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Assessing the Bank Lending Channel of the Monetary Transmission Process in Mauritius. Evidence from Panel Data[1]

by

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Abstract

Empirical studies have found that bank idiosyncratic characteristics, such as asset size, liquidity and degree of capitalization, are important in assessing the impact of monetary policy shocks on loan supply and in determining appropriate distributional effects. Using quarterly panel data spanning from 2009Q1until 2016Q4, this paper develops a dynamic Generalized Method of Moments model to examine the lending behavior of Mauritian banks in the aftermath of monetary policy impulses. We find that, following a tightening of monetary conditions, banks have a natural proclivity to curtail their supply of loans. This incidence of a bank-lending channel operating in the Mauritian jurisdiction is stronger when monetary conditions are gauged through the lens of market yields rather than through the Key Repo Rate. This is not hard to fathom out, given that market rates directly affect the relative attractiveness of various components of the asset portfolio of banks. Our approach also enables us measure the relative importance of cross-sectional bank heterogeneity in supporting this bank-lending channel. We show that those banks that are relatively of smaller sizes or that are relatively more liquidity constrained tend to follow more aggressive asset-liability management strategies by altering their lending behavior following the materialization of a monetary shock.

Key Words: *Asset-Liability Management, Bank Lending Channel, Cross-Sectional Heterogeneity, Dynamic Generalized Method of Moments, Key Repo Rate, Monetary Policy*

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I. Introduction

The archetypal conundrum "*Why are Banks special?*" traces its roots back to the Arrow-Debreu general equilibrium setup in which the equilibrium allocation of banks was shown not to differ from that of financial markets. Theories and paradigms that have developed later endeavored to answer this question by showing banks' superiority over financial markets in addressing a number of market imperfections. Indeed, according to these theories, banks were viewed as mechanisms that result in allocations that Pareto improve over financial markets allocation. The new literature that mushroomed since then portrayed banks as highly leveraged institutions that are engaged in channeling funds from where they are in excess to where they are in need. In discharging this intermediation function from depositors to borrowers, they are engaged in intertemporal transformation of maturity and in providing intra temporal liquidity insurance to depositors. Banks have been shown to be a theoretically superior machinery to financial markets in providing liquidity insurance to depositors and in addressing moral hazard and adverse selection dilemmas in the credit allocation process.

However, in discharging these functions, banks were often perceived as being exposed to a vortex of risks, many of which - if realized - could result in bank panics and failures. More than three decades later, the *"specialness"* of banks in discharging these roles was put into question. Indeed, as financial markets got deeper and more sophisticated and as traditional barriers between banks and financial markets collapsed, the entire intermediation process became threatened. The growth of so-called *"shadow banks"* or of non-deposit taking lenders, aligned with greater emphasis placed on loan sales, loan securitization and originate-and-distribute attributions, have coalesced to change the very nature of the intermediation process.

Against this backdrop, it has become worth investigating if the bank lending channel (BLC) of monetary policy is still operational. Over the last decades, new research - both theoretical and empirical- has examined the role that banks play in the transmission process of monetary policy. The traditional money view surmised that monetary policy is transmitted through changes operating on the liability side of banks' balance sheets, namely deposits. The bank lending channel brought a new perspective by emphasizing the asset side of balance sheets. According to aficionados of the bank lending channel, monetary impulses from Central Banks influence the supply of credit from banks and, by ricochet, aggregate spending in the economy. However, to estimate the bank lending channel empirically is not an easy task using aggregate data, since the task of disentangling the loan supply side from loan demand side proved to be challenging. As a result, studies that use aggregate data often supplemented their analysis with distributional effects of monetary impulses. Studies that use bank-level data have sought to answer whether there are important cross-sectional heterogeneity in the way banks with different characteristics respond to policy shocks. Those idiosyncratic features that are generally found to be important in assessing the impact of monetary impulses on loan growth include asset size, liquidity and degree of capitalization. This paper examines the existence of the BLC in Mauritius using quarterly panel data that covers the period 2009Q1 until 2016Q4 coached in a dynamic GMM model.

The rest of the paper is organized as follows: Section 2 provides an overview of the theoretical literature on the credit channel of monetary policy, of which the BLC is part. Section 3 provides a synoptic overview of the econometric method we use to estimate the BLC. The empirical results are given in Section 4 while the conclusion and policy implications are drawn in Section 5.

II. Financial System and Monetary Policy in Mauritius

This section reviews some of the salient developments in the Mauritian banking and financial system landscape since independence. Successive monetary policy frameworks adopted over the decay of time are presented. Some of the problems plaguing the transmission channel of monetary policy - including excess liquidity - are depicted. The financial market operations guiding the BoM's conduct of monetary policy - including OMOs and the Bank's intervention in the domestic FX market - are reviewed. Finally, we provide a synoptic overview of the macroeconomic environment lying as a backdrop of the decision-making process of the BoM in recent years.

2.1 Financial System

Financial deepening is relatively high in Mauritius. All indicators (loans, deposits and assets as a percentage of GDP) point towards increased level of deepening. The level of dollarization in the banking sector is relatively on par with emerging market standards. Over the period June 2005-2017, loan dollarization hovered at around 19 percent as a proportion of total loans. The ratio of foreign deposits to broad money stayed at slightly under 5 percent, despite the relatively high proportion of GBC deposits as a proportion of banks' funding source. A deep financial system coupled with manageable dollarization levels provides some of the requisite backdrop for monetary impulses to work effectively. Complementing this duo is the smooth operations of a well-developed financial market since a Central Bank's ability to conduct monetary policy and influence the level of banks' liquidity, depends partly on effectiveness of financial markets.

2.2 The Banking System in Mauritius

Mauritius has a large bank-dominated financial sector. Of the 21 banks, five are domestically owned, including the largest two banks; 12 are subsidiaries of foreign banks; three are branches of foreign banks; and one is a domestic/foreign joint venture. The GBC accounts for approximately 60 percent of banking sector assets, and foreign currency deposits of GBC companies and non-residents account for nearly two-thirds of total banking sector deposits. Many banks in Mauritius are part of financial or mixed conglomerates that include other financial services firms. There are a number of important stylized facts of the Mauritian banking system:

- *Stylized Fact 1*: There appears to be a positive correlation in market share measures whether gauged from the lens of deposits as percentage of total, loans as percentage of total or asset size as a percentage of total. The relative sizes are smaller for medium banks and smallest for the smallest banks.

- *Stylized Fact 2*: The largest banks have greater room for maneuverability in their balance sheet structures, as epitomized by relatively low advances to deposits ratio. This means that large banks in Mauritius have a relatively more diversified asset portfolio and can more easily allocate their asset portfolio between loans and investment assets. It also means that large banks have relatively more

diversified funding base and relatively larger capital bulwarks. As a result, they are more likely to follow a passive ALM.

- *Stylized Fact 3:* The largest banks also have relatively low capitalization rates, compared to the benchmark average for the total banking system.
- *Stylized Fact 4*: Large banks are the key players in the Treasury bill market and hold an important part of their total assets in Treasury bill securities.
- *Stylized Fact 5*: The relationship between bank size and bank liquidity ratios tends to be more blurred.

Stylized facts 1 and 2 coalesce to underscore the fact that large banks in Mauritius have more room for manoeuver following an economic shock that plagues their balance sheet. In so-doing, they may have less incentive to alter their loan allocation in response to shocks. This can be vindicated on grounds that they may resort to wholesale funding to plug any funding lacuna as a result of liquidity drainage. Alternatively, they are more in a position to invest or divest from securities investment, thereby keeping their lending unscathed from shocks The smaller banks, on the other hand side, tend to be more constrained in their maneuverability due to lack of alternative asset allocation, and their relatively high dependence on retail deposits as funding source. Furthermore, smaller banks are more poised to follow an aggressive ALM strategy than larger banks, meaning that their lending tends to be more sensitive to economic shocks that impair their balance sheets.

2.3 The Monetary Policy Framework

Central banking in Mauritius traces its roots back to 1966 with the establishment of the BoM under the BoM Ordinance 1966. The BoM started its operation on 14 August 1967 and its focus has evolved since its formation in response to the changing economic environment.

The BoM Act 2004 stipulates that *"the primary object of the Bank shall be to maintain price stability and to promote orderly and balanced economic development*". Prior to 1991, the BoM mostly conducted monetary policy through direct instruments – credit ceilings and administered interest rates, as well as reserve requirements. The BoM imposed ceilings on credit expansion and issued regular interest guidelines to banks. Lower interest rates were set for high priority sectors. Bank rates were established by the Ministry of Finance. From 1973 to 1979, credit was allowed to increase by 15 per cent every year amid a more restrictive ceiling set for non-priority sectors. Interest rates were charged depending on how the credit would be used. Treasury bill rates were established in relation to the Bank rate. However, with a fixed exchange rate regime, this system led to a BoP crisis and forced Mauritius to have recourse to an IMF Stand-by facility which lasted from 1979 to 1986. Interest rates were subsequently fully liberalised in July 1988.

The BoM reconsidered its monetary operations and objectives in the 1990s. The financial system was liberalized. Credit controls had been completely phased out in 1993. In 1994, a secondary market cell was set up with a view to induce secondary trading in treasury bills. In the same year, the BoM suspended exchange controls and an interbank FX market was set up. The Bank thus adopted a more flexible exchange rate regime (which replaced the basket pegged regime) and moved to indirect monetary control by influencing the growth of money and market interest rates.

Under the system of indirect monetary management, the focus moved from direct monetary aggregates towards greater use of market-determined instruments to influence the amount of liquidity in the banking system, money supply growth as well as a spectrum of interest rates. Reserve money was initially the operating target of monetary policy but was replaced by the Lombard rate in 1999, while broad money supply continued to serve its purpose as the intermediate policy target.

With a changing structure of the economy, an independent MPC was established in March 2007 to ensure that the capital market was transparent and efficient, and to reinforce the monetary policy transmission mechanism.

With a view to addressing the disconnect between the Lombard rate and market interest rates, the Bank took the decision in 2006 to replace the Lombard rate by the KRR which, since then, became the Bank's key instrument to signal its monetary policy stance. Liquidity Management has become a recurrent activity of the BoM. Under the new framework, the BoM typically regulates the supply of liquidity in the banking system in order to bring market rates close to the KRR. Efforts to do so have often been fraught with difficulties as market yield rates are also, to a great extent, influenced by banks' asset portfolio compositions. The latter is itself influenced by the BoM's interventions in the domestic FX market and in the domestic money market through OMOs. For instance, as a result of capital-inflow induced upward pressure on the Mauritian rupee, the BoM regularly intervenes in the domestic FX market with a view to maintain the relative stability of the Mauritian rupee. In so-doing, FX intervention contributes towards excess liquidity in the banking system by draining foreign currency from banks and by injecting domestic currency into banks. Thanks to the BoM's sterilization policies – either through the issue of short-term securities or through special unremunerated deposits– the excess liquidity situation is kept in check.

The effectiveness of the KRR as a policy rate has often been undermined by the high level of excess liquidity prevailing in the banking system. This has ultimately weakened the interest rate transmission lever of the BoM. On the other hand, money market rates are often affected by excess liquidity situation of banks, irrespective of what happens to the KRR. Thus, in our setup, we shall consider both cases for our model specification. Under regime 1, we shall allow market yields to be the interest rate regressor. Under regime 2, we shall allow the KRR to be the regressor.

Mauritius faced challenging circumstances after the global financial crisis. To mitigate the impact of the crisis, the country implemented a highly accommodative monetary policy stance. From September 2008 until August 2017, monetary policy has predominantly been accommodative. This has also been possible - thanks to the low inflation environment that has prevailed, both, in Mauritius and abroad, and that has provided room for manoeuvring a monetary relaxation.

III: Literature Review

3.1 Theoretical Literature

Theoretically, there is no agreement on how monetary policy impacts the real economy. The transmission mechanism theory holds that monetary policy can influence real sector activity through several channels, namely: interest rate channel, exchange rate channel, other asset price channel, and

credit channels. Credit lending channel is broadly broken down to BLC and the balance sheet channel (Bernanke and Gertler, 1995). Work on what is now referred to the BLC of the monetary policy transmission, which is the focus of this paper was pioneered by Bernanke and Blinder (1988). They argued that monetary policy works by shifting both the supply of bank assets (loans) and bank liabilities (deposits). This ultimately leads to a decline in investment spending as well as economic activity.

The BLC assumes that (a) banks cannot shield their loan portfolios from changes in monetary policy, (b) commercial banks will not adjust deposit interest rates to match other market interest rates, at least not instantaneously and (c) borrowers cannot fully insulate their real spending from changes in availability of bank credit. The BLC indicates the importance that banks play in the economy through facilitating the savings-investment process. It is argued that monetary policy can affect the bank portfolio behavior through the bank asset in terms of loans, securities and bank reserves (Bernanke and Gertler, 1995). The BLC therefore plays an important role in affecting economic activity because any changes in the monetary policy stance will affect the bank behavior in both the assets and liabilities side. Specifically, contractionary monetary policy results in the draining of bank reserves and deposits leading to contraction of bank loan supply followed by drop in investment and consumer spending which will in turn reduce aggregate demand. The converse is also true; expansionary monetary policy will cause an increase in bank reserves and deposits leading to expansion of bank loan supply. The result will be a rise in investment and consumer spending leading to an increase in aggregate demand.

The effect of monetary policy on the supply of bank loans depends on the characteristics of the banking sector. The stronger the banking sector, the weaker the expected impact of policy movements will be since balance sheets of large, healthy banks are not sensitive to policy because their reserve contraction can be readily offset with alternative forms of financing without involving reserve requirements. A stronger BLC exists in a banking sector with relatively small banks with low liquidity and capitalization and weak bank market concentration, since such banks are more exposed to market imperfections and will face more difficulties in attracting non-deposit financing.

3.2 Empirical Literature

Early work on the role of financial intermediaries in the monetary transmission process can be traced back to Keynes (1936) when he conjured the role of money supply in explaining business cycles. Later work built on Keynes's idea but shifted the focus more towards credit supply process rather than on the money supply process.

An important breakthrough came through the contributions by Bernanke and Blinder (1988) on the credit channel of monetary policy transmission. They provided three conditions for the existence of the bank lending channel in an IS-LM setup: loans and bonds must be imperfect substitutes; the Central Bank is able to influence the supply of bank loans by influencing banks' liquidity; and there is imperfect price adjustment which pre-empts monetary neutrality and allows monetary policy to have a real impact. In their setup, the IS curve morphs into the CC curve. Like the IS curve, the CC curve is negatively sloped. Unlike the IS curve, it is positively affected by changes in monetary policy, which

will also affect the LM curve. A tight monetary policy will drain bank reserves and deposits. As a result, the bank will contract the loan to corporations and households. To the extent that the latter are heavily bank-dependent and lack access to alternative sources of finance, one should expect the loan contraction to affect investment and economic activity negatively. A key feature of the Bernanke and Blinder (1988) paradigm is that the lending channel disappears when borrowers view bank loans and bonds as perfect substitutes[2]. Subsequent revisions have subsequently been brought about by Stein (1998).

The validity of the paradigm offered by Bernanke and Blinder (1988) and Stein (1998) has been put into question by subsequent researchers. Several studies pertaining to the credit channel focus on bank aggregate data. Bernanke and Blinder (1992), for instance, used changes in 3-month Treasury bills to capture exogenous shifts in monetary policy stance. They found evidence of an inverse relationship between tightness of monetary policy and bank loans - which vindicates existence of a credit channel in the US economy. Others have endeavored to explore the link by leveraging on the existence of disaggregated data. Kashyap et al (1995) found that bank loans of small banks were more responsive to monetary policy impulses than those of large banks.

A study by Kashyap et al. (2000) found evidence that the smallest and most illiquid banks were the most responsive to monetary policy shocks. Similar conclusions have been reached in the light of a number of research work undertaken in the UK and in Eurozone. Altunbas et al (2002) show existence of a bank lending channel in countries such as Italy and Spain. They show that undercapitalized banks had a tendency to respond relatively more to changes in policy than well-capitalized banks. However, Favero (1999) used individual bank balance sheet data to investigate the response of banks in France, Germany, Italy, and Spain to monetary tightening in 1992. While there was no evidence of the bank lending channel, an important offshoot of the study was that banks in different countries responded in different ways to shield the supply of loans from the liquidity squeeze. Huang (2003) analyzed the cross-sectional differences between bank-dependent companies and non-bank dependent companies, as well as between listed and unlisted companies in the UK. He shows that the bank lending channel works and that the distributional consequences of a monetary tightening fell disproportionately more on smaller firms since they lacked alternative sources of finance. Other studies have shown that large banks have greater ability to shield their loan portfolios from monetary policy shocks. Kakes and Sturm (2002) have shown that, in Germany, the smallest banks were relatively the most hardly hit following monetary tightening since the impact of the tightening on their clients' balance sheets (mostly small clients) was hard. Two reasons provided were the relatively high external finance premium that theseclients had to face and their lack of alternative sources of finance. As a result, small banks were compelled to curtail their lending in the aftermath of a tightening. The existence of a low aggregate elasticity of output to bank lendingalso vindicates the limited impact of bank lending changes on real economic activity.

Some authors (e.g., Ashcraft (2006)) have questioned the existence of a bank lending channel in the US. Using bank size, capitalization and affiliation to a multi-bank holding company, and data spanning from 1987 to 1999 in the US, he finds that stand-alone bank lending is highly sensitive to changes in

[2]There is no bank lending channel when (i) loan supply is perfectly elastic with respect to the loan rate, or (ii) loan demand is perfectly elastic with respect to the loan rate, or output demand does not respond to changes in the loan rate. Both cases imply that borrowers view loan and bond financing as perfectsubstitutes.

federal funds rate while affiliated bank lending is not. He also uses VAR for a longer period, 1954 to 2002, to assess the response of the bank lending channel to monetary policy shocks. He concludes that the bank lending channel is relatively unimportant in the US for the period considered, in view of the sluggish response of US real output to aggregate bank lending.

Kishan and Opiela (2000) explore the possibility that bank size and capital leverage may act as useful determinants of heterogeneity a period spanning from 1980 to 1995. Two monetary policy indicators are used, namely changes in federal funds rate and changes in the Bernanke-Mihov (1995) indicator. They find that loans of small and under-capitalized banks are the most responsive to monetary policy. By extending their sample coverage to 1999, they find evidence of asymmetric responses of banks to monetary policy shock. Low-capital banks are adversely affected by contractionary monetary policy. However, expansionary monetary policy is not effective in giving a fillip to loan growth of these banks.

Gambacorta and Mistrulli (2004) found that the response of bank lending to a monetary policy impulse has the expected negative sign. The findings also showed that the impact of monetary tightening is weaker for largely capitalized banks. Their findings also showed that there is positive correlation between credit and output. An increase in output causes demand for loans to increase. The interaction term in their regression results between GDP and excess capital is negative. This means that the credit supply of well-capitalized banks is less dependent on the business cycle. This result corroborates with Kwan and Eisenbeis (1997) who showed that capital has a significantly negative effect on loan supply responses.

Jimborean (2006) conducted analysis using GMM and using BankScope data for the period 1995-2005 testing if size, liquidity, capitalization and ownership influence the functioning of a lending channel in Slovenia. According to this study, foreign ownershipinfluenced loan activity of banks when a monetary policy change was effected while factors such as size, liquidity and capitalization did not. Coricell et al (2006) performed SVEC analysis using quarterly data from 1991 until 2005. They found that a monetary policy shock lowers credit growth, which rationalizes the existence of a bank lending channel.

IV. Econometric Methodology

We adopt a dynamic panel data technique, the GMM approach[3] proposed by Arellano and Bond (1991), and the system GMM approach developed by Arellano and Bover (1995), and Blundell and Bond (1998). The GMM approach has the advantage of addressing the Nickell (1981) bias associated with fixed effects in short panels (e.g., bias due to presence of lagged dependent variable and due to endogeneity of explanatory variables).

We use quarterly bank data spanning from 2009Q1 to 2016Q4. A heterogeneous mix of 14 banks (all D-SIBs), medium and small) that have been in continuous operation during this period have been included in the sample. These banks account for over 75 percent of total banking assets and 70 percent

[3] The system GMM approach is usually preferred when the lagged levels of the regressors are poor instruments for the first-differenced regressors. The system GMM estimator uses the levels equation to obtain a system of two equations: one differenced and one in levels. By adding the second equation, additional instruments can be obtained. Thus the variables in levels in the second equation are instrumented with their own first differences. This usually increases efficiency.

of total deposits and loans as at end-2016. Variables that are idiosyncratic or bank-specific (e.g., liquidity, capital, asset size etc.) have been obtained from the BoM database. The set of macroeconomic variables (e.g., GDP, inflation etc.) have obtained from Statistics Mauritius. Financial sector variables (e.g., KRR, yield rates and exchange rates) have been obtained from the BoM. All variables have been seasonally adjusted and expressed in logs. Thus, the following equation is estimated:

$$log(L_{it}) = \alpha_i + \sum_{j=1} \beta_j log\left(L_{i,\,t-j}\right) + \sum_{j=0} \alpha_j \, Int_{t-j} + \sum_{j=0} \emptyset_j log\left(GDP_{t-j}\right) + \sum_{j=0} \psi_j \, inf_{t-j} + \rho x_{i,t-1} + \sum_{j=0} \delta_l \, x_{i,t-1} Int_{t-j} + \omega_i + \mu_{i.t}$$

This, however, suffers from the Nickell (1981) bias, which occurs by virtue of the fact that there is a correlation between the regressors and the error term, in the presence of lagged dependent variables. This so-called 'endogeneity' problem has been addressed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998), who propose the GMM estimators approach.

Arellano and Bond (1991) and Arellano and Bover (1995) recommend that the lagged dependent variables be used as instrument to account for the endogeneity. This provides the basis of the difference GMM approach. Studies by Alonso-Borrego and Arellano (1999) have demonstrated the weaknesses associated with the use of lagged dependent variable as instrument in instances in which the regressors and lagged dependent variables exhibit some form of persistence over time. To decrease the potential bias linked to the difference estimator, Blundell and Bond (1998) propose a system GMM that combines both, regression in differences and regression in levels. In addition to the regression in differences, the instruments for the regression in levels are the lagged differences of corresponding instruments. However, the system GMM can generate moment conditions. If there are too many instruments in the setup, the system GMM will over fit endogenous variables although the Hansen test of the instruments' joint significance will be weakened. In order to address the proliferation of instruments issue, we shall use two techniques in limiting the number of instruments – such as using only certain lags instead of all available lags for instruments and combining instruments through addition into smaller sets by collapsing the block of the instrument matrix. This technique has been used by previous researchers, for example Calderon et al. (2002), Beck and Levine (2004), Cardovic and Levine (2005) and Roodman (2009b).

We develop a one-step system GMM and perform relevant diagnostics tests for checking the robustness of our setupAs mentioned in the literature, the success of a GMM system in producing a consistent, efficient and an unbiased estimator, is highly dependent on appropriate use of instruments. There are a number of specification tests that must be performed, as suggested by Arellano and Bond (1991): First, the Hansen test of over-identifying restrictions which tests the validity of instruments and the correct specification of the model; second, appropriate tests must be conducted to ensure that there is no serial correlation among the error terms. Proper specification, absence of serial correlation and instrument validity lend credence to the belief that the estimated model has been correctly specified.

V: Estimation Results and Interpretation

Tables 1 and 2 summarize the main findings of the determinants of the lending channel by using GMM estimation (Table 1) and system GMM estimation (Table 2). The GMM models have been estimated using one-step estimation under two regimes: regime 1 in which the trigger of monetary conditions is the 3-month Treasury Bill, and regime 2 in which the appropriate trigger is the BoM'sKRR.

Table 1. Determinants of Bank's Loan Supply - GMM Equation - Arellano-Bond Estimation

	Regime 1: Market Yields			Regime 2: Key Repo Rate (KRR)		
	Coefficient	Robust Std Error	P-Value	Coefficient	Robust Std Error	P-Value
Lagged dependent variable (log of bank credit)						
- L1	0.7	0.049	0.000***	0.7	0.049	0.00***
- L2	0.3	0.059	0.000***	0.3	0.059	0.00***
- L3	-0.2	0.049	0.000***	-0.2	0.049	0.00***
Market rates of interest / KRR	-7.6	3.72	0.040**	-2.3	4.79	0.64
Log of GDP	21.8	21.3	0.310	16.9	23.9	0.48
Log of Inflation rate	-101.9	51.6	0.048**	-96.9	65.9	0.14
Bank size (var1)	0.2	0.37	0.000***	0.2	0.04	0.00***
Bank Liquidity (var2)	0.8	0.044	0.081*	0.1	0.04	0.085*
Bank Capitalization (var3)	-0.6	0.023	0.014**	0.0	0.015	0.13
Bank Capitalization*Market rates / KRR	-0.1	0.155	0.343	-0.2	0.016	0.33
Bank Liquidity*Market rates / KRR	0.5	0.029	0.099*	0.0	0.114	0.63
Bank Size*Market rates / KRR	0.2	0.014	0.172	0.0	0.014	0.12

Note: The dependent variable is the log of banks loan. The independent variables are the market rates of interest, log of GDP, log of inflation rate, and of bank characteristics. var1 is the bank size, var2 is the bank liquidity, and var3 is the bank capitalization. var x MP is the interaction effect between monetary policy with the bank characteristics. *** significant at 1% level ; ** significant at 5% percent level, and * significant at 10% percent level.

Table 2: Determinants of Bank's Loan Supply - System GMM Equation - Arellano-Bond / Blundell-Bond Estimation

	Regime 1: Market Yields			Regime 2: Key Repo Rate (KRR)		
	Coefficient	Robust Std Error	P-Value	Coefficient	Robust Std Error	P-Value
Lagged dependent variable (log of bank credit)						
- L1	0.78	0.083	0.000***	0.77	0.081	0.000***
- L2	0.27	0.121	0.002***	0.27	0.124	0.030**
- L3	-0.08	0.0877	0.35	-0.08	0.092	0.38
- L4	-0.10	0.074	0.18	-0.01	0.07	0.16
Market rates of interest / KRR	-3.83	4.21	0.36	-0.23	3.91	0.95
Log of GDP	35.37	15.39	0.022**	32.9	18.8	0.081*
Log of Inflation rate	-82.34	37.48	0.028**	-80.5	37.9	0.034**
Bank size (var1)	0.13	0.06773	0.055*	0.13	0.068	0.052*
Bank Liquidity (var2)	-0.04	0.0125	0.001***	-0.023	0.011	0.035**
Bank Capitalization (var3)	0.06	0.043	0.155	0.065	0.052	0.22
Bank Capitalization*Market rates / KRR	-0.01	0.0099	0.42	-0.0099	0.012	0.39
Bank Liquidity*Market rates / KRR	0.03	0.039	0.455	-0.0009	0.013	0.94
Bank Size*Market rates / KRR	0.02	0.0069	0.012**	0.019	0.008	0.016**
AR (1)			0.03			0.02
AR (2)			0.9			0.97
Sargan-Hansen p-value			.			.

Note: The dependent variable is the log of bank credit. The independent variables are the Key Repo Rates (KRR), log of GDP, inflation rate, and of bank characteristics including size, liquidity ratios and capitalization ratios. var1 is the bank size, var2 is the bank liquidity ratio, and var3 is the bank capitalization ratio. var x MP is the interaction effect between time-variant monetary policy indicator with the bank characteristics. *** significant at 1% level ; ** Significant at 5% percent level, and * Significant at 10% percent level.

In the one-step estimation, the coefficient of the monetary policy impulse – whether market yield rates or KRR - is negative. When market yield rates are the relevant trigger of monetary shocks, the coefficient is also statistically significant. This therefore means that a monetary tightening situation (rise in interest rate) will, by siphoning off banking liquidity, reduce the loan supply of the banking system. Thus, a one percentage point hike in appropriate trigger rate, for instance, will lead to a contemporaneous decrease in bank loan supply, in line with our earlier surmise that the KRR has a weaker impact on loan supply than market yield rates. These results hold under, both, traditional GMM and system GMM approaches. Overall, due to the presence of a negative coefficient in the estimation for the relevant trigger of monetary shocks, there is evidence to vindicate the evidence of a bank lending channel in Mauritius.

The results from both estimation techniques also show that bank size positively affects the supply of loan. Irrespective of whether monetary conditions are gauged by money market rates or by KRR, the coefficients representing these factors are positive and statistically significant. The rationale is not hard to fathom out. Banks of larger size tend to have more room for altering their loan supply portfolios, unless they pursue a passive ALM strategy.

The interaction between monetary policy variable and bank idiosyncratic variables such as size, capitalization and liquidity sheds light on how the presence of bank idiosyncratic variables may affect the response of loan supply to monetary tightening or accommodations. We can subsume our findings along the following points:

- *COROLLARY 1: By influencing the deposit mobilization of banks, monetary tightening negatively affects loan supply of those banks with lower liquidity ratios, in line with the bank lending channel proposal.* This is because banks with lower liquidity ratios are more poised to follow an aggressive ALM strategy than banks with relatively higher liquidity ratios. The positive coefficient resulting from the interaction between bank liquidity and monetary policy (Bank Liquidity*Market rates or Bank Liquidity*KRR) indicates that banks with higher liquidity ratios are more in a position to react positively, lending-wise, and can therefore better shield their loan supply from monetary conditions. This means that banks which are more liquidity constrained will more likely curtail their lending – in line with what the bank lending channel would assert.

- *COROLLARY 2: Banks with relatively higher capitalization ratios are more poised at reducing their loan supply following episodes of monetary tightening, which is inimical to the bank lending channel.* The interaction term between monetary policy and capitalization (Bank Capitalization*Market rates or Bank Capitalization*KRR) is negative and not statistically significant. Recall that the bank lending channel asserts that it is those banks with lower capitalization ratios that should be more inclined at reducing bank loan supply following a monetary tightening. While this opposite situation in Mauritius could be attributed to the fact that banks with relatively higher capitalization ratios often pursue aggressive ALM strategies, we also note that this category of banks includes the smallest banks. This behavior can be verified by the fact that these banks also face relatively stable loan-to-deposit ratios over time.

- *COROLLARY 3: Monetary tightening in Mauritius negatively affects loan supply of small banks more than they do for large banks mainly on grounds that small banks are generally perceived to be less stable and unsecured.* This assertion tallies with the bank lending channel. In Mauritius, we see that the loan supply response of

small banks to monetary shocks was relatively smaller than for larger banks. This could be vindicated on grounds that smaller banks tend to pursue more aggressive ALM strategies and corroborates with the observation made under corollary 2 that banks with higher capitalization ratios pursue aggressive ALM strategy. The interaction term between bank size and monetary policy trigger variable is positive, albeit not statistically significant. This indicates that banks with relatively higher level of assets are more in a position to shield their loan portfolios from monetary shocks and are, as a result, less inclined at curtailing their lending following monetary tightening.

According to Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998), two tests are necessary for testing the validity of the model specification, the Sargan-Hansen test for the validity of instruments and the AR(2) test for serial correlation. The results from these diagnostic tests show that our model setup has been correctly specified because there is no serial correlation in the transformed residuals.

Table 3. Accounting for Cross-Sectional Heterogeneity Among Banks: Linking Theory with Stylized Facts and Empirical Results

Theoretical Implications		Stylized Facts - The Mauritian Case	"What if" Analysis : Do the results from the System GMM model corroborate with theory ?		What does the model suggest ?
Low Liquidity Ratio	Loan supply responds relatively more to monetary shocks	The set of banks with below average liquidity ratios tends to comprise a mixture of small and large banks.	**YES**	Bank lending channel exists for those banks with relatively low liquidity ratio	There is evidence that the bank lending channel exists through the liquidity conduit, based on sign and significance of liquidity interaction coefficient
			NO	No bank lending channel exists - Rationale: Banks could be pursuing a passive ALM strategy that insulates their loan supply from monetary shocks	
Low Capitalization Ratio	Loan supply responds relatively more to monetary shocks	All large banks have below-average capitalization ratios	YES	Bank lending channel exists for those banks with relatively low capitalization ratio	There is evidence that the bank lending channel does not exist through the capitalization conduit, based on sign and significance of the capitalization interaction coefficient
			NO	No bank lending channel exists - Rationale: Banks could be pursuing a passive ALM strategy that insulates their loan supply from monetary shocks	
Small Size	Loan supply responds relatively more to monetary shocks	Small banks are small in all respects - deposits, loans and capitalization. The opposite is true for large banks	**YES**	Bank lending channel exists for those banks with relatively small size	There is evidence that the bank lending channel exists through the size conduit, based on the sign of the size interaction coefficient. However, result is not statistically significant.
			NO	No bank lending channel exists	

Source: BOM Staff

5.1 Robust Checks

We use two approaches to back test our estimated model: the event analysis and counter-factual analysis. Thus, we construct two theoretical hypotheses that should hold if our findings were true. We have established that only the liquidity and size conduits justify the existence of the BLC in Mauritius and that the incidence of this channel is stronger when market yield rates are the appropriate indicator of monetary conditions. We also found that the lending behavior of large banks in Mauritius is relatively less reactive to monetary shocks than does the smaller banks. If these findings are true, then we should be observing two lemmas in theory:

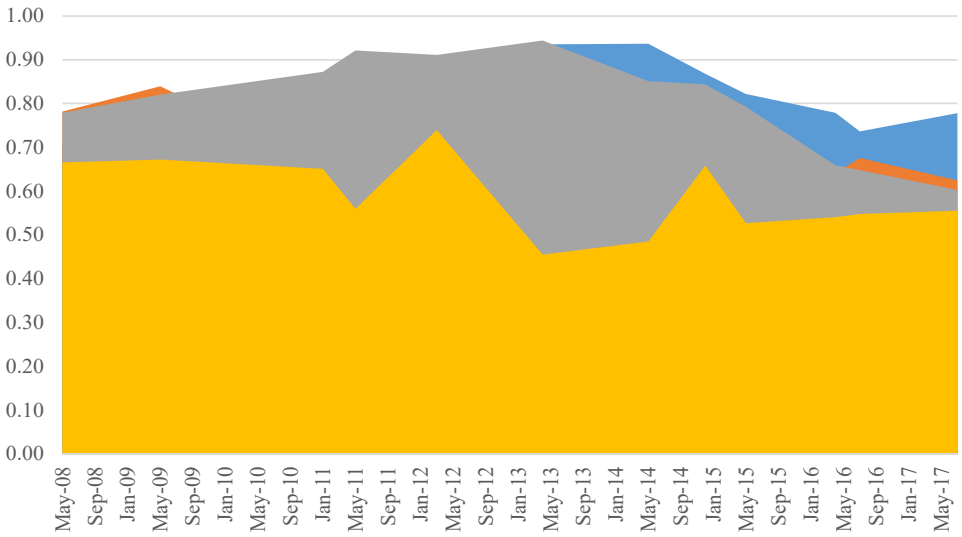
Lemma 1: The loan-to-deposit ratio of larger banks should be subject to greater amplitude and fluctuations than those of smaller banks. What validates this lemma is the fact that, for larger banks, the numerator (i.e., loan) reacts more passively to shocks unlike the denominator.

Lemma 2: The observed elasticity of substitution between loans and investments in the asset portfolio of larger banks should be smaller than that of smaller banks. Although the largest banks are also the largest investors in the T-bill market, their ability to borrow from domestic and external money markets allows them to assuage the severity of monetary shocks in their balance sheets and to better insulate their lending behavior from these shocks. As a result, they are less inclined to switch the composition of their asset portfolio in the aftermath of monetary shocks.

Are these lemmas applicable to banks in Mauritius? Charts 1 and 2 demonstrate that this is indeed the case regarding lemma 1. Using a sample of large banks (Chart 1) and small banks (Chart 2) at specific points in time between 2008 and 2017[4], we can see that the standard deviation accounting for the fluctuations in the loan-to-deposit ratio for the large banks across the period stands at 0.14. For smaller banks, the standard deviation stands at 0.11.

Figure 1. The Loan-to-Deposits ratio of a sample of large banks, 2008-2017

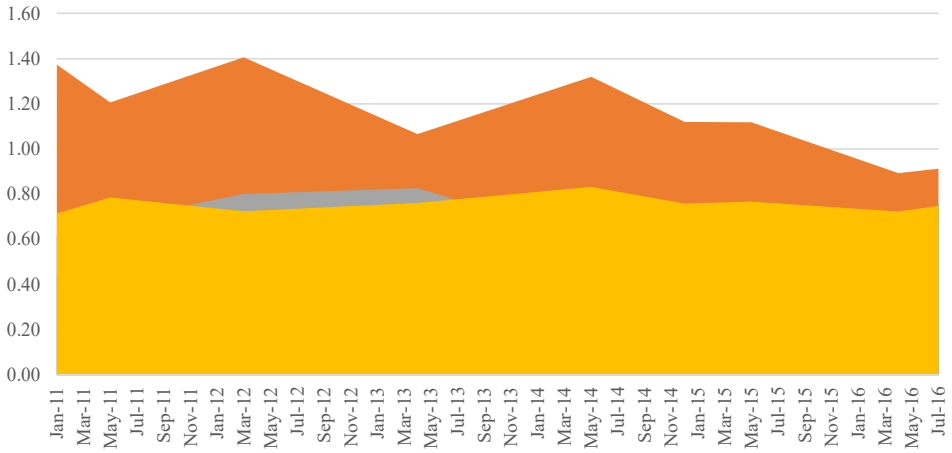
(Standard deviation of fluctuations for large banks: 0.14)



[4] Care has been taken to ensure that all large banks included in the sample include those categorized as domestic systemically important banks.

Figure 2. The Loan-to-Deposits ratio of a sample of small banks, 2008-2017

(Standard deviation of fluctuations for small banks: 0.11)



We also demonstrate that lemma 2 is applicable to banks in Mauritius. Indeed, using a metric which is similar to gauging the average elasticity of substitution between loans and investments over period 2009 - 2016, we observe that the smaller banks tend to have relatively larger elasticity of substitution than larger banks. This vindicates our observation that larger banks are in a better position to shield their lending behavior from monetary shocks. As a result, because of their ability to tap into funding sources from elsewhere, they do not face an inclination to substitute the composition of their assets.

VI: Conclusion and Policy Recommendations

This paper estimated a dynamic panel GMM model for Mauritius using quarterly data stemming from 2009Q1 - 2016Q4. We find evidence of the BLC of monetary policy in Mauritius. We also find that the lending channel operates mainly from the liquidity and size conduits, suggesting that banks with relatively low liquidity ratios and with relatively small size tend to react to monetary tightening episodes by contracting their loan supply - in line with theoretical predictions of BLC models. Our results show that this response is stronger when the monetary trigger is the 3-month Treasury bill rate rather than the KRR. Contrary to the theoretical predictions of the BLC, we do not find evidence that banks with low capitalization ratios face a contraction in their loan supply following a monetary tightening.

Juxtaposing the size and capitalization conduits, we find that large banks in Mauritius are less likely to follow aggressive ALM strategies unlike smaller banks. Since the large banks are also those that face relatively low capitalization ratios, evidence that they have more room for maneuver to shield their loan portfolios from monetary shocks, does not come across as counter-intuitive.

Our finding that a BLC exists implies that for the monetary policy transmission to be effective, it is important that the disconnect between the KRR and market interest rates be addressed at the earliest convenience by the BoM. As we have seen, the supply of loans to monetary impulses coming from the market is stronger than for those coming from the policy rates. Bridging the lacuna between the policy rates and the market rates is crucial if the BoM wants to retain leverage on the transmission channel.

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