diagnostic Tests

	Optimal Lag Length Selection		Residual Diagnostics		Model Stability Tests	
Transmission Channel	Type of Information Criteria	Recommended Lag Length	Type of Test	Results of Test	Type of Test	Results
SARRE, TBR	LR, FPE, AIC, SC, HQ	2	BG, JB, BPG	✓✓✗	IR of CP	Models Stable
L_RGDP, CPIR, TBR	LR, FPE, AIC, SC	3	BG, JB, BPG	✓✓✓	IR of CP	Models Stable
L_RGDP, CPIR, L_BLOANS	LR, FPE, AIC, HQ	3	BG, JB, BPG	✓✓✓	IR of CP	Models Stable
L_RGDP, CPIR, L_REER	LR, FPE, SC, HQ	2	BG, JB, BPG	✓✓✓	IR of CP	Models Stable

LR: sequential modified Likelihood Ratio test statistic
FPE: Final Prediction Error
AIC: Akaike Information Criterion
SC: Schwarz Information Criterion
HQ: Hanna-Quinn Information Criterion
✓ means test is passed while ✗ means test is failed.

BG: Breusch-Godfrey test for autocorrelation
JB: Jarque-Bera test for normality
BPG: Breusch-Pagan-Godfrey test for heteroscedasticity
IR of CP: Inverse Roots of Characteristic Polynomial
Models Stable: No root lies outside the unit circle.

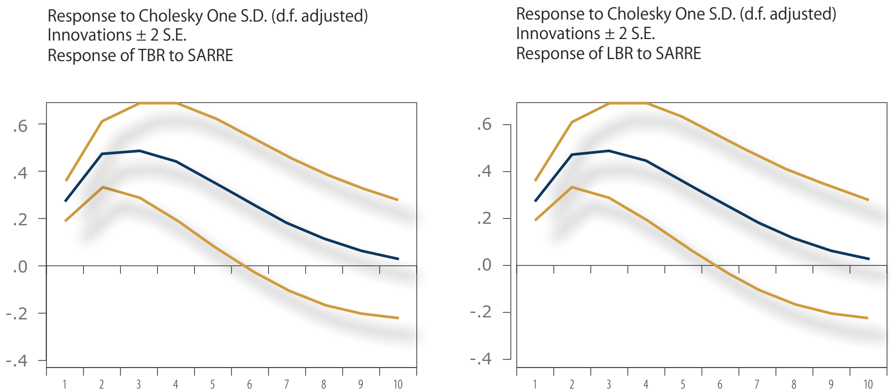
Source Central Bank of Lesotho

5.3 The Effect of SA's Monetary Policy on Lesotho's Interest Rates and The Effectiveness of Monetary Policy Transmission Mechanism

The Effect of SA's Interest Rates on Lesotho's Interest Rates

For an economy following a fixed exchange rate regime, domestic interest rates closely track foreign interest rates, particularly those of the anchor economy. The trilemma suggests that in the absence of capital controls, when the anchor economy raises the interest rate, a pegged country has to increase the domestic interest rates in line with it, otherwise the peg will break. As such, interest rates movements in SA are expected to stimulate interest rates in Lesotho to move in the same direction.

Figure 1 Impulse Response Functions of a Shock to SA's Repo Rate



Source: Central Bank of Lesotho

The impulse response functions of a shock on SA's repo rate show that a one standard deviation positive shock in SA's repo rate results in a positive response in Lesotho's 91-day T-bill rate throughout the 10 quarters. The T-bill rate peaks at 0.49 in the third quarter. The effect of the repo rate on the 91-day T-bill rate becomes statistically insignificant from the 5th quarter. The variance decomposition shows that SA's repo rate explains between 67.0 and 93.0 per cent of the variability in Lesotho's 91-day T-bill rate, which is much higher than the proportion explained by own shocks, over a 2-and-a-half-year horizon. The prime lending rate in Lesotho responds in the same way as the 91-day T-bill rate to a shock on the SA's repo rate.

An increase in SA's repo rate is transmitted into an increase in interest rates in Lesotho. It explains a considerable share of the variability in the 91-day T-bill rate and the prime lending rate. This is consistent with theoretical expectations in a common monetary area setting. These findings corroborate with those of Ikhide and Uanguta (2010), Uanguta and Ikhide (2002), and Sander and Kleimeier (2006) on CMA countries, of which Lesotho is one of them.

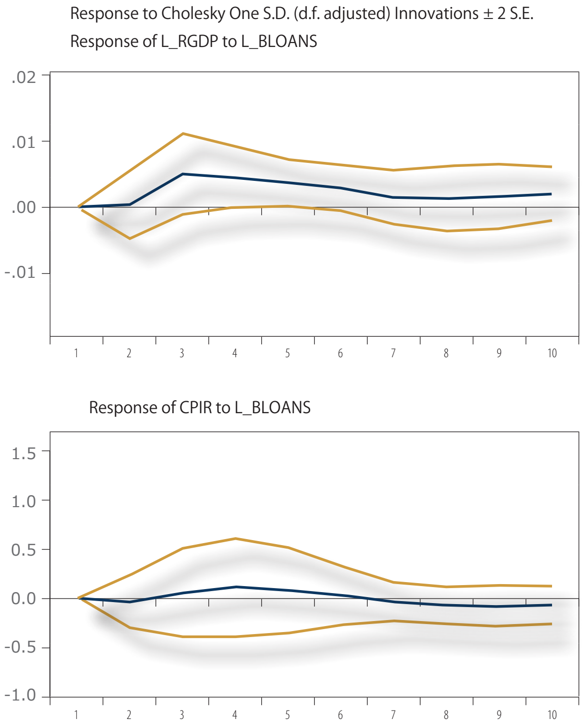
The Interest Rate Channel

The interest rate channel operates through the effect of the real interest rate on interest rate sensitive components of aggregate demand such as consumption and investment. An expansionary monetary policy should lead to a fall in real interest rates, thus lowering the cost of capital. This would, in turn, stimulate increases in consumption and investment spending, hence output. The effect of the change in the domestic interest rate on aggregate demand will depend on the factors that determine the supply of and demand for credit by the private sector.

There are a number of credit supply and demand factors that are likely to hamper the transmission of interest rates movements to the real economy in Lesotho's case. Among others, supply side factors include the low level of development of Lesotho's financial sector[3], a non-existent capital market, reluctance of banks to extend long-term loans of high amounts because of the short-term nature of their liabilities, which are comprised mainly of short-term deposits. Demand side factors that constrain private sector credit include the small size of the economy coupled with the high unemployment rate, which hamper consumption of high value durable consumer goods, the small size of the private business sector, inability of business enterprises, particularly start-ups to meet some of the loans qualification criteria, such as collateral and to prepare and submit bankable business proposals, *inter alia*. Consequently, only a small share of credit extended by the commercial banks, estimated at 30.8 per cent in 2018 goes to business enterprises. It comprises short-term loans, mainly overdrafts for financing short-term short-falls in operations budgets of well-established enterprises.

[3] Using indicators of financial sector development such as size, efficiency, depth and reach, Damane (2019) ranks Lesotho at low level of development amongst the CMA countries.

Figure 4 Impulse Response Functions to a Shock in Commercial Banks' Credit



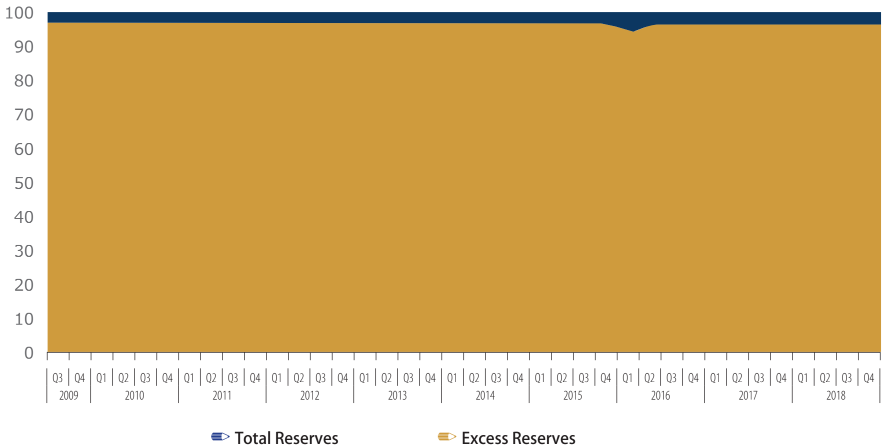
Source: BOS and Authors' Calculations

The results presented in Figure 2 show that a positive shock on the 91-day T-bill rate reduces output from the 3rd quarter. This shows that output responds negatively to the increase in interest rates in Lesotho. However, the effect of the interest rate on output is not statistically significant in both models. Inflation responds positively to a positive shock on the 91-day T-bill rate up to the 8th quarter, after which the effect becomes negative, looking at the model with CPIR. However, this effect is statistically significant only up to the 4th quarter. The interest rate channel is not effective in Lesotho.

The Credit Channel

The credit channel works when banks' excess liquidity is increased through injection of liquidity or a reduction in reserves requirements, which allow banks to increase the volume of credit extension; or when the policy rate has been reduced, thus allowing banks to cut the lending rate, which could in-turn increase the demand for credit. The increase in credit would stimulate investment and/or consumption expenditure, hence real growth and/or inflation. The effectiveness of this channel is dependent on factors such as is the ability of the central bank to control liquidity (for example inject liquidity or induce a liquidity squeeze) in the banking system.

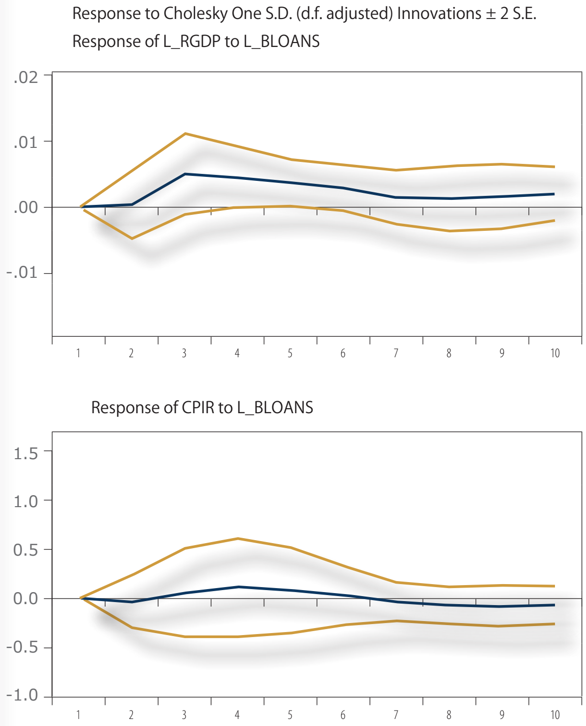
Figure 3 Commercial Banks' Liquidity



Source: Central Bank of Lesotho

The banking industry in Lesotho is characterised by structural liquidity surpluses. As depicted in Figure 3 above, commercial banks' holding of excess reserves has been increasing over the years and is in excess of M12 billion on average from the first quarter of 2016 to the last quarter of 2018. This limits the Central Bank of Lesotho's ability to control liquidity, hence credit availability. Second is the extend or magnitude of bank lending to the private sector, that is, how significant are banks as a source of capital for the private sector. Credit supply and demand factors that constrain private sector credit in Lesotho as discussed under the interest rate channel above also weaken the credit channel.

Figure 4 Impulse Response Functions to a Shock in Commercial Banks' Credit



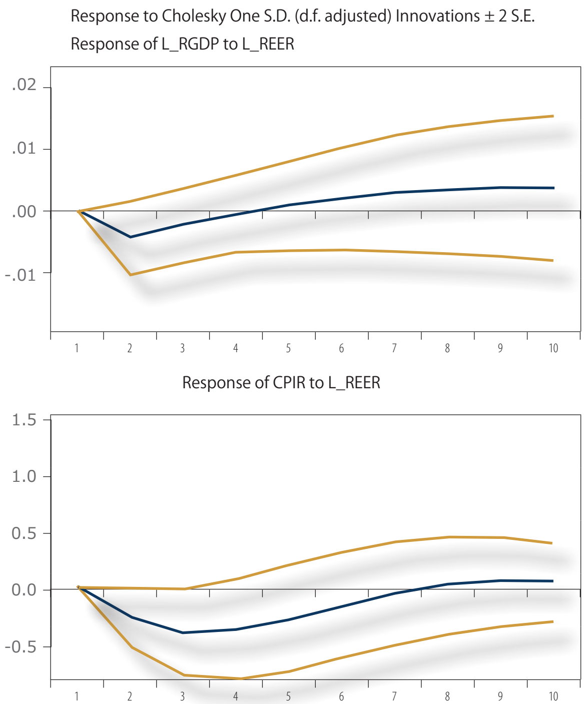
Source: BOS and Authors' Calculations

The results of Model (4) depicted in figure 4 above show that a one standard deviation positive shock on credit extended to the private sector results in a positive response in output throughout the ten-year period. This is in line with theoretical postulations. However, the effect is miniscule and statistically insignificant. These results are similar to those of Sheefeni (2017) on Namibia. The effect on the inflation rate varies over time. It is negative in the first 2 quarters, positive from the 3rd to the 5th quarter and thereafter it becomes negative. It is not statistically significant throughout.The credit channel is not effective in Lesotho.

The Exchange Rate Channel

The exchange rate channel captures the effect of monetary policy on aggregate demand that is transmitted through the effects of the exchange rate on net exports. Local currency deposits become less attractive following a decline in domestic interest rates. This, in turn, causes a nominal depreciation of the local currency. Consequently, domestic goods become cheaper than foreign goods, thereby causing an increase in exports, hence aggregate output. This channel of monetary policy transmission is not applicable in a fixed exchange rate regime economy, particularly where the bulk of the anchored economy's trade in goods and services takes place with the anchor economy. Thus this channel is not expected to be effective in Lesotho.

Figure 5 Impulse Response Functions to a Shock in the Exchange Rate



Source: BOS and Authors' Calculations

The results from Model (5) indicate that the effect of the exchange rate appreciation on output is not consistent over time. It is neutral in the 1st period, followed by a decline in the second and third periods and then output increases. Nonetheless, this effect is not statistically significant. A one standard deviation positive shock on the real effective exchange rate (an appreciation) results in a negative response in the inflation rate for 7 quarters after which it becomes positive. However, this effect is also statistically insignificant throughout. The exchange rate channel of monetary policy transmission is not effective in Lesotho. These findings corroborate with those of other studies including Devereux (2001), Adolfson (2001) and Mabulango and Boboy (2016).

These findings are statistically robust as they are confirmed by models (6) to (9). For space considerations, the results of the robustness check models are not included in this paper but interested readers can request them from the author. The findings of this paper show that SA's monetary policy decisions are transmitted to interest rates developments in Lesotho. In addition, monetary policy transmission to output and inflation through the exchange rate, credit and interest rate channels is miniscule and statistically non-significant.

6 CONCLUSION AND POLICY RECOMMENDATIONS

In Lesotho, monetary policy is conducted with price stability as the primary objective. Price stability is the most crucial contribution that the Central Bank of Lesotho can make towards macroeconomic stability and economic development of Lesotho. Thus it is important to understand the transmission mechanism and channels through which monetary policy affects the real economy for the design and implementation of appropriate and effective monetary policy regime and frameworks.

The results of this paper show that, there is strong transmission of SA's monetary policy decisions to Lesotho's short-term interest rates. Monetary policy transmission to output and inflation through the exchange rate, credit and interest rate channel is weak. These mean that Lesotho's interest rates respond to interest rates developments in SA in line with the requirements for protecting the fixed exchange rate regime. In addition, changes in Lesotho's interest rates do not influence domestic output and inflation. Consequently, any policy efforts to steer Lesotho's interest rates in a different direction to or out of line with SA's, to stimulate output growth, are futile and put the exchange rate peg at risk of collapse.

The literature identifies a number of credit supply and demand factors that curtail the transmission of monetary policy to the real economy. In Lesotho's case, supply side factors are centred around the low level of development of the financial sector as explained in Section 5.2 under the Interest Rate Channel. As such, financial sector reforms and other efforts geared towards increasing competition in the banking system, facilitating growth in credit to business enterprises, developing the domestic financial markets and addressing other institutional and structural bottlenecks that hinder the development of Lesotho's financial system should be accelerated. The demand side factors are related to Lesotho's low level of economic development and the small size of the business sector. These require identification and implementation of policies for effective transformation and modernization of Lesotho's economy[3].

[3] For further information on this matter refer to Khoabane S. (2018), Determinants of Poverty and Remedial Measures: Lessons for Lesotho, CBL Research Bulletin, December 2018, Central Bank of Lesotho. Link: https://www.centralbank.org.ls/images/Publications/Research/December_2018_Research_Bulletin.pdf.

REFERENCES

Bańbura M., Giannone D., and Lenza M. (2015). Conditional Forecasts and Scenario Analysis with Vector Autoregressions for Large Cross-sections, *International Journal of Forecasting*, Vol. 31, No. 3.

Bernanke B.S., Boivin J., and Eliaz P. (2004). Measuring the Effects of Monetary Policy: A Factor-Augmented Vector Autoregressive (FAVAR) Approach, *NBER Working Paper Series*, Working Paper 10220, National Bureau of Economic Research.

Bonga-Bonga L. (2017). Assessing the Effectiveness of the Monetary Policy Instrument during Inflation Targeting Period in South Africa, *International Journal of Economics and Financial Issues,* Vol 7. Issue 4.

Brooks C. (2014). Introductory Econometrics for Finance, Third Edition, *Cambridge University Press*.

Carranza L., Galdon-Sanchez J. E., and Gomez-Biscarri J. (2010). Understanding the Relationship between Financial Development and Monetary Policy, *Review of International economics*, 18(5).

Catão L. (1997). Bank Credit in Argentina in the Aftermath of the Mexical Crisis: Supply or Demand Constrained?, *IMF Working Paper WP/97/32*, International Monetary Fund.

Cheng C.K. (2006). A VAR Analysis of Kenya's Monetary Policy Transmission Mechanism: How Does the Central Bank's REPO Rate Affect the Economy, *IMF Working Paper WP/06/300,* International Monetary Fund.

Christensen B.V. (2011). Have Monetary Transmission Mechanisms in Africa Changed?, *BIS Papers No. 56*, Bank for International Settlements.

Chuku A.C. (2009). Measuring the Effects of Monetary Policy Innovations in Nigeria: A Structural Vector Autoregressive (SVAR) Approach, *African Journal of Accounting, Economics, Finance and Banking Research*, Vol 5., No. 5.

Ciccarelli M., and Rebucci A. (2003). Bayesian VARs: A Survey of the Recent Literature with an Application to the European Monetary System, *IMF Working Paper WP/03/102*, International Monetary Fund.

Damane M. (2019). An Analysis of Comparison of Banking Sector Development in the CMA, *Occasional Analytical Note*, Central Bank of Lesotho.

Damane M., Letsie K., Mofuoa M., and Moeti M. (2018). An Economic Toolkit for Evaluating the Impact of External Factors on Lesotho's Economy, *Central Bank of Lesotho Working Papers Series*, Central Bank of Lesotho.

Effiong E., Esu G., and Chuku C. (2017). Financial development and Monetary Policy Effectiveness in Africa, *MPRA Paper No. 79732*, Munich Personal RePEc Archive.

Gumata N., Kabundi A.,and Ndou E. (2013). Important Channels of Transmission of Monetary Policy Shocks in South Africa, *ERSA Working Paper 375,* Economic Research Southern Africa.

Ikhide S. and Uanguta E. (2010). Impact of South Africa's Monetary Policy on the LNS Economies, *Journal of Economic Integration*, 25(2), June 2010;324-352.

Khoabane S., and Molise T. (2015). Modelling Inflation in Lesotho, *Central Bank of Lesotho Working Paper No. 3/2015*, Central Bank of Lesotho.

Litterman R.B. (1980). A Bayesian Procedure for Forecasting with Vector Autoregression, Working papers, *MIT Department of Economics*, Massachusetts Institute of Technology.

Miranda-Agrippino S., and Ricco G. (2018). Bayesian Vector Autoregressions, *Staff Working Paper No. 756*, Bank of England.

Mishra P., and Montiel P. (2012). How Effective is Monetary Transmission in Low-Income Countries? A Survey of the empirical Evidence, *IMF Working Paper WP/12/143*, International Monetary Fund.

Mishra P., Montiel P., and Spilimbergo A. (2010). Monetary Transmission in Low Income countries, *IMF Working Paper WP/10/223*, International Monetary Fund.

Otero J.D.Q (2017). Industrial Structure and Transmission of Monetary Policy in Latin American Countries, *Invetigación Económica*, Vol. 76, No. 302.

Poole W. and Wheelock D.C. (2008). Stable Prices, Stable Economy, *The Regional Economist*, www.stlouisfed.org.

Saborowski C. and Weber S. (2013). Assessing the Determinants of Interest Rate Transmission Through Conditional Impulse Response Functions, *IMF Working Paper WP/13/23*, International Monetary Fund.

Sander H. and Kleimeier (2006). Interest rate Pass-Through in the Common Monetary Area of the SACU Countries, *South African Journal of Economics*, Vol. 74:2, June 2006.

Sheefeni J.P.S. (2017). Monetary Policy Transmission Mechanism in Namibia: A Bayesian VAR Approach, *Journal of Economics and Behavioural Studies*, Vol. 9, No. 5.

Sims C.A. (1980). Macroeconomics and Reality, *Econometrica*, Vol. 48, No. 1.

Sims C.A., Stock J.H., and Watson M.W. (1990). Inference in Linear Time Series Models with some Unit Roots, *Econometrica*, Vol. 58, No. 1.

Thamae R.I., and Mohapi M. J. (2014). Modelling Inflation in Lesotho: A Cointegration Analysis, *African Journal of Business and Economic Research*, Vol. 9, Issue 2/3.

Tsangarides C. (2010). Monetary Policy Transmission in Mauritius Using a VAR Analysis, *IMF Working Paper WP/10/36*, International Monetary Fund.

Uanguta E. and Ikhide S. (2002). Monetary Policy Transmission Mechanism in Namibia, *BON Working Paper No. 2/02*, Bank of Namibia.

Van de Schoot R., Denissed J., Franz J.N., Kaplan D., Asendorpf J.S., and van Aken M.A.G. (2014). A Gentle Introduction to Bayesian Analysis: Applications to Developmental Research, *Child Development*, Vol. 85, No. 3

APPENDIX

Table A 1 Optimal Lag Length Selection

Endogenous Variables	Lag Length	LogL	LR	FPE	AIC	SC	HQ
SARRE TBR	0	-90.1721	NA	0.3074	4.4962	4.5798	4.5266
	1	-20.6343	128.8995	0.0126	1.2992	1.5500	1.3905
	2	-9.7467	19.1197*	0.0090*	0.9632*	1.3812*	1.1154*
	3	-6.1193	6.0161	0.0092	0.9814	1.5665	1.1945
SARRE LBR	0	-90.2584	NA	0.3087	4.5004	4.5839	4.5308
	1	-20.8266	128.7027	0.0127	1.3086	1.5593	1.3999
	2	-9.8353	19.3019*	0.0090*	0.9676*	1.3855*	1.1198*
	3	-6.2623	5.9259	0.0093	0.9884	1.5735	1.2015
L_RGDP CPIR TBR	0	-103.995	NA	0.0371	5.2192	5.3446	5.2649
	1	26.3513	235.2586	9.99e-05	-0.7001	-0.1985	-0.5174
	2	48.1433	36.1428	5.39e-05	-1.3241	-0.4464*	-1.0045
	3	60.0001	17.9298*	4.79e-05*	-1.4634*	-0.2096	-1.0068*
L_RGDP CPIR	0	-19.5116	NA	0.0006	1.0981	1.2235	1.1438
L_BLOANS	1	138.2976	284.8262	4.24e-07	-6.1608	-5.6593*	-5.9782
	2	150.6351	20.46235	3.64e-07	-6.3237	-5.4459	-6.0040
	3	163.6703	19.71167*	3.05e-07*	-6.5205*	-5.2667	-6.0639*
L_RGDP CPIR	**0**	**-13.6474**	**NA**	**0.0005**	**0.8121**	**0.9374**	**0.8577**
L_REER	**1**	**115.7908**	**233.6202**	**1.27e-06**	**-5.0629**	**-4.5614**	**-4.8803**
	2	**135.7092**	**33.0355***	**7.53e-07***	**-5.5956**	**-4.7179***	**-5.2759***
	3	**144.8259**	**13.7861**	**7.64e-07**	**-5.6013***	**-4.3474**	**-5.1447**

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error

AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table A 2 Breusch-Godfrey Test for Autocorrelation

Endogenous Variables	Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
SARRE TBR		Null hypothesis: No serial correlation at lag h					
	1	2.895643	4	0.5754	0.728601	(4, 68.0)	0.5755
	2	1.873173	4	0.7591	0.467828	(4, 68.0)	0.7591
		Null hypothesis: No serial correlation at lags 1 to h					
	1	2.895643	4	0.5754	0.728601	(4, 68.0)	0.5755
	2	3.773008	8	0.8770	0.463435	(8, 64.0)	0.8772
SARRE LBR		Null hypothesis: No serial correlation at lag h					
	1	2.854692	4	0.5824	0.718082	(4, 68.0)	0.5825
	2	1.747302	4	0.7821	0.435992	(4, 68.0)	0.7822
		Null hypothesis: No serial correlation at lags 1 to h					
	1	2.854692	4	0.5824	0.718082	(4, 68.0)	0.5825
	2	3.722443	8	0.8813	0.457050	(8, 64.0)	0.8815
L_RGDP CPIR TBR		Null hypothesis: No serial correlation at lag h					
	1	12.96815	9	0.1641	1.506825	(9, 63.4)	0.1650
	2	9.602313	9	0.3836	1.087260	(9, 63.4)	0.3847
	3	7.427216	9	0.5927	0.827136	(9, 63.4)	0.5937
		Null hypothesis: No serial correlation at lags 1 to h					
	1	12.96815	9	0.1641	1.506825	(9, 63.4)	0.1650
	2	20.04991	18	0.3300	1.141222	(18, 65.5)	0.3356
	3	26.25147	27	0.5047	0.969403	(27, 59.1)	0.5211
L_RGDP CPIR L_BLOANS		Null hypothesis: No serial correlation at lag h					
	1	6.091128	9	0.7308	0.671492	(9, 63.4)	0.7314
	2	5.892383	9	0.7506	0.648604	(9, 63.4)	0.7513
	3	10.39743	9	0.3193	1.184480	(9, 63.4)	0.3204
		Null hypothesis: No serial correlation at lags 1 to h					
	1	6.091128	9	0.7308	0.671492	(9, 63.4)	0.7314
	2	15.00741	18	0.6615	0.824295	(18, 65.5)	0.6659
	3	37.15199	27	0.0923	1.488840	(27, 59.1)	0.1018
L_RGDP CPIR L_REER		Null hypothesis: No serial correlation at lag h					
	1	13.78381	9	0.1302	1.601252	(9, 73.2)	0.1309
	2	15.78534	9	0.0715	1.858643	(9, 73.2)	0.0720
		Null hypothesis: No serial correlation at lags 1 to h					
	1	13.78381	9	0.1302	1.601252	(9, 73.2)	0.1309
	2	23.34296	18	0.1778	1.352018	(18, 76.9)	0.1812

Table A 3	Jarque-Bera Test for Normality		
	Skewness (Chi-square)	Kurtosis (Chi-square)	Normality (Jarque-Bera)
SARRE TBR			
Statistic	1.5745	8.9604	10.5349
Probability	0.4551	0.0113	0.0323
SARRE LBR			
Statistic	1.3949	8.8434	10.2383
Probability	0.4979	0.012	0.0366
L_RGDP CPIR TBR			
Statistic	0.4786	2.5164	2.995
Probability	0.9236	0.4723	0.8095
L_RGDP CPIR L_BLOANS			
Statistic	5.1539	5.1461	10.3
Probability	0.1609	0.1614	0.1126
L_RGDP CPIR L_REER	1.141222	(18, 65.5)	0.3356
Statistic	4.5870	5.6886	10.2756
Probability	0.2047	0.1278	0.1100

Table A 4	Breusch-Pagan-Godfrey Test for Heteroscedasticity		
	Chi-Square	Degrees of Freedom	Probability
SARRE TBR	61.4934	24	0.0000
SARRE LBR	61.0151	24	0.0000
L_RGDP CPIR TBR	140.9156	108	0.0183
L_RGDP CPIR L_BLOANS	122.5501	108	0.1602
L_RGDP CPIR L_REER	90.8076	72	0.0664

Figure A1 Model Stability - Inverse Roots of Characteristic AR Polynomial

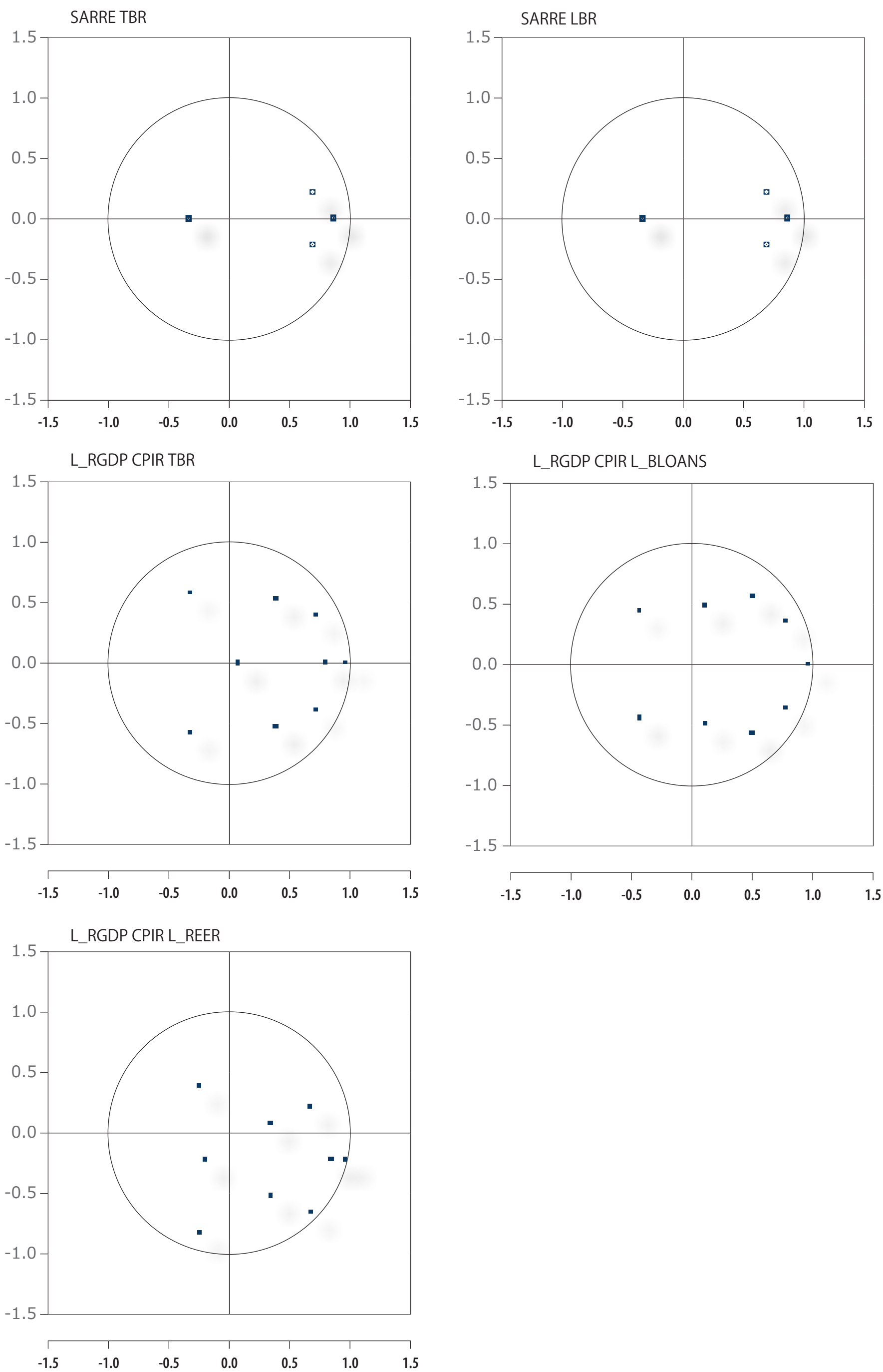


Table A 5	Model Stability - Inverse Roots of Characteristic AR Polynomial		
SARRE TBR		SARRE LBR	
Root	Modulus	Root	Modulus
0.867410	0.867410	0.866877	0.866877
0.697852 - 0.217793i	0.731048	0.699870 - 0.216520i	0.732597
0.697852 + 0.217793i	0.731048	0.699870 + 0.216520i	0.732597
-0.331567	0.331567	-0.339634	0.339634
L_RGDP CPIR TBR		L_RGDP CPIR L_BLOANS	
Root	Modulus	Root	Modulus
0.955266	0.955266	0.967351	0.967351
0.718037 - 0.394316i	0.819184	0.777852 - 0.359250i	0.856805
0.718037 + 0.394316i	0.819184	0.777852 + 0.359250i	0.856805
0.791358	0.791358	0.505186 - 0.575507i	0.765781
-0.328932 - 0.579392i	0.666252	0.505186 + 0.575507i	0.765781
-0.328932 + 0.579392i	0.666252	-0.431976 - 0.448945i	0.623021
0.380318 - 0.527892i	0.650624	-0.431976 + 0.448945i	0.623021
0.380318 + 0.527892i	0.650624	0.113716 - 0.490470i	0.503480
0.070918	0.070918	0.113716 + 0.490470i	0.503480
L_RGDP CPIR L_REER			
Root	Modulus		
0.929532	0.929532		
0.886908	0.886908		
0.708986 - 0.390633i	0.809478		
0.708986 + 0.390633i	0.809478		
-0.098006 - 0.315509i	0.330380		
-0.098006 + 0.315509i	0.330380		

Table A 6	Impulse Response Functions by Transmission Channels			
Response to Cholesky one S.D. (D.F. Adjusted) Innovations			Response to Cholesky one S.D. (D.F. Adjusted) Innovations	
VAR Model: SARRE TBR			VAR Model: SARRE LBR	
Response of			Response of	
Period	TBR to SARRE	TBR to TBR	LBR to SARRE	LBR to LBR
1	0.2752	0.1903	0.2753	0.1903
2	0.4714	0.0348	0.472	0.0366
3	0.4872	-0.0293	0.4883	-0.0254
4	0.4404	-0.1132	0.4428	-0.1094
5	0.3542	-0.1642	0.3571	-0.1605
6	0.2625	-0.1959	0.2656	-0.1931
7	0.1789	-0.2064	0.1817	-0.2046
8	0.1114	-0.2024	0.1136	-0.2015
9	0.0614	-0.1884	0.063	-0.1882
10	0.0277	-0.1689	0.0285	-0.1691
VAR Model: L_RGDP CPIR TBR			VAR Model: : L_RGDP CPIR L_BLOANS	
Response of			Response of	
Period	L_RGDP to TBR	CPIR to TBR	L_RGDP to L_BLOANS	CPIR to L_BLOANS
1	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.4061	0.0004	-0.0373
3	-0.0057	0.7078	0.0051	0.0559
4	-0.0063	0.7408	0.0045	0.1122
5	-0.0060	0.6022	0.0037	0.0808
6	-0.0083	0.3512	0.0029	0.0269
7	-0.0097	0.1159	0.0015	-0.0358
8	-0.0104	-0.0184	0.0014	-0.0737
9	-0.0109	-0.0703	0.0016	-0.0799
10	-0.0103	-0.0649	0.0020	-0.0697
VAR Model: L_RGDP CPIR L_REER				
Response of				
Period	L_RGDP to L_REER	CPIR to L_REER		
1	0.0000	0.0000		
2	-0.0044	-0.2528		
3	-0.0023	-0.3862		
4	-0.0005	-0.3552		
5	0.0007	-0.2601		
6	0.0020	-0.1452		
7	0.0029	-0.0413		
8	0.0034	0.0297		
9	0.0036	0.0618		
10	0.0036	0.0609		

Table A 7	Variance Decomposition by Transmission Channels							
Cholesky Ordering: SARRE TBR					Cholesky Ordering: SARRE LBR			
Variance Decomposition of TBR					Variance Decomposition of LBR			
Period	S.E.	SARRE	TBR		S.E.	SARRE	LBR	S.E.
1	0.334616	67.66658	32.33342		0.334686	67.66586	32.33414	0.334686
2	0.579117	88.84426	11.15574		0.579756	88.82536	11.17464	0.579756
3	0.757346	93.32682	6.673179		0.758440	93.35852	6.641485	0.758440
4	0.883389	93.45320	6.546804		0.885018	93.59506	6.404936	0.885018
5	0.965824	91.63244	8.367555		0.967755	91.89132	8.108679	0.967755
6	1.019844	88.80750	11.19250		1.021939	89.15861	10.84139	1.021939
7	1.055796	85.73342	14.26658		1.057931	86.14443	13.85557	1.057931
8	1.080787	82.87666	17.12334		1.082923	83.31481	16.68519	1.082923
9	1.098805	80.49364	19.50636		1.100949	80.93599	19.06401	1.100949
10	1.112052	78.64916	21.35084		1.114230	79.08326	20.91674	1.114230
Cholesky Ordering: L_RGDP CPIR TBR								
Variance Decomposition of L_RGDP					Variance Decomposition of CPIR			
Period	S.E.	L_RGDP	CPIR	TBR	S.E.	L_RGDP	CPIR	TBR
1	0.017806	100.0000	0.000000	0.000000	0.741815	0.523184	99.47682	0.000000
2	0.022033	99.98998	0.008328	0.001695	1.294490	1.506429	88.65392	9.839655
3	0.023444	93.32257	0.766554	5.910875	1.732730	2.743310	75.07818	22.17851
4	0.025376	87.93583	0.782886	11.28128	2.012336	5.282278	64.72237	29.99536
5	0.027014	81.46074	3.578743	14.96052	2.153252	7.838343	58.14104	34.02062
6	0.029082	71.23058	7.665076	21.10435	2.194629	8.706121	55.98341	35.31047
7	0.031706	60.72405	12.08394	27.19201	2.202496	8.776259	55.88793	35.33581
8	0.034276	52.14352	15.36598	32.49050	2.210981	8.728509	56.19947	35.07202
9	0.036573	45.80549	16.81488	37.37963	2.222054	8.851690	56.32483	34.82348
10	0.038415	41.52960	17.37099	41.09941	2.229670	9.049939	56.27925	34.67081

Table A 7	Variance Decomposition by Transmission Channels (continued)							
Cholesky Ordering: L_RGDP CPIR L_BLOANS								
	Variance Decomposition of L_RGDP				Variance Decomposition of CPIR			
Period	S.E.	L_RGDP	CPIR	L_BLOANS	S.E.	L_RGDP	CPIR	L_BLOANS
1	0.016801	100.0000	0.000000	0.000000	0.881747	1.686838	98.31316	0.000000
2	0.020303	95.87292	4.075028	0.052049	1.532195	0.592492	99.34816	0.059349
3	0.021193	90.29978	3.951333	5.748890	1.914313	0.392689	99.48402	0.123295
4	0.021974	85.46902	5.031443	9.499536	2.100081	0.327115	99.28483	0.388054
5	0.023708	74.08008	15.29954	10.62039	2.151072	0.319034	99.16993	0.511037
6	0.026407	61.69703	28.55847	9.744499	2.153446	0.374248	99.10025	0.525502
7	0.029263	52.92618	38.87190	8.201915	2.164827	0.556569	98.89602	0.547411
8	0.031294	48.15630	44.48462	7.359078	2.195234	0.693795	98.66106	0.645149
9	0.032441	46.05833	46.83967	7.101993	2.226317	0.710485	98.53318	0.756331
10	0.033066	44.98521	47.79947	7.215327	2.246262	0.701538	98.45931	0.839153
Cholesky Ordering: L_RGDP CPIR L_REER								
	Variance Decomposition of L_RGDP				Variance Decomposition of CPIR			
Period	S.E.	L_RGDP	CPIR	L_REER	S.E.	L_RGDP	CPIR	L_REER
1	0.017994	100.0000	0.000000	0.000000	0.844963	2.322754	97.67725	0.000000
2	0.023898	98.55922	0.856358	0.584425	1.467197	0.839836	95.69539	3.464770
3	0.025568	96.54194	0.818911	2.639150	1.943945	0.484215	91.81655	7.699231
4	0.028631	92.19974	4.166860	3.633399	2.201745	0.418486	89.22276	10.35875
5	0.032065	85.60510	10.99768	3.397219	2.287873	0.419430	87.52414	12.05643
6	0.035013	77.77659	17.96673	4.256678	2.302783	0.470859	86.68339	12.84575
7	0.038449	69.66335	24.98683	5.349821	2.308817	0.606296	86.47522	12.91848
8	0.041789	63.40242	30.57478	6.022795	2.319486	0.770339	86.42963	12.80003
9	0.044460	59.14696	34.06363	6.789418	2.327289	0.927058	86.33969	12.73325
10	0.046626	56.46794	36.07606	7.456004	2.329757	1.073630	86.21079	12.71558