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The Bank Lending Channel of Monetary Policy in Nepal: Evidence from Bank Level Data

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Abstract

This paper examines the bank lending channel of monetary policy transmission in Nepal using data during 2003-2012. Using the dynamic Arellano-Bond GMM estimation with annual data of 25 Nepalese commercial banks, this study tries to estimate the loan supply responses of the Nepalese Commercial banks, depending on their balance sheet characteristics. The main results suggest that banks play a role in Nepal's monetary transmission mechanism. The empirical result shows that the bank lending decreases after a monetary tightening. Bank size is found to have significant impact on loan supply in Nepal. Similarly, liquidity in the case of private sector banks is also playing significant role in the bank lending in response to the monetary policy changes. But, the capitalization is found to have no significant impact on the bank lending. The bank loan supply is also found to be significantly affected by the gross domestic product.

Jel Classification: E 52

Key Words: Bank lending channel, bank loans, monetary policy, Nepal.

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Contents

I. Introduction

Monetary policy operates through the various transmission channels and, thus, affects the economic activities.[1] The bank credit plays an important role in monetary policy transmission mechanism, which is described under the credit channel. Bernanke and Gertler (1995) explain two mechanisms of the credit channel: the balance-sheet channel and the bank lending channel. The latter one explains how the monetary policy actions directly affect the banks' balance sheet with the changes in supply of loans and, thus, the output. This channel amplifies and propagates the effects of changes in policy instruments referred to in the (direct) interest rate channel (Al-Mashat and Billmeier, 2007).

Theoretically, it is expected that, due to the imperfections in the credit markets, the loan supply responses to the monetary shocks are different for the banks with different characteristics: size, liquidity and capitalization. In other words, banks have cross sectional differences that introduce heterogeneity in their loan supply sensitivity to monetary shocks (Ozsuca and Aakbostanci, 2012). Kashyap and Stein (1995) state that the lending channel should be more important for small banks, which have a very simple capital structure and are financed almost exclusively with deposits and common equity. The impact of bank lending channel should also be greater for banks with less liquid assets and less capital. Less liquid banks cannot protect their loan portfolio against monetary tightening simply be drawing down cash and securities (Kashyap and Stein, 2000). In addition, poorly capitalized banks have less access to markets for uninsured funding, so their lending is more dependent on monetary policy shocks (Peek and Rosengren, 1995; Stein, 1998).

The importance of the different monetary policy transmission channels differs across economies. In the developing economies like Nepal, the financial markets are underdeveloped characterized by the dominance of informal sector, the very poor integration with the international financial markets and the absence of well-functioning markets for securities, equities and assets. In such situations, there is little scope for the functioning of the conventional interest rate channel, the asset price channel and the exchange rate channel. Because these other channels are likely to be weak, and banks are by far the dominant formal financial intermediaries in such economies, the bank lending channel is likely to be dominant in developing countries, with the balance sheet channel operating as a financial accelerator- i.e. as a factor that magnifies the effect of the bank lending channel by increasing the external finance premium when bank credit is plentiful and reducing it when such credit is scarce (Mishra et al., 2012). In addition, the exchange rate peg with Indian Rupee may also make the exchange rate channel of Nepalese monetary policy weak in operation.

Nepalese economy is under the crucial transformation through changes in both intersectoral importance and linkages. The composition of GDP has changed with service sector emerging as nearly the largest sector, trade-GDP ratio has increased, foreign exchange regime has been liberalized (Khatiwada, 2005). With the on-going reforms, the Nepalese financial sector has

[1] The channels of monetary policy may be the interest rate channel, exchange rate channel, asset price channel and credit channel.

been changing in terms of its depth, spread and competitiveness. The rapid financial innovation and globalization are also influencing the Nepalese macroeconomic environment and financial structure. With the resulting change in the monetary policy environment, it is crucial to understand the working of and the importance of the monetary policy transmission channels, particularly the bank lending channel, given the exchange rate peg and weaknesses in the stock market constraining the operation of the other transmission channels. But, to our knowledge, the importance of banks in transmitting the monetary policy in Nepal has not yet been studied in detail and the idea of the monetary transmission to the real economy is still unclear.

This study aims to explore the role of bank lending channel in the monetary policy transmission in Nepal by using the disaggregated bank level data. More specifically, it tries to analyze : i) the effect of monetary policy variable, that is, inter-bank rate on bank lending, and ii) the distributional effects of the monetary policy in different types of Nepalese commercial bank, mainly in terms of size, liquidity and capitalization. In order to meet the objectives, this study has estimated the loan supply equation following the Kashyap and Stein (1995) and Ehrmann et al. (2001) based on the GMM technique proposed by Arellano and Bond. In addition, this paper has employed the bank-level microeconomic data in estimating loan supply equation, which is assumed to be better to disentangle the loan supply effects from loan demand effects, allowing precise estimation of the bank lending channel.[2]

The rest of the paper is divided as follows in the different sections. Section II discusses about the bank lending channel and brief survey of studies on this channel using disaggregated bank-level data. Section III provides the discussion on the potential of the bank lending channel in Nepal by making descriptive analysis of the Nepalese monetary policy, the structure of banking system and the bank lending. Section IV presents the methodology employed in the study to analyze the bank lending channel. Section V presents the empirical results of the estimated loan supply equation taking the different characteristics and also the sub-sample of only private banks. Finally, the conclusions of this paper are presented in section VI.

II. **Literature Review**

The bank lending channel, which highlights the important role of the banks in the financial system and in transmitting the monetary policy impulses, has both the theoretical underpinnings as well as many of the empirical researches. With the operation of this channel, monetary policy may influence the aggregate demand by affecting the supply of bank loans and reinforcing the interest rate channel. The traditional bank lending channel focuses on the financial frictions deriving from the balance-sheet situation of banks. It assumes that a monetary policy tightening raises the opportunity cost of holding deposits,

[2] Many studies have applied the VAR methodology to explore the bank lending channel in developing countries. This methodology is based on a set of macroeconomic variables that includes an indicator of aggregate demand and the assumed intermediate target of monetary policy (Mishra et al., 2010). However, the use of macroeconomic time series data in studying bank lending channel may cause the difficulty of disentangling loan supply effects from loan demand effects.

which in turn leads banks to reduce lending on account of the relative fall in funding sources. In other words, it contends that after a monetary policy tightening, banks are forced to reduce their loan portfolio due to a decline in total reservable bank deposits (Gambacorta and Marque-lbanez, 2011). Key assumptions for the operation of the bank lending channel are: (i) banks cannot fully shield their loan portfolios from the changes in monetary policy, and (ii) there is a substantial group of borrowers, firms or consumers, that cannot insulate their spending from the reduction in bank credit (Bernakke and Gertler, 1995; Farinha and Marques, 2001; Brooks, 2007).

Many empirical researches on the bank lending channel can be found for the developed as well as for the emerging economies. Based on the quarterly data of US commercial banks from 1976 to 1993, Kashyap and Stein (2000) found that the impact of monetary policy on lending is stronger for banks with less liquid balance sheets. Favero et al. (1999) explored the existence of the bank lending channel for four European countries (France, Germany, Italy and Spain) using the disaggregated bank data and found no evidence of the bank lending channel in these countries. Many other studies on the Euro area revealed the important facts about the bank lending channel. For Euro area countries, Ehrmann et al. (2001) found the existence of the bank lending channel, with the effects most dependent on the liquidity of the individual banks. Similarly, the liquidity of the bank is found to have significant impact on the lending behavior of the banks in France (Loupias et al., 2001). In the case of Netherlands, Haan (2001) found that the lending channel is operative for unsecured lending, but not for secured lending. In addition, the effects of the monetary tightening are more negative for smaller, less liquid and less capitalized banks.

Ozsuca and Akbostanci (2012) found the existence of the bank lending channel in the case of Turkey with the significant distributional effects due to the bank specific characteristics in the impact of monetary policy on the supply of bank loans. Size and capitalization of the banks are found to be important determinant of the loan supply in Estonia (Juks, 2004), Jamica (Urquhart, 2006) and Jordan (Boughrara and Ghazouni, 2010). Likewise, the liquidity of banks found to be significant impact on loan supply for Estonia (Juks, 2004), Turkey (Alper et al., 2012), Jamica (Urquhart, 2006) and Morocco (Boughrara and Ghazouni, 2010). Similar results for the bank lending channel with different bank characteristics also exists for Italy (Gambacorta, 2001), Malaysia (Karim et al., 2011) and Sweden (Westerlund, 2003).

Several descriptive studies provide the background of Nepalese monetary policy. Sigdel (2006) reviewed the historical development of the Nepalese monetary policy focusing on their features, goals and instruments, and concluded that the monetary policy is effective in Nepal to some extent. Thapa (2004, 2007 & 2011) shed light in detail on the Nepalese monetary policy mainly focusing on the framework, conduct and environment of the Nepalese monetary policy. While providing the insightful discussion on the various aspects of Nepalese monetary policy, Khatiwada (2005) made a descriptive analysis of the effectiveness of monetary policy transmission mechanism. This study has argued that the credit availability channel is likely to be the most direct and powerful channel of transmission of monetary impulses in Nepal because of the existence of the insatiable demand for credit at the prevailing interest rates in the formal financial sector. It also argues that the interest rate

channel and wealth effect channel are weak in Nepal because of no proper term structure of interest rates consistent with liquidity and maturity of financial instruments, weak or lag in linkages between the short term and long-term interest rates and bonds markets at primitive stage of development, among others. Despite the focus on the Nepalese monetary policy and financial sector development, these studies did not test the existence of the transmission mechanism of Nepalese monetary policy based on either aggregate time-series data or microeconomic data.

III. Overview of Nepalese Monetary policy and Bank Lending

Overview of Nepalese Monetary Policy

Nepal Rastra Bank[3] has been exercising the monetary policy since mid-1960s. In the early period, the monetary policy primarily hinged upon the direct tools such as credit ceilings, directed credit programs, interest rate administration and credit control regulations. Before 1980s, NRB had adopted the direct monetary policy stance (Sigdel, 2006). With the inception of the economic reforms in the mid-1990s, there was shift in NRB's monetary policy stance from direct to indirect. In 1989, the interest rate was fully deregulated; the credit ceilings were eliminated and the open market operation (OMO) was introduced as an indirect monetary policy instrument. As a result of on-going reform measures[4] in the Nepalese financial system, the monetary policy environment, framework and operating procedures have also changed since the 1990s. Accordingly, the monetary policy was announced and made public by the Nepal Rastra Bank for the first time in 2002. Prior to this, there was no monetary policy as such in the documented form and, thus, frequent NRB announcements regarding the changes in the policy instruments were the basis of the policy.[5]

After the new NRB act in 2002, NRB has been trying to achieve the multiple objectives simultaneously. Thus, the Nepalese monetary policy has adopted the objectives of maintaining price stability, financial stability, external sector stability and achieving higher economic growth.[6] The monetary policy strategy in Nepal since 2003 can be defined as an exchange rate targeting. The (adjustable) exchange rate peg is the nominal anchor of monetary policy of Nepal. The peg is used to achieve price stability. To support the peg,

[3] Nepal Rastra Bank was established in April 1956 under the Nepal Rastra Bank Act, 1955. However, this initial act did not explicitly spell about who formulates the monetary policy.

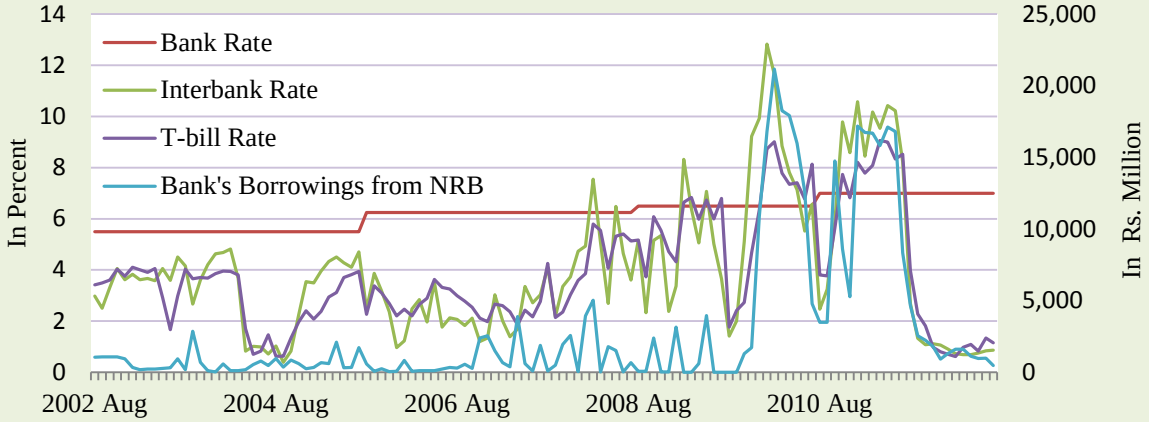
[4] Though financial sector liberalization in Nepal began in mid-1990s, the comprehensive reform programme was launched only in 2000s. Nepalese government issued the Financial Sector Strategy Statement (FSSS) in 2000 which outlines the financial sector reform programme (FSRP). The goal of the FSRP was to create a well-regulated, sound, market oriented and stable financial system. One of the objectives of the FSRP was also to increase the autonomy and capability of central bank for making its monetary policy, supervisory and regulatory functions effective and enhance the regulatory regime for the financial sector (Adhikary et al., 2007).The basic component of the reform program were the re-engineering of NRB, restructuring of two state owned commercial banks (Rastriya Banijya Bank and Nepal Bank Limited) and capacity building in the financial sector including legal and institutional reforms.

[5] Nepal Rastra Bank Act, 2002 has explicitly incorporated the provision for annual monetary policy announcement and implementation.

[6] The financial stability has been taken as one of the objective of monetary policy only since 2011.

monetary cum credit aggregate-based sub intermediate targets are set (Thapa, 2004). Thus, the annual growth rate of broad monetary aggregate (M2) has been used as an intermediate target of monetary policy.[7] The operating targets for the policy are the excess liquidity estimated by the NRB based on the Liquidity Monitoring and Forecasting Framework (LMFF) and private sector credit from the banks and financial institutions.[8]

Figure 1: Monetary Policy Indiactors (2003-2012)



Source: Nepal Rastra Bank.

In recent years, the open market operation has been an important instrument of monetary policy even though NRB also relies on standing liquidity facility, bank rate and reserve requirements. In recent years, the bank rate is playing no significant role in determining banks' funding costs. This is because the monthly stock of outstanding central bank credit to the banking sector was very low except the period between 2010 and 2011 during which Nepalese economy faced the liquidity crunch (figure 1). The T-bill rate mostly varies according to the domestic financing needs of the government. The interbank rate closely follows the T-bill rate as liquidity in the money market also depends on the government's treasury position. Since the bank rate or cash reserve ratio has less to no relevance to banks and T-bill rate also depends on the fiscal policy to some extent, the interbank rate is an important monetary policy variable in Nepal.

Overview of the Banking Structure and Bank Lending

The process of financial liberalization in Nepal was initiated in the mid-1980s, allowing entry of commercial banks in joint venture with foreign banks. Prior to this, there were only 3 state owned banks in existence. With the speed up in liberalization, the Nepalese financial sector has witnessed the growth of the financial institutions with the significant increase in outreach, breadth and depth. Thus, there were 32 commercial banks ('A' class financial institutions), 88

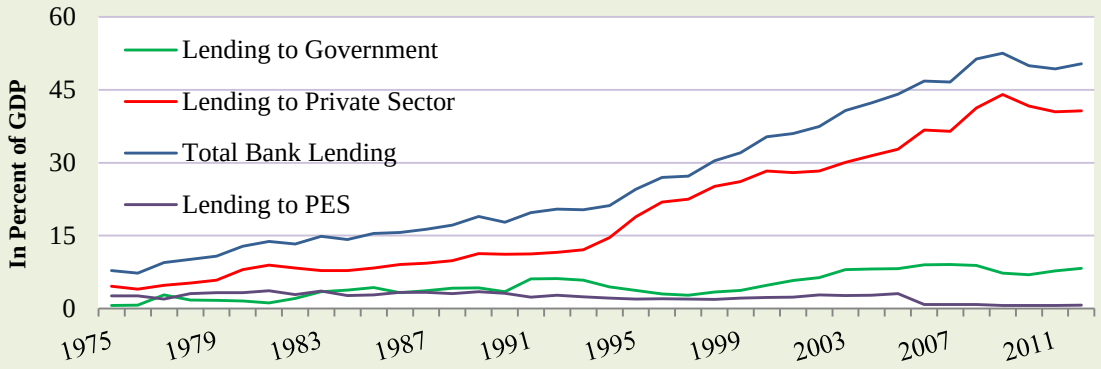
[7] The effectiveness of the anchor chosen will rely, among other things, on renouncing all other anchors. For example, policymakers cannot credibly adopt one price anchor, such as exchange rate and commit to maintaining another price or quantity anchor such as monetary aggregate (Khan, 2003). Despite such fact, Nepalese monetary policy has taken monetary aggregate as intermediate target under the exchange rate peg. The underlying reason behind this may be the partially convertible capital account with strict control of capital flows and, thus, the resulting autonomy of monetary policy to some extent.

[8] Between 2003 and 2005, the operating target of the monetary policy was the net domestic assets of the NRB.

development banks ('B' class financial institutions) and 69 finance companies ('C' class financial institutions) as of mid-July 2012, among others. Even with the change in the structure of the Nepalese banking sector after liberalization, the share of three state-owned banks in the financial system is still large and playing the dominant role in the system.[9]

The lending by the Nepalese commercial banks is in increasing trend. The bank lending in Nepal is divided into private sector, government sector (investment in government securities by commercial banks), and state-owned enterprises.

Figure 2: Lending of Commericail Banks by Recipient (1975-2012)



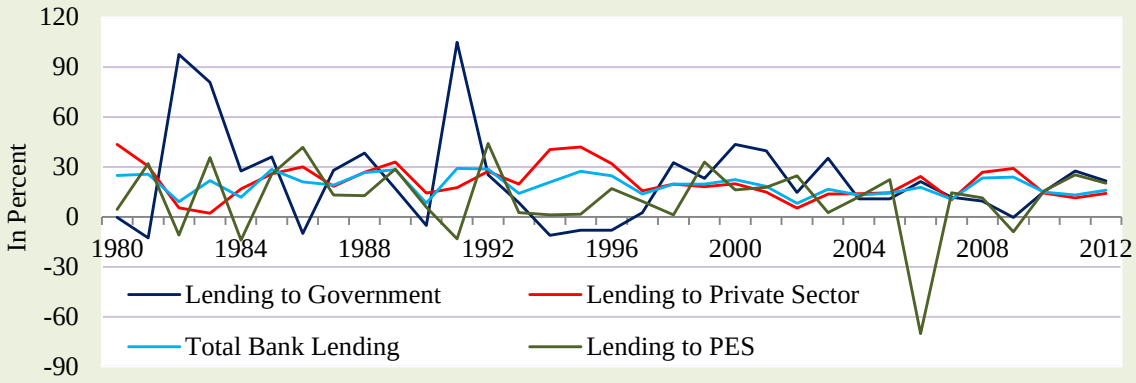
Source: Nepal Rastra Bank and author's calculation.

As a percent of GDP, the bank credit shows the increasing trend in an overall, but taking the composition, it has the mix trend (figure 2). Total commercial bank credit to the government sector as percent of GDP was relatively low and below 5 percent before the democratic system (until 1990), higher in the early years of democracy (from 1991 to 1993) and again lower thereafter (until 2000). Then, it has increased and, on an average, reached about 8 percent a year since 2001, which may be due to the NRB policy of reducing its stock of government securities by selling to the commercial banks.[10] Total commercial bank lending to the private sector as a percent of GDP has increased from 4.6 percent of 1975 to 40.7 percent in 2012. The substantial rise in private sector credit took place only after the implementation of the economic liberalization in early 2000s. On the contrary, the credit to state-owned enterprises as a percent of GDP has shown the declining tendency with the liberalization process.

[9] The share of the state-owned banks has been declining in the financial system. For instance, the share of these banks in total assets and deposits was 51.7 percent and 47 percent respectively in mid-July 2001, which were declined respectively to18 percent and 17 percent as of mid-July 2012. Likewise, the share in total loans and advances of the banking system declined from 44.5 percent of mid-July 2001 to 14.3 percent in mid-July 2012. In terms of branch network, these banks have the largest network, covering 38 percent of total bank branches in the system as of mid-July 2011.

[10] Nepal Rastra Bank act, 2002 states that the total amount of debt bond purchased by the NRB from government of Nepal and taken into its ownership shall not be more than ten percent of the revenue income of the preceding year. After such provision in the act, NRB followed the policy of selling the government securities from its stock so as to keep the government securities under the statutory limit and to facilitate the task of mopping up of the excess liquidity of the commercial banks.

Figure 3: Growth of the Bank Lending (1980-2012)



Source: Nepal Rastra Bank and author's calculation.

The growth of bank lending is volatile though the volatility has been declining in recent years as shown in figure 3. Regarding the composition, the credit to the non-bank private sector is less volatile than the credit to the government and public enterprises. For example, the growth of credit to the government was 301 percent in 1976, 98 percent in 1982, 87 percent in 1983, -0.5 percent in 1990, 102 percent in 1991 and -0.2 percent in 2009. The political transition, frequent changes in government and policy instability would be the causes of higher volatility in the growth of credit to the government sector. The privatization process of public enterprises (PEs) in Nepal is not continuous, with reversal and almost stagnant frequently with the changes in government. As a result, the credit growth to the PEs was highly volatile in the past. The growth of the private sector credit was more than 10 percent since 1976 except the fiscal year 1982, 1983 and 2002. Likewise, the growth of the total credit also followed the same pattern in the respective period.

IV. **Methodology**

Model Specification

This study has employed the empirical model of Ehrmann et al. (2003), which basically depends on the model of Bernanke and Blinder (1988), to analyze the bank lending channel of monetary policy in Nepal. Following Ehrmann et al. (2001 & 2003), and Kayshap and Stein (1995), the empirical model can be written as:

$$\Delta \ln(L_{it}) = a_i + \sum_{j=1}^{l} b_j \, \Delta \ln(L_{it-j}) + \sum_{j=0}^{l} c_j \, \Delta r_{t-j} + \sum_{j=0}^{l} d_j \, \Delta \ln(GDP_{it-j}) + \sum_{j=0}^{l} e_j \, \pi_{t-j} + f x_{it-1} + \sum_{j=0}^{l} g_{1j} \, x_{it-1} \Delta r_{t-j} + \sum_{j=0}^{l} g_{2j} \, x_{it-1} \Delta \ln(GDP_{t-j}) + \sum_{j=0}^{l} g_{3j} \, x_{it-1} \pi_{t-j} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

With $i = 1, \ldots\ldots, N$ and $t = 1, \ldots\ldots\ldots, T_i$. N denotes the number of banks and l is the number of lags. L_{it} is the amount of loans by bank i in year t to private non-banks. r_t is the inter-bank rate, $\Delta \ln(GDP_t)$ is the growth rate of real GDP, and π, the inflation rate. The bank specific characteristics are denoted by x_{it}. On the assumption of the homogenous reaction of loan demand across banks, this model also incorporates fixed effects across banks, as denoted by

the bank specific intercept, a_{it} . Then, under the assumption that the demand addressed to each bank is homogenous with respect to its interest rate elasticity, the g_{1j} interaction coefficients can be interpreted as reflection of the heterogeneity of loan supply responses across banks (Loupias et al, 2001). As an indicator of the monetary policy shocks, changes in interbank rate are used to capture the effect of monetary policy on bank lending. It is observed from the literature that a small, less liquid or less capitalized bank reacts more strongly to the monetary policy change than a bank with a high value of the respective bank characteristics.[11] Hence, g_{1j} is expected to be positive. With the availability of only annual data on macroeconomic variables, the time unit of analysis in the study is a year and, thus, the maximum lag (l) used in model estimation is two. This choice of lag (l) may be consistent with the fact that monetary policy shocks propagate up to two years. The sign for the coefficients of the real GDP and inflation is assumed positive.

Interaction of bank characteristics with the control variables allows banks with different values of the bank characteristics to respond differently to business cycles. It also permits the bank characteristics to have a different impact on banks in each phase of the business cycle. Coefficients associated with the variable, $x_{it}\Delta r_{t-j}$ which indicates the interaction term with monetary policy measures, describe how responses differ according to bank characteristics. These cross-terms allow for testing the asymmetric effects of monetary policy on individual banks. The test for the bank lending channel amounts to checking whether the coefficients of interaction terms are statistically significant or not. If so, the lending channel could be considered as operative. If, in addition, the coefficients on these cross terms are positive and statistically significant while the coefficient associated to Δr_{t-j} is negative, then the lending channel is at work.

Data and Variables

This paper has used annual macroeconomic and bank-level data of Nepalese commercial banks covering for the sample period from 2003 to 2012. The reason for selecting 2003 as a starting year of the empirical study is that the announcement of the Nepalese monetary policy has taken place only since 2003. The original, unbalanced panel dataset contains 18 commercial banks and, because of the financial liberalization and increase in number of banks, the ending period covers 25 commercial banks of the Nepalese banking sector. Since the definitions of the banks' balance sheet items were changed during the study period, the capital fund, particularly capital funds of the state owned banks, has been adjusted to make date series consistent.[12] The source of data on gross domestic product is Economic survey of

[11] Size and capitalization are the most obvious proxy for informational asymmetries regarding the difficulties in raising external funds. Large, liquid and well-capitalized banks are expected to be more able to shield their loan portfolio from monetary policy shocks by drawing on their liquid holdings of securities and/ or by attracting non-deposit funding (Haan, 2001).

[12] The capital fund is the sum of the paid-up capital, calls in advance, statutory reserves, share premium, retained earnings, other reserves and the exchange fluctuation fund. The provision of including the retained earnings since 2005 makes the capital fund of these state-owned banks negative so that, in this study, only the changes in the decline in negative retained earnings are added in the capital fund of the these state-owned banks.

Ministry of Finance whereas the Quarterly Economic Bulletin of Nepal Rastra Bank is data source for inter-bank rate, policy rates, and aggregate bank lending. For the data on size, liquidity and capital assets of each commercial bank, this paper has used Banking and Financial Statistics of the Regulation Department, Nepal Rastra Bank.

Regarding the monetary policy instruments, this paper has used the interbank rate as monetary policy instruments for empirical analysis.[13] Inflation rate is calculated by the percentage changes in CPI. Three measures of bank specific characteristics used in the study are size (Siz), liquidity (Liq) and capitalization (Cap), which are calculated as:

$$Siz_{it} = lnA_{it} - \frac{1}{N_t}\sum_i lnA_{it} \ldots\ldots\ldots(2)$$

$$Liq_{it} = \frac{L_{it}}{A_{it}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \frac{L_{it}}{A_{it}}\right) \ldots\ldots\ldots(3)$$

$$Cap_{it} = \frac{C_{it}}{A_{it}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \frac{C_{it}}{A_{it}}\right) \ldots\ldots\ldots(4)$$

Bank size is measured by the log of total assets, A_{it}. Liquidity is measured by the ratio of liquid fund (L_{it}) to total assets, and capitalization is defined by the ratio of capital and reserves (C_{it}) to total assets.[14] Bank characteristics are normalized with respect to averages across all banks in the respective sample so that they sum up to zero over all observations. This implies that the average of the interaction term, $x_{it-1}\Delta r_{t-j}$ is zero and, as a result, the parameters β_j in equation (1) is directly interpretable as the overall monetary policy effect. Regarding size, the normalization is done with respect to the mean over the whole sample period as well as to each single period. This procedure removes unwanted trends in size.

Estimation Methodology

This study has used the Generalized Method of Moments (GMM) for panel data analysis suggested by Arellano and Bond (1991) to estimate the model (1). This GMM methodology is better because of the lagged dependent variable incorporated in the empirical model.[15] In comparison to the fixed and random effect model, this dynamic panel data model has advantage of taking into account the autoregressive properties in the dependent variable and the endogenous relationship between the dependent and explanatory variable.

[13] Bernanke and Blinder (1992) take the short term interest rate under the control of central bank as a good measure of monetary policy shocks. Most empirical studies on US use Fed Fund rate as the monetary policy variable, while others on European economies and emerging economies use central bank repo rates or short-term money market rates, irrespective whether countries conduct inflation targeting regime (Juurikkala et al., 2011).

[14] Liquid fund is defined as the sum of cash balance, bank balance and money at call denominated in both domestic and foreign currency (NRB, 2012).

[15] Many economic relationships are dynamic in nature and these dynamic relationships are characterized by the presence of a lagged dependent variable among the regressors. Inclusion of such lagged dependent variable in the model makes the OLS estimator biased and inconsistent. The within estimator of the fixed effects estimator will also be biased and its consistency will depend on T being large. Moreover, the random effects GLS estimator is also biased in a dynamic panel data model (Balgati, 2005).

The use of GMM estimation technique to analyze the bank lending behavior enable to control the unobserved heterogeneity resulting from bank-specific effects and the possible simultaneity between these individual effects and the regressors. In estimating equation (1), the problem of endogeneity may occur due to the fact that the situation of the banking sector could also affect the monetary policy decision. Such problem is addressed by the GMM estimator of Arellano and Bond (1991). In the Arellano-Bond estimator, the available lags of the dependent variables and the lagged values of the regressors are used as instruments to deal with the problem of endogeneity. This study has used the second and third lagged value of the bank loans as instrument variables. The possible endogeneity due to bank-specific characteristics and monetary policy rate can be resolved by using their internal instruments, which are lagged values of the explanatory variables. These instruments are assumed to be highly correlated with the endogenous variables and not directly correlated with the error term. We choose the second lag of bank specific characteristics and interbank rate. Regarding the lag of dependent variable, we use two lags on the dependent variable to obtain the maximum amount of information in the dataset without losing any efficiency. This is because of the fact that the total observations are only 214 for 25 commercial banks and thus taking more lags on the dependent variable will reduce the number of observations.

In Arellano and Bond model, the consistency of GMM estimator requires the validity of instruments and no second-order correlation for the disturbances of the differenced equation. Thus, this paper has employed the specification tests proposed by Arellano and Bond (1991), Arellano and Bover (1995), and Bundell and Bond (1998). At first, we examine the hypothesis that the error tem is not serially correlated. Under the null hypothesis of no second-order correlation, the statistic associated with this test has a standard-normal distribution. The second test is the Sargen test of over-identifying restrictions for the instruments. This test examines the overall validity of instruments and thereby confirms the absence of correlation between the instruments and the error terms in the models. The null hypothesis for the Sargen test is that the instruments are valid. Under the null hypothesis of the valid instruments, the test statistic is distributed with $\chi^2_{(L-k)}$, where L is the number of instruments and k is the number of parameters in the model.

V. **Empirical Results**

In order to analyze the role of the Nepalese banks in monetary transmission, this study has estimated the equation (1) using the Arellano-Bond GMM technique. The estimated results for both one-step and two-step GMM estimator of Arellano and Bond are reported in table 2-5, which presents the estimated long-run coefficients, their p-values and the misspecification test for the regressions. It is known that the two-step standard errors tend to biased downward in small samples. For this reason, the one-step results are generally recommended for inference on the coefficients, although the two-step Sargen test is recommended for inference on the model specification (Haan, 2001). Thus, the results of the one-step GMM are only interpreted in the empirical analysis. In addition, due to the large size of the state-owned

banks and some special features of these banks[16], the loan supply equation has been estimated taking all banks in the sample and only the private banks (or excluding the state-owned banks from the sample).

Empirical Results: Private Banks

Table 2 and 3 show the results of the Arellano-Bond one-step and two-step difference GMM taking only the private banks in the analysis (excluding the state owned banks from the sample). In table 2, the one-step GMM estimator results of four models have been reported taking different bank characteristics and one model with all three bank characteristics at a time. The coefficient of monetary policy variable is negative and significant in all four models, implying the negative relationship between the bank lending and monetary policy rate. For instance, the coefficient of the monetary policy rate is -0.01 in loan equation with size (model 1 of table 2), implying that an increase (decrease) in the inter-bank rate by one percentage leads to decrease (increase) in the amount of bank lending by 0.01 percent. This indicates that monetary tightening reduces the loan supply in the long-run. Such results for the monetary policy variable are also found in the two-step GMM presented in table 3.

The interaction term of monetary policy with size has the positive sign and is statistically significant as shown in model 1 of table 2. The positive sign of interaction term with size is consistent with the theoretical explanation of the bank lending channel, which assumes that lending volume of larger banks are less sensitive to monetary policy conditions than that of smaller banks. This result also support the prediction of Kashyap and Stein (1995) that the lending volume of smaller banks is more sensitive to monetary policy than that of large banks.

The interaction term between the monetary policy and liquidity is positive and statistically significant, which is also supportive to the theoretical explanation of the bank lending channel. Such positive sign indicates that banks with higher liquid funds are better able to buffer their lending activity against the availability of external finance, by drawing on their stock of liquid assets. In other words, less liquid banks are found to show a stronger reduction in lending after a monetary tightening than do more liquid banks. The underlying reason is that banks with more liquid balance sheets can use their liquid assets to maintain their loan portfolio and as such are affected less heavily by a monetary policy tightening (Erhmann et al., 2001).

The interaction term of bank capitalization with monetary policy does not have the expected sign and statistically insignificant. The statistical insignificance of the interaction term implies that bank capitalization is not a source of asymmetric response of banks to monetary policy stance. But, when all the characteristics are included in the loan supply equation, the interaction term between the capitalization and monetary policy indicator is found significant and positive, implying that banks with lower capitalization are more likely to cut back their

[16] Two-state owned banks namely Rastriya Banijya Bank and Nepal Bank Limited, which dominated the banking system in the past, are in the way of reforms since 2002 mainly focusing on the restructuring and ownership reform. The detail of reform can be found at (Adhikary et al., 2007).

lending in response to a change in monetary policy stance. One reason for the statistical insignificance and thus implication of no existence of a bank lending channel operating through banks' degree of capitalization could be the changes in the provision of capital regulations and accordingly discontinuous steps in meeting the paid-up capital taken by some of the private banks in the study period. One of the conditions for bank capital to have an impact on lending is that breaking the minimum capital requirement should be costly and accordingly, banks tend to limit the risk of future capital inadequacy (Van den Heuvel, 2001; Gambacorta and Ibanez, 2011). In addition, there is no evidence of the bank failures in Nepal so that less capitalized banks could have been considered similarly safe by the market.

Regarding the effects of macroeconomic variables, the coefficient of real GDP is found significant in all specifications with different bank characteristics, indicating that the change in economic activity have a positive effect on bank lending. The coefficient of real GDP being 4.24 in loan equation with size, for instance, implies that increase (decrease) in GDP by 1 percent causes the increase (drop) in lending of average bank by 4.24 percent. In the loan supply equation with liquidity and capitalization, the long-run coefficient of inflation rate is statistically insignificant.

The test statistics in all the models presented in table 2 and 3 satisfies the specification requirements. Based on the results of table 1, we can reject the null hypothesis of no first order autocorrelation in all specifications, but it is not possible to reject the null hypothesis of no second order autocorrelation in all models. The instruments used in these models are valid as the Sargan statistic is insignificant in all the models. Similar results are also reported in table 3 with Arellano-Bond two-step difference GMM.

Empirical Results: State-owned and Private Banks

Table 4 and 5 presents the Arellano-Bond one step and two step difference GMM results taking all banks in the sample in estimation with different bank characteristics. The coefficient of the monetary policy variable shown in all specifications of table 4 is negative and significant, implying the inverse relationship between the bank lending and the monetary policy rate as proxied by the interbank rate.

The interaction term of monetary policy with size has the positive sign and significant, which is consistent with the theoretical explanation of the bank lending channel. Such term in the case of liquidity and capitalization reported in the loan equation with liquidity and capitalization are insignificant. Since the interaction coefficients of these characteristics with monetary policy variable has no statistical significance, these bank characteristics are not the sources of asymmetric response of banks to monetary policy stance. Considering the case of capitalization, this could be due to the changes in capital regulations, discontinuous steps of the private banks to meet the requirement of paid up capital, no evidence of bank failure, and not strict capital rule for the state-owned banks. Two state-owned banks do not strictly comply with the limit of capital adequacy regulations and as a result capital constraints do not restrict their loan supply. In the case of liquidity, the insignificant relationship between the liquidity and loan supply may result from the behavior of two large state-owned banks, which

had higher liquid funds in the study period and, thus, no significant role of liquidity in loan supply.

Regarding the macroeconomic variables, the coefficient of GDP is found to be positive and significant in all models, indicating that the growth has positive impact on the bank lending. But, the coefficient of inflation is found to be statistically insignificant. The test statistics in the models presented in table 4 and 5 satisfies the specification requirements. Based on the results of table 4 and 5, we can reject the null hypothesis of no first order autocorrelation at 10 percent, but the null hypothesis of no second order autocorrelation cannot be rejected. The instruments used in these models are valid as the Sargan statistic is insignificant in all the models.

VI. **Conclusion**

This paper tries to examine the role of the Nepalese commercial banks in monetary policy transmission in Nepal. More specifically, it aims to investigate the loan supply response of the Nepalese commercial banks based on their balance sheet characteristics to the monetary policy stance. This study has estimated the loan supply equation by employing the micro-level bank data of 25 commercial banks and aggregate macroeconomic data. Given the importance of the state-owned banks in the banking system, the analysis has also been carried out separately excluding the state-owned banks from the sample.

Understanding the transmission mechanism of the Nepalese monetary policy is crucial for the appropriate design, management and implementation of the monetary policy. Despite such importance, there have not yet been any empirical studies on the monetary transmission in Nepal. Under such background, this study tries to fill this gap and encourage the future research in the area of monetary transmission in Nepal. Descriptive analysis shows that the bank lending to the government is more volatile than the lending to the private sector. The causes of such volatility in lending to the government may be the frequent changes in the government and thus accordingly the government policies. The volatility of the lending has been declining in recent years. In addition, the bank lending to private sector as percent of GDP has witnessed the high growth mainly after the liberalization in 1990s. But, with the speed up in liberalization, the bank lending to the public enterprises has been declined.

The empirical results show that the tightening of the monetary policy leads to a reduction in bank lending and vice versa. But, only small change in bank lending resulting from the change in the interbank rate implies that it is crucial to address the inefficiencies in the money market in order to improve the monetary transmission and thus effectiveness of bank lending channel. Real GDP growth is found to be positively affecting the bank's loan growth. We also find the cross-sectional heterogeneity in banks' response to monetary policy changes, when the different bank characteristics, namely size, liquidity and capitalization are taken into account in the specification. First, bank size plays significant role in shaping the response of the Nepalese commercial banks to monetary policy changes. Second, liquidity in the case of private banks seems to be the important determinant of the loan supply suggesting that less liquid banks must reduce their loan supply after monetary policy contraction. But, taking the

entire sample into consideration, the liquidity is found to have no significant impact on loan supply. Finally, capitalization does not play any significant role. Such result for capitalization may be due to the changes in capital regulation in the study period, the discontinuous steps taken by the private banks in meeting the paid up capital, no strict capital regulations for state-owned banks and no evidence of the bank failures causing the reduction in the informational frictions.

Though this study has revealed some important facts, the interpretation of the results needs to consider some of the caveats. The sample period in the study is relatively short because of annual data employed in the study. Thus, the availability and use of quarterly data may improve the results by incorporating more samples in the study. In addition, the data quality may be a limitation because the data on the commercial banks in the sample are taken from unaudited balance sheet. Similarly, the data on aggregate output may also have a limitation due to the existence of the large informal sector.

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Table 1: Bank Lending by Recipient, 1975-2012

(In percent of GDP; end of fiscal year mid-July)

	1975	1980	1985	1990	1995	2000	2005	2010	2012
Total bank loans	7.8	12.8	15.5	17.8	24.6	35.4	44.1	50.0	50.3
Private sector	4.6	8.0	8.3	11.1	18.8	28.3	32.8	41.6	40.6
Government sector	0.6	1.6	4.3	3.5	3.7	4.8	8.2	7.0	8.3
State-owned enterprises	2.6	3.2	2.8	3.1	2.0	2.3	3.1	0.6	0.7
Financial	0.0	0.3	0.3	1.2	1.4	1.8	1.9	0.2	0.1
Non-financial	2.6	3.0	2.5	2.0	0.6	0.5	1.1	0.5	0.6

Sources: Nepal Rastra Bank and authors' calculations.

Table 2: Arellano-Bond One-step GMM estimates without State owned Banks

Dependent Variable: Annual loan supply to non-bank private sector	Models estimated with the different bank characteristics			
	Model 1 Size	Model 2 Liquidity	Model 3 Capitalization	Model 4 Size, Liquidity and Capitalization
Loan(-1)	0.26*	0.67*	0.55*	0.41*
	(0.01)	(0.00)	(0.00)	(0.00)
Loan(-2)	-0.09	-0.14	0.11	-0.11
	(0.56)	(0.22)	(0.45)	(0.41)
Real GDP	4.24*	2.91**	4.54*	5.12*
	(0.00)	(0.02)	(0.00)	(0.00)
Monetary Policy(r)	-0.01**	-0.01***	-0.01**	-0.02*
	(0.03)	(0.08)	(0.05)	(0.00)
Inflation (π)	0.01***	-0.01	-0.002	0.002
	(0.09)	(0.13)	(0.80)	(0.75)
Char 1*Monetary policy	0.02**			0.03*
	(0.05)			(0.00)
Char 2* Monetary Policy		0.20***		0.12
		(0.10)		(0.45)
Char 3* Monetary Policy			-0.13	0.60**
			(0.46)	(0.04)
Char*Real GDP	-0.96	-0.36	16.59	
	(0.52)	(0.98)	(0.46)	
Char*Inflation	-0.02*	0.10	-0.03	
	(0.01)	(0.27)	(0.80)	
No of Banks	22	22	22	22
No of Observations	99	99	99	99
AR(1), p-value	0.02	0.01	0.01	0.03
AR(2), p-value	0.93	0.30	0.76	0.24
Sargen test (p-value)	0.66	0.50	0.52	0.69

Note: *, ** and *** reflect a statistical significance at the 1%, 5% and 10% respectively.

Table 3: Arellano-Bond Two-step GMM estimates without State owned Banks

Dependent Variable: Annual loan supply to non-bank private sector	Models estimated with the different bank characteristics			
	Model 1 Size	Model 2 Liquidity	Model 3 Capitalization	Model 4 Size, Liquidity and Capitalization
Loan(-1)	0.26**	0.64*	0.43*	0.63**
	(0.04)	(0.00)	(0.00)	(0.04)
Loan(-2)	-0.10	-0.06	0.10	0.15
	(0.63)	(0.70)	(0.44)	(0.41)
Real GDP	4.08*	2.63*	4.48*	5.12*
	(0.00)	(0.00)	(0.00)	(0.00)
Monetary Policy(r)	-0.004	-0.01	-0.01*	-0.02*
	(0.65)	(0.24)	(0.02)	(0.00)
Inflation (π)	0.01	-0.01	-0.0003	0.002
	(0.27)	(0.15)	(0.97)	(0.75)
Char 1*Monetary policy	0.01			0.04*
	(0.16)			(0.00)
Char 2* Monetary Policy		0.28*		0.12
		(0.05)		(0.46)
Char 3* Monetary Policy			0.008	0.60**
			(0.94)	(0.04)
Char*Real GDP	-1.06	3.60	10.16	
	(0.46)	(0.90)	(0.68)	
Char*Inflation	-0.02**	0.07	0.003	
	(0.02)	(0.60)	(0.98)	
No of Banks	22	22	22	22
No of Observations	99	99	99	99
AR(1), p-value	0.09	0.05	0.03	0.03
AR(2), p-value	0.87	0.55	0.88	0.23
Sargen test (p-value)	0.66	0.50	0.52	0.69

Note: *, ** and *** reflect a statistical significance at the 1%, 5% and 10% respectively.

Table 4: Arellano-Bond One-step GMM estimates with State owned Banks

Dependent Variable: Annual loan supply to non-bank private sector	Models estimated with the different bank characteristics			
	Model 1 Size	Model 2 Liquidity	Model 3 Capitalization	Model 4 Size, Liquidity and Capitalization
Loan(-1)	0.25***	0.33**	0.54*	0.42*
	(0.10)	(0.02)	(0.00)	(0.00)
Loan(-2)	0.25**	0.26**	0.13	0.06
	(0.04)	(0.06)	(0.45)	(0.67)
Real GDP	4.21**	4.22**	4.99*	4.85*
	(0.02)	(0.03)	(0.00)	(0.00)
Monetary Policy(r)	-0.01**	-0.01**	-0.01*	-0.01
	(0.02)	(0.05)	(0.00)	(0.13)
Inflation (π)	0.01	-0.005	0.002	-0.0001
	(0.58)	(0.70)	(0.79)	(0.98)
Char 1*Monetary policy	0.01*			0.01**
	(0.01)			(0.02)
Char 2* Monetary Policy		-0.03		0.13
		(0.87)		(0.37)
Char 3* Monetary Policy			-0.13	0.20
			(0.46)	(0.21)
Char*Real GDP	-0.44	25.69	16.64	
	(0.69)	(0.64)	(0.46)	
Char*Inflation	-0.01	-0.14	-0.03	
	(0.26)	(0.65)	(0.80)	
No of Banks	25	25	25	25
No of Observations	117	117	113	113
AR(1), p-value	0.06	0.05	0.01	0.01
AR(2), p-value	0.35	0.47	0.75	0.52
Sargen test (p-value)	0.35	0.48	0.52	0.56

Note: *, ** and *** reflect a statistical significance at the 1%, 5% and 10% respectively.

Table 5: Arellano-Bond Two-step GMM estimates with State owned Banks

Dependent Variable: Annual loan supply to non-bank private sector	Models estimated with the different bank characteristics			
	Model 1 Size	Model 2 Liquidity	Model 3 Capitalization	Model 4 Size, Liquidity and Capitalization
Loan(-1)	0.24***	0.29**	0.46*	0.38**
	(0.09)	(0.02)	(0.01)	(0.04)
Loan(-2)	0.25*	0.28**	0.13	0.10
	(0.01)	(0.04)	(0.41)	(0.53)
Real GDP	4.02*	4.77*	5.20*	4.98*
	(0.01)	(0.00)	(0.00)	(0.00)
Monetary Policy(r)	-0.01**	-0.02*	-0.01**	-0.01
	(0.03)	(0.00)	(0.03)	(0.11)
Inflation (π)	0.003	0.0001	0.004	-0.003
	(0.81)	(0.99)	(0.59)	(0.66)
Char 1*Monetary policy	0.01**			0.02*
	(0.02)			(0.00)
Char 2* Monetary Policy		-0.09		0.22
		(0.64)		(0.36)
Char 3* Monetary Policy			-0.84	0.23
			(0.25)	(0.21)
Char*Real GDP	-0.13	-13.56	-17.37	
	(0.91)	(0.84)	(0.61)	
Char*Inflation	-0.01	0.33	0.12	
	(0.50)	(0.93)	(0.52)	
No of Banks	25	25	25	25
No of Observations	117	117	113	113
AR(1), p-value	0.26	0.20	0.02	0.17
AR(2), p-value	0.43	0.48	0.78	0.72
Sargen test (p-value)	0.40	0.48	0.71	0.56

Note: *, ** and *** reflect a statistical significance at the 1%, 5% and 10% respectively.