The bank lending channel of monetary policy transmission: evidence from an emerging aarket, India

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THE BANK LENDING CHANNEL OF MONETARY POLICY TRANSMISSION: EVIDENCE FROM AN EMERGING MARKET, INDIA

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ABSTRACT

This study analyzes the monetary policy transmission in India with the help of bank lending channel hypothesis. We test the shift in loan supply emanating from the changes in the prime policy rate used by the Reserve Bank of India. Using yearly bank balance sheet data from 1996 to 2007, the paper provides evidence of an operational BLC in India. Further, segregating banks by asset size and liquidity, we find that small, illiquid banks are more affected by policy changes, and the effect is more pronounced in areas of non-priority sector lending. Finally, the domestically owned banks are more sensitive to policy rate changes vis-à-vis foreign banks.

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1. INTRODUCTION

The issue of monetary policy transmission has remained by and large elusive. Although most economists tend to agree that, at least in the short run, monetary policy can significantly influence the course of the real economy; the exact process of this transmission mechanism still remains a "black box" (Bernanke and Gertler, 1995). Recent research has shown that accurately defining the role of banks in the transmission of monetary policy holds the key in explaining the effects of policy on the economy. Specifically, in the credit channel, banks are assumed to play a pivotal role in the transmission of policy. Assuming asymmetric information between lenders and borrowers, proponents of the credit channel offers an intuitive explanation for the strength, timing, and distributional effects of policy on the economy.

A large body of literature over the last decade has examined the existence of the credit channel by further dividing it into two sub-channels that account for the role of banks in transmitting central bank impulses: the balance sheet channel and the bank lending channel (BLC). This paper provides evidence in support of the credit channel, in general, and the bank lending channel, in particular, from the perspective of an emerging economy, India.

The bank lending channel of monetary transmission hypothesize that during a contractionary policy pursued by the central bank, there would be a substantial decline in the reservable deposit in the banking system due to higher reserved requirements on banks and the increased alternative cost of holding money. Therefore, if banks cannot replace the fall in loanable funds through liquidating assets or through external forms of finance, the contractionary policy will decrease their loan supply and, in turn the real spending of their borrowers. The existence of the bank lending channel hypothesis critically hinges on two necessary assumptions: (a) some spending are dependent on bank lending and (b) monetary policy can affect supply of bank loans and the resulting decrease in loan supply reduces real aggregate spending (Kashyap & Stein 1995).

Typically, as the first assumption is likely to be empirically valid, most of the studies therefore focus on testing the latter assumption by examining whether monetary policy shift the supply of bank loan and these impacts are if at all uniformly spread across all types of banks.

The testing of bank lending channel hypothesis has gained importance of late, due to the significant structural change witnessed by the Indian banking sector in both its working as well as its regulation. Prior to mid-eighties, India's banking sector has been perceived to be excessively regulated and financially repressed. Though intervention in India has for long been justified on grounds of achieving the government's development goals and achieving equitable growth, the long-drawn-out existence of excessively large public banks led to inefficient allocation of resources as well as concentration of power within a few banks. Over 90% of the assets and credit during 1991 lay within the control of 27 public-sector banks.

However, following the Chakravarthy Committee (1985) recommendations, the coupon rates on government bonds were gradually increased to reflect market conditions. More comprehensive reforms followed the Narasimham Committee report of 1991. The year 1991 saw India going through a balance of payment crisis following which, comprehensive reforms were initiated. The Narasimham Committee's recommendations brought in prudential regulations and norms, a reduction in the CRR and SLR requirements, as well as interest rate and entry deregulation. In the following year, the Basel Accord capital adequacy standards were adopted. Therefore, in the liberalized regime the role of the RBI and its working through the monetary policy has gained increasing importance in India.

In this paper, we hypothesize that a contractionary policy pursued by RBI, through the prime policy rate (bank rate and repo rate) will reduce the loanable funds of banks and if banks cannot replace this fall without any cost by liquidating their assets or through external forms of finance, it would lead to a decrease in loan supply.

The empirical test for the existence of the BLC have been carried out for many economies, on a varying scale, both with respect to the methodology used as well as the

reasons and implications cited. While the earlier empirical studies mainly used time series techniques to study the bank loan models, the more recent researches tend to focus on individual bank behavior using panel data models.

Using aggregate level bank data for the US banking sector from 1959-1978, Bernanke and Blinder (1992) concluded that the interest rate on Federal funds was a good indicator of future movement in real macroeconomic activity, and also of the monetary policy actions. Monetary policy was understood to work partly through credit and partly through deposits. Bernanke followed up this work with a paper with Gertler (1993), that tried to establish how exactly monetary policy exerts its influence on real output and spending. The paper looked into the credit channel as an interim between monetary policy actions and changes in the real economy, changes that are traditionally seen with a lagged response. In conclusion, the paper proposed that the lag was due to the BLC taking effect.

However, a primary drawback of these aggregate level studies lies in their inability to distinguish between lending responses resulting due to changes in loan demand or from the BLC through changes in the loan supply (Westerlund, 2003). Recent studies have hence increasingly used panel data models to study the BLC at the micro level. Panel data models tend to provide more accurate and precise estimates due to the extra time series observations they employ.

Developing on this, various bank level studies followed. The studies primarily attempted to distinguish banks based on asset size, capitalization, and liquidity. These studies attempted to show that bank lending was affected by monetary policy changes and that small, undercapitalized, and illiquid banks were most responsive and affected to that end. Most papers have supported the existence of a BLC, though the degree to which they agree upon its effectiveness varies. Using a panel of bank balance sheet data, Ehermann et. al. (2001), tested for the BLC in the Euro zone, and concluded that monetary policy does alter bank loan supply, and the effect is highly dependent on the individual bank's liquidity. Working on similar lines, Westerlund (2003) tested for the BLC in Sweden for the period 1998-2003, using an

ARDL panel data model approach. Her conclusions supported the existence of an operational BLC in Sweden. Cetorelli and Goldberg (2008) developed on the work of Kashyap et al (1993, 1995, and 2000) for the US banking sector. They brought in an important element of globalization and studied its effect on US banking as well as the effect US monetary policy could have on other nations. Large globally oriented banks were shown to rely extensively on internal capital markets to smoothen domestic liquidity shocks. Even though they agreed upon its existence, they did conclude on the weakening of the BLC in US.

We attempt to add to this vast literature on the Bank Lending Channel of monetary policy transmission, using a panel of yearly disaggregated data on individual banks covering the period 1996-2007, for an emerging economy, India. We model the lending responses using dynamic panel data model. The paper aims to contribute in three primary ways: First, the paper can be viewed as the first work on studying the BLC in India[2]. Since India is one of the largest emerging economies with strong banking sector, a study of its banking behaviour and the effectiveness of its monetary policy provide the critical insight into the BLC hypothesis. Second, despite the comprehensive reforms, banking service in India remains highly regulated. Lending has always been viewed with particular interest and priority sector lending still remains legislated. We attempt to distinguish between priority and non-priority lending effects, simply because given its nature, inclusion of priority lending will only dilute the BLC. Finally, another distinguishing feature of this study is the methodology used. The paper recognizes the pro-cyclical lending behaviour and employs a dynamic panel data model to account for the lag effect in the lending behaviour.

[2] The only other existing work which had examined the BLC in India for the period 1993-94 to 2003-04 is by Pundit et. al. (2006). However, their paper was done at the Department of Economic Analysis and Policy (RBI) mainly for in-house usage.

The main findings reveal that monetary policy changes have a direct impact on bank lending and that these responses are more pronounced in the case of small banks. We also show that non-priority sector better supports the existence of a BLC, and that domestically-owned banks are more responsive to monetary policy changes. Specifically, the paper establishes the BLC in India; examines the dynamics between domestic and foreign banks as well as the dynamics between small and large banks and also differentiates the priority sector lending and non-priority sector lending.

The rest of the paper is structured as follows: In section 2 we present the methodology and the estimation procedure used in the paper. Section 3 presents a brief description of the data. Section 4 contains the empirical findings of our model. Section 5, presents the conclusion.

2. Methodology

In this section we outline the hypothesis that we are trying to test through an empirical model and explain the methodology used. The general model used for our estimation is:

$$Ln_{it} = \alpha + \sum_{j=1}^{n} \alpha_j Ln_{it-j} + \sum_{j=0}^{n} \beta_j PR_i + \sum_{j=0}^{n} \delta_j PR * BS\_Strength + \sum_{j=0}^{n} \psi_j CD_{it-j} + \sum_{j=0}^{n} \xi_j SEC_{it-j} + \sum_{j=1}^{n} \theta_j DUM_{ij} + \varepsilon_{it} \ldots\ldots\ldots (1)$$

In equation 1, Ln_{it} is the growth in loan supply captured by the total advances in the bank's balance sheet. The variable has been constructed as the first difference of the logarithmic transformation of the loan supply. The main explanatory variable is *PR*, an exogenous variable, indicative of monetary policy shocks, or changes

in the prime policy rate (bank rate and repo rate). Thus, the variable PR captures the direct effect of changes in monetary policy on the growth rate of loan supply. The variable *PR*BS_Strength* captures the effect monetary policy has on the loan supply of a bank depending on the balance sheet strength of the bank. This variable interacts *PR* with a variable to account for the respective banks balance sheet strength. Here, the variables used to measure the balance sheet strength of the banks are liquidity and asset size. Liquidity is constructed as the ratio of bank liquid assets to total assets. Further, the variable is centered on its overall sample average after taking its logarithmic transformation. This makes the variable for balance sheet strength sum to zero across all banks. Asset size is constructed in a manner similar to liquidity by taking the total assets of the respective banks. Thus, the effect of *PR*BS_Strength* can be interpreted distinctly as an effect of policy change depending on the balance sheet strength of the bank. In most of our models, we have used liquidity, due to its statistical significance.

To account for movements in loan demand, most models are usually augmented with macroeconomic variables like GDP and other macro indices. However, because macroeconomic aggregates of this sort do not capture cross-sectional differences in lending opportunities, we instead include the growth of certificates of deposit (CD) and growth in securities (*SEC)*. *CD* is the first difference of the logarithm of certificates of deposit and hence represents a measure of growth. *SEC* has been constructed on similar lines. The variable *DUM* is included to account for the incorporation of certain dummy variables in sub-sample models to obtain segment specific effects.

To test for an operational BLC we require the following conditions to be satisfied: (i) the estimated coefficient of *PR* should be less than zero ($\beta < 0$). This would imply that shifting to a tighter monetary policy regime reduces the growth rate of loan supply in the economy; (ii) the estimated coefficient on the interaction variable PR*BS_Strength should be positive ($\delta > 0$) indicating that the effect of a policy change is more pronounced for the weaker banks (i.e. banks having liquidity or asset size lesser

than the mean sample liquidity or asset size), than on the stronger banks. Therefore, fulfillment of these two conditions is sufficient to prove the existence of BLC in India.

Most studies use a static model to study the dynamics of bank lending ignoring the pro-cyclic lending behavior. To this end Ln(-i) in equation 1 corrects the lag effect in the growth of loan supply.

Due to the presence of many panels and relatively few periods, we use the Arellano-Bover and Blundell-Bond system estimation for dynamic linear panel models. However, by construction, in this dynamic panel-data model in equation 1, the lagged dependent variables are correlated with the unobserved cross-sectional effects, making estimators inconsistent. Arellano-Bond (1991) developed a GMM method to estimate these models by using instruments to form the moment conditions. Moreover, Arellano-Bond estimators become weak if the AR process is too persistent or ratio of the variance of the idiosyncratic error becomes too large. Therefore given the nature of our panel, we use Blundell and Bond (1998) system estimation for dynamic linear panel models. Blundell and Bond (1998) developed on the work of Arellano and Bover (1995), and proposed a system estimator. Finally, the validity of the empirical model used in the paper is established using the Sargan test. Under the test, the rejection of the null hypothesis justifies the validity of the instruments and the strength of the model.

3. DATA ANALYSIS

The individual bank balance sheet data used in this paper has been obtained from the Reserve Bank of India's annual publication. Other macroeconomic data has been taken from the RBI's handbook of statistics on the Indian economy. We use yearly data covering the period 1996 to 2007. The modeling universe encompasses a total of 96 banks, 8 belonging to the State Bank of India and associates group, 19 nationalized banks, 35 other scheduled commercial banks, and 34 foreign banks. To account for the frenzied merger and acquisition activity witnessed by the banking sector after the initial reforms, we use an unbalanced panel data. Of the 96 banks, 57 enter the model in a balanced data framework, and the rest 37 are in an unbalanced form. The total number of observations used in the model is 999, which averages to just over 10 years of data for each bank. Rural and cooperative banks have been omitted from our analysis, owing to the fact that their lending responses aren't the same as other commercial banks and are legislatively crafted, rather than market determined.

Lending by banks initially captures all the loans disbursed by the respective banks in the particular financial year; however for further analysis we also distinguish priority sector lending from non-priority sector lending. Banks' liquid asset is defined as sum of cash in hand and balances with RBI and money at call and short notice. Asset size is the total assets as captured by the individual bank's balance sheet. Due to the policy regime shift adopted by the RBI in 2002, the Repo rate has been used as the effective policy rate for the period 2002-2007, while the bank rate has been used for the earlier period (1996-2002). Bank Rate can be defined as the interest rate charged by the RBI on loans to commercial banks. It is mainly used by the RBI to influence the rates that commercial banks offer on loans to businesses and consumers. In India, the Bank Rate had been used as the prime policy rate till 2002, and now the Repo Rate is used as the prime policy rate[3]. The Repo Rate refers to the rate at which the banks can borrow from the RBI against approved securities. Figure 3.2 gives a brief idea about the

[3] The bank rate has been fixed at 6%

relationship seen between prime policy rates and the total loan supply by the banks in the sample. Fig 3.2a demonstrates this for the bank rate regime, and Fig 3.2b does the same for the Repo Rate regime. We observe a very well pronounced inverse relation between the bank rate and loan supply. However, this inverse relation seems to have weakened after the adoption of the repo rate as the prime policy rate.

Figure 3.1 demonstrates the highly skewed nature of our data. Even though the banking sector has undergone comprehensive reforms, and seen a wave of deregulation, over 80% of the loan supply in the economy has been offered by big banks(Fig 3.1a), i.e., banks with an asset base greater than the sample average asset base in that particular year.

Figure 3.1a: **Percentage of total loans supplied by big banks**

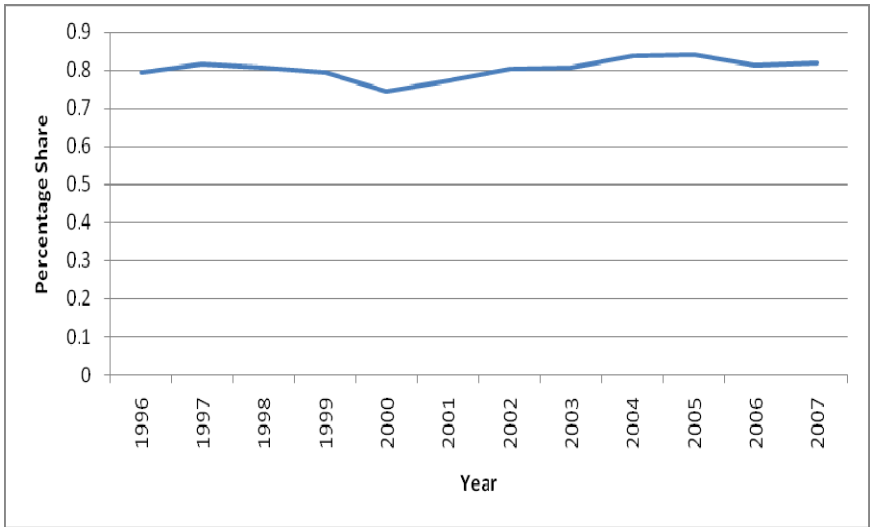
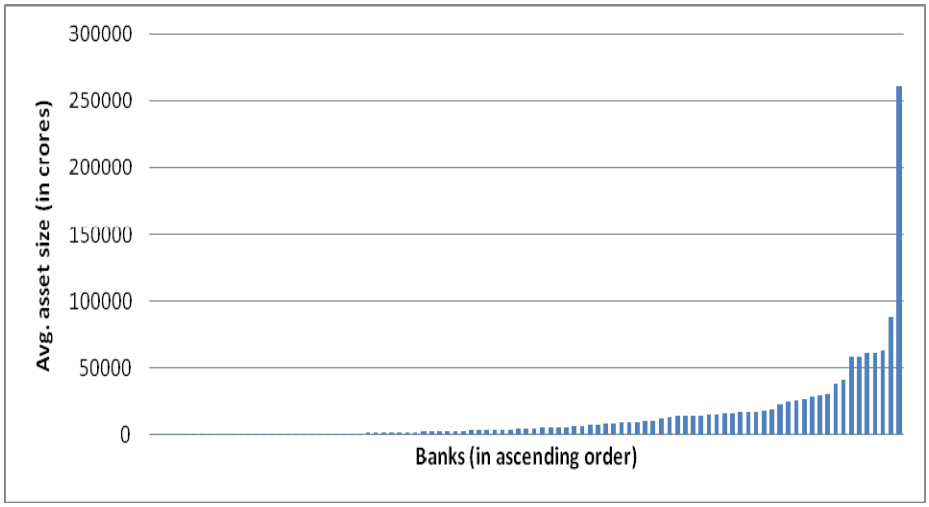


Figure 3.1b: Average asset size across banks (in Crores of rupees)



There is also a particularly large gap between the small and the big banks as seen through Fig 3.1b. The average asset size here is defined as the average of the asset base of the respective bank for its respective sample period. The average asset base could be seen as a proxy for the power that lies in the hands of the respective banks. Going by this notation, over 80% of the market power is controlled by the top quartile of the banks (by average asset size).

Figure 3.2a: Bank Rate Regime

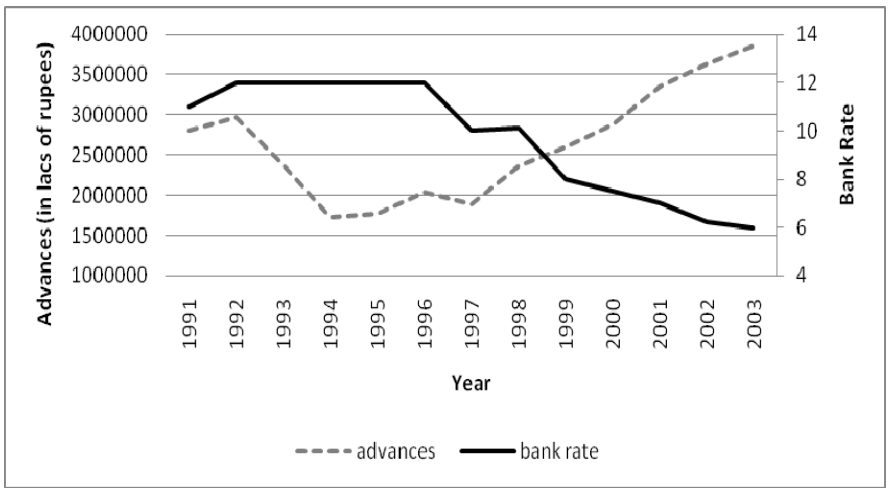


Figure 3.2b: Repo Rate Regime

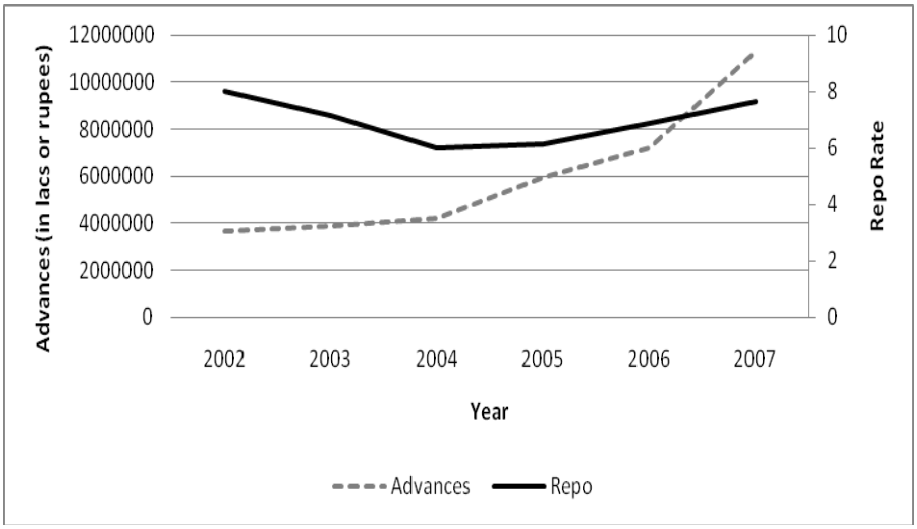


Table 3.1 presents a power profile of the top 10 banks in India, based on loan disbursements for the last two sample periods. The numbers in parenthesis reported in Table3.1 represent bank's market shares in that particular year. These 10 banks have consistently controlled over 55% of the industry's total loan disbursements as well as the asset base. Expectedly enough, only two private banks feature in this list, and these two happen to be the only ones recording an average yearly growth rate well above the industry growth rate for the period 1996 to 2007. It should be noted that these two banks began only in the year 1995-96, clearly indicating their edge over public-sector banks.

Table 3.1: Profile of top 10 banks in India

Bank Name	Average Asset Base	Total Advances			M & A	Avg. Annual Growth rate
	1996-2007	1996	2001	2007	1991-2007	1996-2007
SBI	26195905 **(0.1949)**	5982565 **(0.2394)**	11359027 **(0.2188)**	33733649 **(0.1776)**	NA	**17.32%**
ICICI BANK***	8810178 **(0.0655)**	65075 **(0.0026)**	703146 **(0.0135)**	19586560 **(0.1031)**	1	**96.04%**
CANARA BANK	6151319 **(0.0458)**	1309584 **(0.0524)**	2783177 **(0.0536)**	9850569 **(0.0519)**	NA	**20.26%**
PNB	6345776 **(0.0472)**	1267989 **(0.0507)**	2802905 **(0.054)**	9659652 **(0.0509)**	2	**20.40%**
BANK OF BARODA	5868217 **(0.0437)**	1601255 **(0.0641)**	2742068 **(0.0528)**	8362087 **(0.044)**	3	**16.87%**
BANK OF INDIA	5834680 **(0.0434)**	1559580 **(0.0624)**	3182314 **(0.0613)**	8493590 **(0.0447)**	1	**16.91%**
UNION BANK OF INDIA	3820563 **(0.0284)**	868108 **(0.0347)**	1750535 **(0.0337)**	6238643 **(0.0329)**	NA	**19.98%**
CENTRAL BANK OF INDIA	4103232 **(0.0305)**	890257 **(0.0356)**	1883338 **(0.0363)**	5179547 **(0.0273)**	NA	**18.02%**
HDFC BANK***	2718032 **(0.0202)**	36862 **(0.0015)**	463666 **(0.0089)**	4694478 **(0.0247)**	1	**57.48%**
SYNDICATE BANK	2935503 **(0.0218)**	539766 **(0.0216)**	1311616 **(0.0253)**	5167044 **(0.0272)**	NA	**23.36%**
Sample total	72783406	14121041	28981792	110965819	8	
Industry total	134428520.4	24987609	51925566	189904579	14	
Market Power	**54.143%**	**56.512%**	**55.814%**	**58.432%**		
Industry Growth Rate						**18%**

The banking sector has witnessed over 14 mergers/ amalgamations in the domestic scheduled commercial banks, involving some of India's largest private banks like HDFC, UTI (now Axis) and ICICI. It is noteworthy, that 8 out of the 14 mergers took place within these top10 banks and of the 8 only 2 were in the private sector. Sample statistics also point to the fact that the bottom half of the banking sector controlled just over 5% of the credit in India during 2007. Drawing from the profile of the top 10 banks, it is not likely that this 5% figure has changed much during our sample period.

The next section analyzes the BLC in detail. These preliminary observations provide further insight into the empirical analysis presented in the next section.

4. Empirical Results

In this section we present the empirical findings of our BLC hypothesis. We begin by examining the effect of monetary action on total loan disbursements by banks, followed by a close examination of the lending behvoiur for the priority versus non-priority sectors. We then explore the differential impact of the BLC on public and private sector banks, and also on small and large banks. Finally, we study the dynamics between domestic and foreign banks.

Ideally, when the central bank in any country adopts a contractionary policy stand, the economy experiences a fall in money balances primarily through fall in lending by the financial institutions or banks in the country. Expectedly enough, big banks due to their reserves of other assets/ securities and power to issue greater amounts of CD's are able to preempt this liquidity shock as compared to small banks.

TABLE 4.1: Loan Supply dynamics in event of Monetary Policy changes

An unbalanced panel of 92 banks in India from the RBI database has been used. The sample period is 1996-2007. The dependent variable in the model is current period growth in loan supply. A dynamic panel-data estimation technique has been used.

Ln	Coef.	Std. Err.	P>z	95% Conf.	Interval
Ln(-1)	0.0131***	0.00097	0.00000	0.01123	0.01504
PR	-0.0096***	0.00081	0.00000	-0.01123	-0.00807
PR(-1)	-0.0107***	0.00057	0.00000	-0.01186	-0.00962
PR*Liq	.0867***	0.00217	0.00000	0.08239	0.09091
CD	.1527***	0.00183	0.00000	0.14916	0.15632
_cons	.0339***	0.00075	0.00000	0.03237	0.03533
Sargan	chi2(63)	84.94911			
Test	Prob > chi2	0.0341			

***=significant as 1% level; **=significant at 3%; *=significant at 5%

$$\frac{\delta Ln}{\delta PR} = -0.0096 + 0.0867\,Liq \ldots\ldots (4.1)$$

Table 4.1 presents the estimates for the total loan supply. All the variables included in the model are significant. The one period lag of loan supply has a positive and significant impact on the current period loan supply, justifying our choice of a dynamic estimation framework. The estimates clearly demonstrate the effect monetary policy has on loan supply, and its differential impact based on balance sheet strength. As hypothesized, the coefficients of policy rate and the one period lag of policy rate are both negative, implying a contractionary monetary policy (increase in bank rate or repo rate) will reduce the supply of credit in the economy. The *'PR*Liq'* variable helps to understand the effect of monetary policy on individual banks loan supply depending on their balance sheet strength as shown through the respective banks liquidity. Importantly, the estimated coefficient on this variable is positive. It implies that banks with liquidity greater than the mean sample liquidity are less affected by monetary actions than other banks. From equation 4.1, we see that when a bank's liquidity is lower than the mean sample liquidity ($Liq<0$), the effect of a monetary action is amplified, on the other hand, stronger banks ($Liq>0$) are able to cushion the impact. Growth in CD has a positive and significant impact on growth of loan supply. Given the construction of the respective variables, it implies that a 1% growth in CDs results in a 0.15% growth in loan supply. CD enters the model to account for cross-sectional differences in funding opportunities that vary across individual banks, and provides for a good substitute for other macroeconomic variables that may be included to control for loan demand effects.

Therefore, table 4.1 evidently shows the existence of a BLC in the total loan supply behavior. Post estimation Sargan tests reveal that the model is correctly specified. Further, in India, the government and RBI have tried to use the banking sector to its advantage in terms of achieving equitable growth and serving credit to the under-privileged sections of the economy. All banks, domestic and foreign, are required to provide a fixed percentage of their total loan disbursements to the 'priority-sector' in India. Priority sector can thus be claimed to be legislatively governed, and banks have

little choice with respect to this. Therefore, we attempt to break-up bank lending into two parts, priority sector lending, and non-priority sector lending.

TABLE 4.2: Loan Supply dynamics in event of Monetary Policy changes: Priority Sector vs. Non-Priority Sector lending

An unbalanced panel of 92 banks in India from the RBI database has been used. The sample period is 1996-2007. A dynamic panel-data estimation technique has been used. The dependent variable in the model is current period growth in loan supply to priority sectors and non-priority sectors respectively, respectively.

	Priority Sector			Non-Priority Sector		
Ln	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Ln(-1)	-0.09742***	0.00059	0.00000	-0.21547***	0.00044	0.00000
PR	-0.00754***	0.00142	0.00000	-0.01507***	0.00095	0.00000
PR(-1)	-0.01574***	0.00123	0.00000	-0.03025***	0.00113	0.00000
PR * Liq	-0.15345***	0.00309	0.00000	0.16838***	0.00260	0.00000
CD	0.25480***	0.00208	0.00000	0.19011***	0.00302	0.00000
Const	0.04392***	0.00097	0.00000	0.02793***	0.00131	0.00000
Sargan	chi2(63)		79.9046	chi2(63)		82.6343
Test	Prob > chi2		0.0739	Prob > chi2		0.0492

***=significant as 1% level; **=significant at 3%; *=significant at 5%

$$\frac{\delta Ln}{\delta PR}_{\Pr\_ Sector} = -0.00754 - 0.15345\ Liq \ldots\ldots\ldots (4.2)$$

$$\frac{\delta Ln}{\delta PR}_{Non\_\Pr\_ Sector} = -0.01507 + 0.1684\ Liq \ldots\ldots (4.3)$$

Further, given the nature in which the priority sector lending is governed in India, we expect a weak BLC for priority sector lending. Table 4.2 and equations 4.2 (priority sector) and 4.3 (non-priority sector) show the estimates obtained for disaggregated (priority and non priority) lending. We see a stronger BLC operating in non-priority sector lending. Both, the direct effect of change in monetary policy on the loan supply, as well as the effect of monetary policy depending on the balance sheet

strength of the banks is greater in non-priority sector lending. Weak banks tend to decrease lending to non-priority sectors at a faster rate than to priority sectors in a policy tightening regime. On the other hand, strong banks increase lending to non-priority sectors at a faster rate than to priority sectors in a less stringent policy regime. It is important to note the difference between equation 4.1 and 4.3. In comparison to equation 4.1 we see that there is a stronger BLC in operation when we consider only non-priority sector lending than when we consider total lending. This happens particularly in the Indian case since priority sector lending tends to dilute the BLC. Given our findings in the above case, we consider only the non-priority sector lending for all our further analysis.

TABLE 4.3: Loan Supply dynamics in event of Monetary Policy changes: Public vs. Private Sector Banks

An unbalanced panel of 92 banks in India from the RBI database has been used. The sample period is 1996-2007. A dynamic panel-data estimation technique has been used. The dependent variable in the model is current period growth in loan supply. To view the differential impact of policy on public and privates sector banks, appropriate binary variables have been used. The binary variable *Private* takes the value 1 for observations that belong to private banks and 0 otherwise.

Ln	Coef.	Std. Err.	P>z	[95% Conf.	Interval]
Ln (-1)	-0.20939***	0.00080	0.00000	-0.21095	-0.20783
PR	-0.01720***	0.00313	0.00000	-0.02334	-0.01107
PR (-1)	-0.02782***	0.00171	0.00000	-0.03118	-0.02447
PR * Liq	-0.00818	0.01717	0.63400	-0.04184	0.02548
Private	0.11888***	0.01951	0.00000	0.08064	0.15712
Private* PR	0.00466	0.00361	0.19600	-0.00241	0.01174
Private*PR*Liq	0.24749***	0.01695	0.00000	0.21427	0.28071
CD	0.17193***	0.00432	0.00000	0.16347	0.18039
Const	-0.03561*	0.01820	0.05000	-0.07128	0.00006
Sargan Test	chi2(57)	=	68.18062		
	Prob > chi2	=	0.1475		

***=significant as 1% level; **=significant at 3%; *=significant at 5%

$$\frac{\delta Ln}{\delta PR}_{Public\_Sector} = -0.01720 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.4)$$

$$\frac{\delta Ln}{\delta PR}_{\text{Pr}\,ivate\_Sector} = -0.01720 + 0.24749 \; Liq \quad \ldots\ldots (4.5)$$

Table 4.3 analyzes the differential impact of policy actions on public sector banks vis-à-vis private sector banks. The binary variable *Private* takes the value one for observations that belong to private banks and zero otherwise. Interaction terms have been created to account for the differential impact of policy on public and private banks. Equation 4.4 (public sector) and 4.5 (private sector) summarize the results presented in table 4.3. The impact of policy on lending by public and private sectors banks is similar. This is seen through the insignificant coefficient of *Private*PR*. However, in the case of private sector banks, policy actions tend to affect weaker banks more than the stronger ones. This can be explained by the fact that most public sector banks are large banks and hence we do not see a differential impact of policy actions. We therefore try to study the differential impact of policy on small versus large banks in our next analysis.

TABLE 4.4: Loan Supply dynamics in event of Monetary Policy changes: Small Banks vs. Large Banks

An unbalanced panel of 92 banks in India from the RBI database has been used. The sample period is 1996-2007. A dynamic panel-data estimation technique has been used. The dependent variable in the model is current period growth in loan supply. To view the differential impact of policy on small and large banks, appropriate binary variables have been used. The binary variable *Size_Dummy* takes the value 1 for observations that belong to small banks and 0 otherwise.

Ln	Coef.	Std. Err.	P>z	[95% Conf. Interval]	
Ln(-1)	-0.20986***	0.00090	0.00000	-0.21162	-0.20810
PR	-0.02674***	0.00557	0.00000	-0.03767	-0.01582
PR(-1)	-0.02806***	0.00209	0.00000	-0.03216	-0.02396
PR*Liq	-0.03975	0.02148	0.06400	-0.08185	0.00235
Size_Dummy	0.04499***	0.01156	0.00000	0.02233	0.06765
PR*Size_Dummy	0.01881***	0.00600	0.00200	0.00705	0.03058
PR*Liq*Size_Dummy	0.24790***	0.02328	0.00000	0.20227	0.29354
CD	0.16700***	0.00357	0.00000	0.16001	0.17399
Const	0.00339	0.01104	0.75900	-0.01824	0.02502
Sargan Test	chi2(54) =	69.99043			
	Prob > chi2 =	0.0706			

***=significant as 1% level; **=significant at 3%; *=significant at 5%

$$\frac{\delta Ln}{\delta PR}_{L\arg e} = -0.02674 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.6)$$

$$\frac{\delta Ln}{\delta PR}_{Small} = -0.00793 + 0.20815 \; Liq \quad \ldots\ldots (4.7)$$

To account for the size we have constructed a new binary variable *Size Dummy*, which takes the value 1 if the bank is a small bank, i.e., does not fall into the top quartile of the asset distribution of the firms in that particular year, and zero otherwise. A negative and significant co-efficient on PR*Liq indicate that the large banks do not get affected differently by monetary action depending on their balance

sheet strength, though tight monetary policy tend to reduce their loan portfolio (equation 4.6). On the other hand, an effective BLC is witnessed within the small banks as seen through equation 4.7. Interestingly, the estimates from the public vs. private sector banks, and the estimates from the small vs. large banks follow similar trends. This can be attributed to the fact that most large banks are public sector banks.

TABLE 4.5: Loan Supply dynamics in event of Monetary Policy changes: Domestic vs. Foreign Banks

An unbalanced panel of 92 banks in India from the RBI database has been used. The sample period is 1996-2007. A dynamic panel-data estimation technique has been used. The dependent variable in the model is current period growth in loan supply. The binary variable *Foreign* takes the value 1 for observations that belong to foreign banks and 0 otherwise.

Ln	Coef.	Std. Err.	P>z	[95% Conf. Interval]	
Ln(-1)	-0.2236***	0.0006	0.0000	-0.2249	-0.2224
PR	-0.0297***	0.0020	0.0000	-0.0336	-0.0258
PR (-1)	-0.0270***	0.0014	0.0000	-0.0298	-0.0241
PR*Liq	0.0733***	0.0111	0.0000	0.0515	0.0951
CD	0.1690***	0.0040	0.0000	0.1612	0.1769
Foreign	0.3901***	0.0117	0.0000	0.3672	0.4130
PR*Foreign	0.0520***	0.0021	0.0000	0.0479	0.0561
PR*Liq*Foreign	0.1313***	0.0111	0.0000	0.1094	0.1531
Const	-0.0842***	0.0089	0.0000	-0.1017	-0.0667

***=significant as 1% level; **=significant at 3%; *=significant at 5%

$$\frac{\delta Ln}{\delta PR}_{Domestic} = -0.0297 + 0.0733\ Liq \quad \ldots\ldots (4.8)$$

$$\frac{\delta Ln}{\delta PR}_{Foreign} = -0.0223 + 0.2046\ Liq \quad \ldots\ldots (4.9)$$

Given that India's banking sector has undergone a structural change and there is an increasing presence of foreign banks in the country, it is imperative to study the behavior of foreign banks within the economy. In order to analyze the behavior of the foreign banks we have created a binary variable *'Foreign'* which takes the value 1 if the observation belongs to a foreign bank and zero otherwise. Further, *PR*Foreign* represents the interaction variable between the *change in policy rate* and the binary variable *Foreign*. This variable shows the differential impact policy rate has on foreign banks vis-à-vis domestic banks.

Equation 4.8 (domestic banks) and equation 4.9 (foreign banks) summarize the effects of policy changes on loan supply. Firstly the direct impact of changes in policy is more pronounced in case of domestic banks as opposed to the impact on foreign banks. Owing to the presence of well-built internal capital markets, and the vast economies of scale they enjoy, foreign banks are able to shift resources from one country to another, allowing them to deftly dampen the effects of domestic liquidity shocks. Secondly, stronger foreign banks are less sensitive to policy actions as compared to stronger domestic banks, while weak foreign banks are more sensitive to policy changes than weak domestic banks. This clearly points to the fact that a stronger BLC operates within the domestic banking sector.

Finally to avoid the arbitrariness involved in our sub sample analysis, an endogenous liquidity threshold analysis is carried out on an extended sample. In the threshold model, as developed by Hansen (2000), we specify a regression equation and a threshold variable. Depending upon the regression, the program finds a threshold value for the specified threshold variable. This value attempts to optimally divide the sample into two distinct groups experiencing markedly different impacts on the dependent variable in the specified model as well as a point where there is a break in the threshold variable. Here, we attempt to divide the sample into two multiple groups based on the liquidity of the banks. In this model, the panels are pooled into one cross-sectional analysis augmented with additional observations, by extending the sample to 1991.

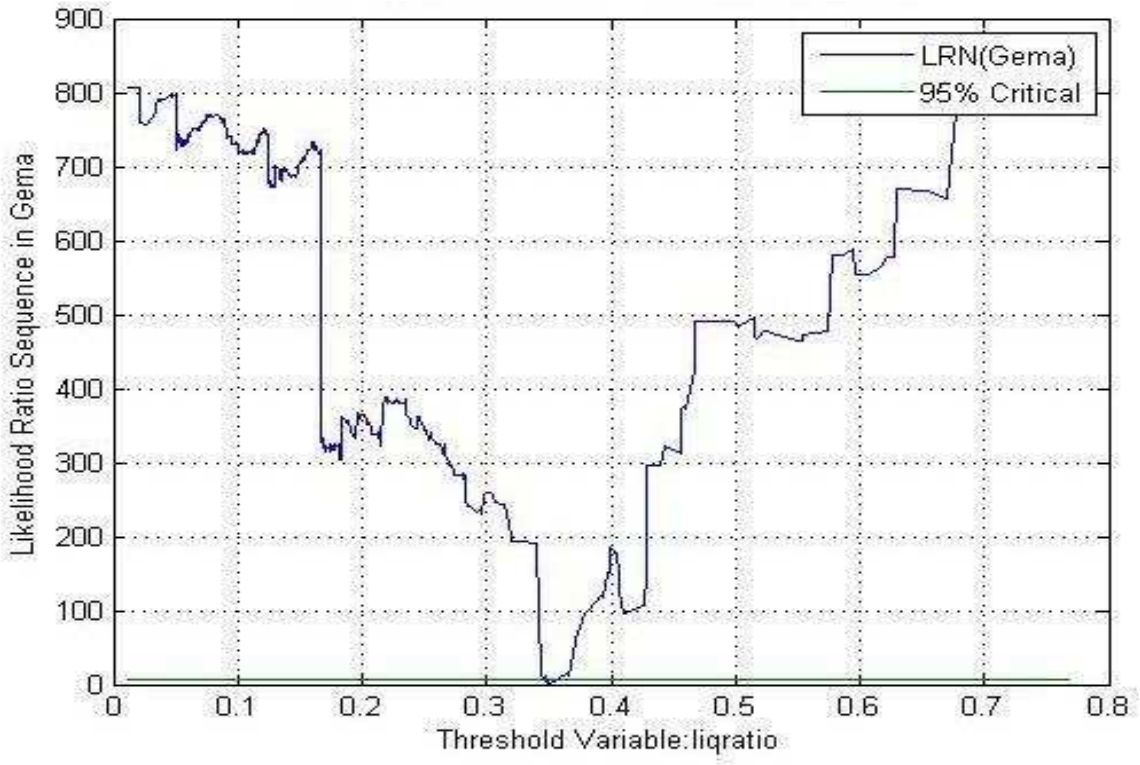
TABLE 4.6: Loan Supply dynamics in event of Monetary Policy changes: Threshold Regression Estimates

Threshold Variable	log (liquid assets/ total assets)
Threshold Estimate	0.349092
.95 Confidence Interval	[0.346649,0.349092]
Sum of Squared Errors	37.324755
Residual Variance	0.031956
Joint R-squared	0.187470
Heteroscedasticity test (p-value)	0.000000

	Global OLS	**Regime 1**	**Regime 2**
Ln	Without Threshold	liquidity<=0.349092	Liquidity>.349092
PR	-0.020043***	-0.009172***	0.22383***
PR (-1)	-0.002629	-0.011264***	-0.014458***
Liquidity*PR	0.217428***	0.196234***	-0.39012***
CD	0.362298***	0.507864	0.039612***
Const	0.048623***	0.044044	-0.072811***
Observations	1178	1111	67
Sum of Squared Errors	40.29410	26.00795	11.31681
Residual Variance	0.03435	0.02352	0.18253
R-squared	0.12283	0.21416	0.01334

***=significant as 1% level; **=significant at 3%; *=significant at 5%

Figure 4.1: Confidence Interval Construction for Threshold



The estimates from a threshold model are presented in table 4.6. The threshold variable used is the natural logarithm of the ratio of the banks liquid assets to total assets. The threshold value obtained is 0.349092 which divides the sample into two groups with 6% of the observations falling into the higher liquidity category. Thus, table4.6 establishes that banks within the lesser liquidity group are more affected by policy rate changes, although the lagged effect of policy on both the groups is similar. Further, within the group comprising of less liquid banks, the relatively stronger banks are less prone to the BLC effect as indicated by the positive and significant co-efficient on the interaction variable (PR*Liq) in table 4.6.

5. Conclusions

The study establishes the existence of an operational Bank Lending Channel for monetary transmission in India. Specifically, the result shows that monetary policy

changes have a direct impact on bank lending and these responses are more pronounced in case of small banks. The paper also reveals that the non-priority sector better supports the existence of a BLC, and that domestically owned banks are more responsive to monetary policy changes. Our results have certain important implications for the conduct and effectiveness of monetary policy: First, the results clearly point to the fact that monetary actions have little effect on large banks, and since these large banks control a major portion of the lending in India, policy effectiveness and transmission could be moderate[4]. Measures to check inflation and the supply of output through police rates changes may not be highly effective.

Second, since large banks are able to insulate themselves from monetary and liquidity shocks, formation of even larger banks through M&A activity should be advocated with cautions. As banks grow bigger, the autonomy they enjoy is huge, and the control of the Central Bank over their lending policy weans. Of the 14 mergers in our sample, 8 took place within the top 10 banks. Formation of overtly larger banks, through the merger of large banks, will only hinder effective policy action.

[4] This is little contradictory, due to the fact that , since most large banks in India are state-owned, some kind of ideological evenness between them can be expected. Despite this, we see a very weak lending channel in large banks.

REFERENCES

1. Arellano, Manuel and Bond, 1991 Stephen, Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations, The Review of Economic Studies, 1991, 58, pp. 277-297.
2. Arellano, Manuel and Bover, 1995, Olympia, Another look at the instrumental variable estimation of error-component models, Journal of Econometrics, vol. 68, issue 1, pp. 29-51.
3. Bernanke, B.S. and A. S. Blinder, 1992, The Federal Funds Rate and the Channels of Monetary Transmission, The American Economic Review, Vol.82, No.4, pp. 901-921.
4. Bernanke, B.S. and A. S. Blinder, 1988, Credit, Money and Aggregate Demand, The American Economic Review, Vol. 78, No. 2, pp. 435-439.
5. Bernanke, B. and M. Gertler, 1995, Inside the black box: the credit channel of monetary policy transmission, The Journal of Economic Perspectives, Vol.9, No.4, pp. 27-48.
6. Blundell, R and S, Bond, 1998, Initial conditions and moment restrictions in dynamic panel data models, Journal of Econometrics, 1998, 87: 115-143.
7. Cetorelli, N. and Linda S. Goldberg, 2008, Banking Globalization, Monetary Transmission, and the Lending Channel, NBER working paper, No. 14101.
8. Ehrmann M., L. Gambacorta, J. Martinez-Pagés, P. Sevestre and A. Worms, 2001, Financial Systems and the Role of Banks in Monetary Policy Transmission in the Euro Area, ECB Working Paper, No. 105.
9. Hansen, B. E., 2000, Sample Splitting and Threshold Estimation, Econometrica, Vol. 68, No. 3, pp. 575-603.

10. Kashyap, A.K., J.C. Stein and D.W. Wilcox, 1993, 'Monetary policy and credit conditions: Evidence from the composition of external finance,' American Economic Review, vol.83 1: 78-98.
11. Kashyap, A. K. and J. C. Stein 1995, "The Impact of Monetary Policy on Bank Balance Sheets," *Carnegie-Rochester Conference Series on Public Policy*, 42,151-195.
12. Kashyap, A.K. and J.C. Stein, 2000, 'What do a million observations on banks say about the transmission of monetary policy?' American Economic Review, vol.90 (3): 407-28.
13. Kishan, R.P. and T.P. Opiela, 2000, Bank Size, Bank Capital, and the Bank Lending Channel, Journal of Money, Credit, and Banking, Vol. 32, No.1, pp. 121-141.
14. Pandit, B. L., A. Mittal, M. Roy, and S. Ghosh, 2006, Transmission of Monetary Policy and the Bank Lending Channel: Analysis and Evidence for India, Development Research Group Study, No. 25.
15. Westerlund, J., 2003, A Panel Data Test of the Bank Lending Channel in Sweden. Department of Economics, Lund University.