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Monetary Policy Transmission in Nepal

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ABSTRACT

This paper examines the monetary policy transmission in Nepal based on the data for the period 2002-2015. As a first step in the analysis, the paper analyzes the issue of inflation convergence and the monetary independence in the context of the existing exchange rate peg and the capital flow policy of Nepal. The paper employs a number of macro indicators, and alternative empirical strategies based on the peculiarities of Nepal. The results show that the existing exchange rate peg has resulted in the convergence of the Nepalese price level to the Indian price level in the long-run. Despite the peg, there is an evidence of the independence of the Nepalese monetary policy to a large extent. The narrative approach of identifying monetary policy shows the evidence of the bank lending channel, interest rate channel, and the asset price channel of the Nepalese monetary policy though there exists a lag in monetary policy transmission due to high information asymmetry, adjustment costs and the poor financial infrastructure. In addition, the SVAR approach provides the evidence of the monetary policy transmission, in which the effect of the expansionary monetary policy on the gross domestic product decays to zero at about 8 quarters. Moreover, the paper also shows that the money market liquidity is largely guided by the remittance inflows in recent years. The analysis of the money market development indicates the need for the review of the operating procedures and the implementation aspects of the monetary policy. The evidence of monetary transmission channels implies that NRB can use its policy to achieve the specified objectives over certain time horizon.

Key words: Monetary policy transmission, Narrative approach, SVAR

JEL: E420, E520, E580

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I. Introduction

The analysis of monetary policy transmission is crucial for the appropriate design and the implementation of the monetary policy, though such a task in the case of Nepal is constrained by data limitations and highly unpredictable structure of the economy. Even after the formal announcement of the Nepalese monetary policy in 2002, only very few works have been done to analyze the transmission of the Nepalese monetary policy and these studies also constrained from the lack of an adequate data support in the monetary policy analysis. In addition, the knowledge of the monetary policy transmission is also crucial for Nepal Rastra Bank (NRB) to enhance the effectiveness of the monetary policy. Under such a backdrop, this paper attempts to explore the transmission of the Nepalese monetary policy using alternative empirical strategies– narrative approach and structural vector autoregression (SVAR) approach.

Measuring the Nepalese monetary policy is important from the policy perspective. Since 2002, the NRB has formally announced its monetary policy, but its framework remains unchanged. In the context that the Nepalese economy has undergone significant changes in recent years, it is also important to identify the monetary policy transmission in order to enhance the policy effectiveness and the policy framework. One of the strategic pillars in the NRB Strategic Plan (2012-2016) is "to improve the effectiveness of monetary policy". In order to stabilize the short-term money market rate, the NRB (2012) also mentioned about the implementation of interest rate corridor. This paper contributes in the area of the Nepalese monetary policy by focusing on the transmission channels, and its related aspects.

Few of the earlier empirical literature also discussed about the monetary policy transmission in Nepal. For instance, Budha (2013) show the evidence of the bank lending channel in Nepal based on the bank level data of the Nepalese commercial banks. Khatiwada (2005) provides the description of the transmission channels relating to the Nepalese context and argues that credit availability channel is a most powerful channel in Nepal. However, this study has not used adequate data support to validate the arguments for policy transmission. In addition, all previous empirical literatures in the Nepalese context were unable to identify the transmission mechanism based on the event analysis or the SVAR approach. Such a gap in empirical literatures also justifies the significance of the analysis of the Nepalese monetary policy transmission channels.

The analysis of monetary policy transmission in Nepal needs to consider its unique monetary policy environment. It is important to take into account the existing exchange rate of the Nepalese Rupee with the Indian Rupee because it is acting as a nominal anchor of the monetary policy. Likewise, the analysis of monetary independence that the NRB can achieve due to the partially open capital account in the existing peg is also crucial for the monetary policy analysis. Thus, the paper begins with the examination of the questions: Does the existing exchange rate peg result in the convergence of Nepal's inflation with Indian inflation rate? Is there monetary dependence in the existing exchange rate peg? The problem of data and the short-history of the formal announcement of the Nepalese monetary policy are the challenges in the analysis. In addition, the complexity in monetary policy transmission also arises because of the working of monetary policy through several channels (Kuttner and Mosser, 2002). In this context, this paper tries to address these issues by using a number of macro indicators and alternative empirical strategies.

Primarily, the contribution of this paper is the examination of the monetary policy transmission in Nepal based on both the narrative identification approach and the SVAR approach based on the data for the period 2002-2015. The paper at first relies on the narrative approach (Romar and Romar, 1989; Berg et al. 2014) of identifying the monetary policy transmission, which is appropriate in the Nepalese context because of the data unavailability on the real sector and the short history of the monetary policy announcement only after 2002. Under the narrative approach, the paper tries to exploit the information from the development in the Nepalese monetary sector in the period 2009-2014. In addition, the paper also attempts to identify the monetary policy transmission using the SVAR approach of Bernanke and Mihov (1998) despite some limitations in the estimation of the SVAR due to the data problems.

This paper attempts to use the information from the peculiar episodes of the Nepalese monetary sector under the narrative approach. Obviously, a major challenge in measuring the monetary policy is to isolate the exogenous policy changes from the endogenous monetary policy responses to the real sector developments. Given the short-history of the Nepalese monetary policy, and less frequent changes in the policy rates, the paper adopts a broad approach in narrative identification of the policy shocks, including both expansionary and contractionary episodes. More specifically, it takes the episodes of the excessive (unusual) changes in remittance inflows, which unusually drives the banking system liquidity in Nepal and represent the exogenous shocks, not driven by the real sector developments. It is reasonable to take such episodes because the remittance inflows, which covers more than 65 percent of the inflows in the balance of payments, amounting more than 25 percent of the gross domestic product, is a major driver of the banking system liquidity in Nepal.

An excessive increase (decrease) in remittance inflows, if not sterilized, results in the unexpected increase (decrease) in the banking system liquidity, which represents as an expansionary (contractionary) policy shock pushing the money market rate to the lower (higher) level. Such major episodes, which can be categorized as exogenous policy shocks, include the period from August 2011 to December 2011, August 2012-January 2013, and August 2013-April 2014. Moreover, the identification of these episodes is also considered on the basis of the seasonality in the banking system liquidity due to the government budgetary operations. Since the excessive (unusual) growth of remittance inflows was unexpected, these episodes largely represent an expansionary policy shock, which assist us to identify the monetary policy transmission in Nepal.

The paper found a number of findings related to the Nepalese monetary policy. First, the paper shows the convergence of the Nepalese inflation to the Indian inflation rate in the long-run, which is one of the expected outcomes in the existing exchange rate peg of the Nepalese Rupee with the Indian Rupee. Any deviation of Nepalese CPI from the long-run path (with Indian CPI) corrects in about a 4 to 8 months period. Second, the Nepalese monetary policy is found largely independent from the Indian monetary policy in recent years, reflecting the lack of close association between developments in money markets in Nepal, and India. Third, the narrative approach provides the evidence of the bank lending channel, interest rate channel and asset price channel. There is long-lag in the bank lending channel and the interest rate channel, which are commonly expected in the weak monetary policy environment, particularly the high information asymmetry and poor financial infrastructure. The interest rate channel is found weak, as indicated by the low contemporaneous correlation between the interbank rate and the lending

rates and deposit rates, though the analysis is constrained by data limitations. However, the weak interest rate channel may be a natural outcome of existing quantity based excess reserve targeting procedure, resulting in the volatility in money market rate and weakening the interest rate pass-through.

In addition, the SVAR approach and the analysis of the money market development provides some interesting results. The SVAR approach also provides the evidence of the monetary policy transmission in Nepal. An expansionary monetary policy shock increases both GDP and CPI in the beginning. The impact on GDP and CPI decays to zero by about 8th quarter and 11th quarter respectively. Finally, the most interesting result of the paper is that the source of fluctuations in Nepalese money market is the remittance inflows and subsequent changes in net foreign assets due to unsterilization of such flows in recent years. Moreover, the money market development in recent years also raises the question of monetary policy implementation in Nepal.

The findings of the paper are largely original in the area of Nepalese monetary policy. Despite the data limitations, the efforts are made to exploit the information as far as possible. However, some caveats need to be considered for the policy inference. Primarily, the SVAR analysis suffers from the limitations of short-time span of data. Moreover, the paper still needs to address the issues related to the estimation of the SVAR.

The rest of the paper is organized as follows. Section II presents the brief outline of the monetary policy development in Nepal. Section III discusses about the inflation convergence and the monetary independence in the context of Nepal. Section IV focus on the monetary policy transmission based on the narrative identification approach. Moreover, this paper discusses the monetary sector development in the recent years, and the interest rate pass-through. Section IV deals with the monetary policy transmission in Nepal based on the SVAR approach. Finally, Section V presents the conclusion of the paper.

II. Overview of the Nepalese monetary policy development

The central banking in Nepal began with the establishment of Nepal Rastra Bank in 1956, and the monetary policy was exercised through the use of policy instruments only in mid-1960s. The dual currency system in the 1950s, in which both the Indian and the Nepalese currency were in circulation in the economy, made the NRB to focus more on currency unification in the initial year of establishment.[1] The major function of NRB then was to purchase and sale Indian currency. As a result, the dual currency system was a major limiting factor for the efficient conduct of monetary policy during that period. The initiation of monetary management took place only after the second decade of the NRB's establishment, which was facilitated by the currency unification, stabilization in the exchange rate with the Indian Rupee, and the initiation

[1] Nepalese government took several steps to enable the orderly and progressive withdrawal of Indian currency and, thus, circulation of the Nepalese currency in the economy. Some examples of such steps include the extending the areas where only the Nepalese rupees would be legal tender, compulsory conversion of deposit accounts in the Indian rupees with Nepal bank into accounts in Nepalese rupees, establishment of the fixed official exchange rate for the Nepalese currency at NRs 160 equal to IRs 100. The Foreign Exchange Act 1962 made the use of foreign currencies, including Indian Rupees, illegal for domestic transactions (NRB, 1981).

of development of the database of the Nepalese economy (NRB, 1996).[2] Likewise, the traditional central banking function of credit control began only after the enactment of the commercial bank Act in 1963, which formally provided the task of credit control to the NRB. And, NRB framed the credit control regulation in 1966 with the approval of the government.

Nepal Rastra Bank began the use of monetary policy instruments in mid-1960s, and the overall policy was directed towards regulating the supply of and demand for credit in the economy through the direct instruments rather than the indirect instruments. For instance, the regulation of interest rate was started in 1966 by fixing the interest rates on deposits and lending. The concept of cash reserve ratio was introduced in 1966 in which commercial banks were required to maintain reserves with the NRB at least 8 percent of their total deposit liabilities. Likewise, the NRB also introduced the margin requirement (on loans/advances for financing import trade) and refinancing facilities (for loans issued to industry and the export trade). Other direct instruments introduced by the NRB include the priority sector in 1976, the statutory liquidity requirement (SLR) in 1974, and the selected credit control in 1978. Despite the changes in the policy instruments based on the situation of the economy, the NRB relied on the direct instruments of monetary and credit control until mid-1980s.[3] In addition, no formally announced policy framework was adopted during that period.

The development of the Nepalese monetary policy underwent significant changes after the implementation of the structural adjustment program in the mid-1980s.[4] The NRB gradually moved away from direct monetary policy instruments to indirect market-based instruments. The NRB began the deregulation of interest rate in 1984 and finally the complete deregulation of interest rate took place in 1989 with a view of achieving the efficient allocation of available financial resources, the competition in the mobilization of savings, and improving the refinancing instruments and the modalities of monetary control (See, for instance, Thapa, 2005; NRB, 1990, 1996). As an indirect instrument of monetary policy, open market operation (OMO) was given more emphasis to influence the monetary aggregates. To manage the liquidity with banks, treasury bills auction system was introduced in 1988.[5] The NRB introduced outright purchase and sale of treasury bills in 1994 and repos in treasury bills in 1997. In addition, the NRB relied on cash reserve requirements and the margin rates in order to regulate the commercial bank liquidity. For monetary management purpose, the NRB was given the authority to issue its own bonds and, subsequently, the NRB started issuing own bond in 1991 to mop up excess liquidity. The policy of quantitative credit ceiling was abolished in 1991. Despite the policy of interest rate liberalization, the policy to control interest rate spread was introduced in 1992, which was later on removed in 2002 after the implementation of financial sector reform program. The provision of statutory liquidity ratio (SLR) was abolished in 1986 though it was

[2] For instance, the data on GDP, prices and foreign trade were published only in 1964/65.

[3] The evolution of exchange rate system and the monetary management in the early period were discussed in NRB (1981, 1996).

[4] After the severe external and internal imbalances in early 1980s, Nepal adopted the stabilization program in 1986 and the structural adjustment program in 1987. Primarily, Nepal faced the situation of huge fiscal deficit, overvalued exchange rate, declining exports and slowdown in growth. For instance, in 1983, the fiscal deficit, the current account deficit, and the balance of payments deficit were about 8 percent, 5 percent, and 2 percent respectively.

[5] The details of the development of monetary instruments until 1995 are available on NRB (1996).

reintroduced during the period 1991-1993. However, the SLR and the interest rate spread control were reintroduced respectively in 2009 and 2013.

Though there was no formal announcement of monetary policy with explicit framework until 2002, the exchange rate peg served as a nominal anchor during that period too.[6] The peg with Indian currency (IC) during the period 1956-1983, the basket peg during 1983-1993, and the peg with Indian currency in later period explicitly acted as an intermediate target of the Nepalese monetary policy. The policy goals were primarily the price stability and the balance of payment stability. For instance, the monetary policy had the twin objectives of price stability and balance of payments stability during the structural adjustment period 1987/88-1990/91(NRB, 1992). In addition, NRB (2001) stated that one of the objectives in 2000 was "to enhance economic growth rate at least the plan target of 6 percent with the provision of adequate level of liquidity in the economy". It also mentioned the implementation of the monetary aggregates based framework with narrow and broad money growth as the intermediate targets of the policy. However, the existing exchange rate peg with Indian currency has been continued since 1993. Despite the focus on the indirect instruments and the early reforms (in 1980s and 1990s), the lack of explicit formal announcement and adequate transparency were the basic feature of the Nepalese monetary policy framework.

The first announcement of the Nepalese monetary policy in 2002 is a breakthrough in the history of the Nepalese monetary policy, which clearly stated the policy framework and enhanced the policy transparency.[7] Since then, the NRB has been announcing monetary policy annually. Despite some revisions in the policy documents, the Nepalese monetary policy framework basically remains same since the explicit announcement of the policy in 2002.[8] The basis of current Nepalese monetary policy framework is NRB Act 2002. The key elements of the existing Nepalese monetary policy framework are presented in Figure 1. Currently, the explicit goals of monetary policy include the monetary stability (containing CPI inflation rate at a certain level) and external sector stability (maintaining adequate foreign exchange reserve to sustain peg). In addition, broad money growth (M2) is taken as an intermediate target of the policy (NRB, 2014). It is argued that the existing capital control policy provides the monetary policy independence, which allows the NRB to take M2 as an intermediate target.[9] Thapa (2007) also argued that monetary cum aggregate-based sub intermediate targets are set to support the existing exchange rate peg. The monetary policy strategy can primarily be defined as an exchange rate targeting in the current context of the exchange rate peg with the Indian currency, which is serving as a

[6] The level of exchange rate peg with IC was revised in 1966, 1967, 1975, 1978, 1981, 1983 and 1993. The existing peg of Nepalese Rupee 160 equal to Indian Rupee 100 was set in 1993 (NRB, 1996).

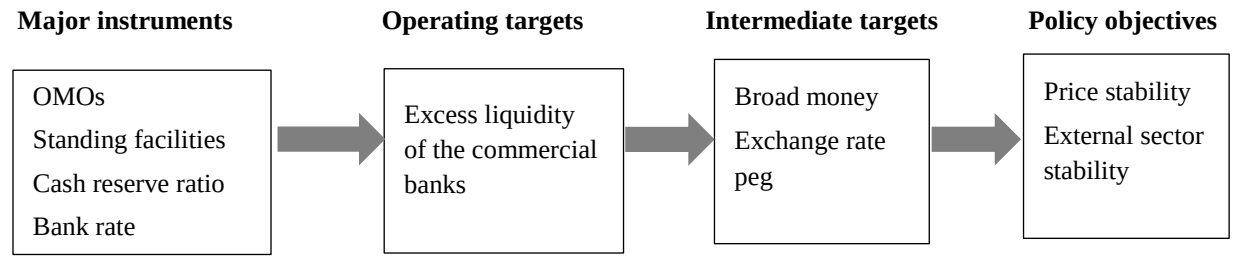
[7] The financial sector reform program in 2002 played crucial role in the development in Nepalese monetary policy. The reform program included the re-engineering of NRB, restructuring of the two state-owned commercial banks, capacity building of the financial sector, and institutional reforms. The NRB Act 2002 which came after the reform program has provided the foundations for the monetary policy; include the provision of annual monetary policy announcement and implementation, the central bank independence, the institutional framework and the objectives of the monetary policy, among others.

[8] Minor modifications were made in the components of the policy framework. For instance, net domestic asset (NDA) was taken as an operating target during the period 2003-2005. Financial stability was also incorporated as a monetary policy objective in 2009/10. In the external sector stability, the monetary policy also targeted the level of the balance of payments until 2012.

[9] However, such monetary independence may be weakened by the long-open border, cross-border illicit capital flows, and high trade integration with India.

nominal anchor of the policy. There is mixed evidence on the record of achieving the targets, as given by the targeted growth and actual growth of broad money, projected and actual inflation, as well as targeted and actual balance of payments (Table 1).

Figure 1: Key Components of the Nepalese Monetary Policy Framework



The excess liquidity of commercial banks is an explicit operating target of the policy. NRB focuses on the management of the liquidity in the system. And, OMOs is major instrument of monetary policy operation though the NRB relies on the reserve requirements, standing facilities (lending facility), the bank rate, and the auction based interest paying deposit collection too. The short descriptions of the major policy instruments include as follows:

- Open market operation (OMOs): OMOs, the sale and purchase of government securities, is used to manage liquidity in the banking system and, thus, influence the short-term interest rates. OMOs are primarily used to mop up excess liquidity, and to inject the liquidity in the banking system. The tools under OMOs are outright sale auction, outright purchase action, repo auction, and reverse repo auction. Whereas outright sale and reverse repo are used to absorb excess liquidity in the banking system, outright purchase and repo are used to inject the liquidity in the system. OMOs are also categorized as regular, fine tuning, and structural OMOs. The regular OMOs are conducted for only 7 days, fine tuning OMOs for a maximum of three months period, and structural OMOs for the maximum period of 6 moths (NRB, 2014).
- Bank rate: It is also called a discount rate, the rate at which commercial banks borrow from the NRB to meet unexpected liquidity shortage. It is used as a lender of the last resort facility, and, in July 2015, it was 8 percent.
- Cash reserve ratio (CRR): The role of reserve requirement or CRR as a major tool of monetary policy has declined in recent years. Both excess and required reserves are unremunerated. No CRR has been applied to foreign currency deposits. In July 2015, the CRR for commercial banks was fixed at 6 percent.
- Standing liquidity facility (SLF) and auction based interest-paying deposit collection: In order to manage the short-term liquidity short-fall, standing liquidity facility (SLF) is provided to the banks. On the other hands, in order to absorb the structural liquidity surplus, the NRB has introduced the auction based interest-paying deposit collection in 2014.

Box 1: Institutional Framework of the Nepalese monetary policy

The basis of the Nepalese monetary policy is Nepal Rastra Bank Act 2002, which has a clear provision on the institutional framework of the policy. The objectives of the NRB, defined in the NRB Act, are the basis for the monetary policy objectives. The NRB formulates and implements the monetary policy to meet the objectives specified in the Act. As per the NRB Act, the NRB board of directors (an apex body in the NRB) is responsible for formulating monetary policy. And, the responsibility to implement monetary policy goes in the Governor of the bank.

The NRB Act has also made a provision of the management committee (MC) under the board of directors, which is chaired by the governor. Thapa (2007) states that since the MC is designed to conduct the business of the bank in an orderly manner, the task of formulating and reviewing Nepalese monetary policy goes to the MC. The initial draft of the monetary policy is made by the research department of the Bank, which is later on discussed and reviewed in the MC. And, the monetary policy is announced publicly through press conference after the approval from the NRB board of directors. Open Market Operation Committee, chaired by a deputy governor, is responsible for conducting the open market operations in order manage the liquidity situation in the economy. The task of liquidity management is supported by the Liquidity Monitoring and Forecasting Framework (LMFF).

III. Inflation convergence and monetary independence

The first step in the analysis of monetary policy transmission in Nepal is to examine the issue of inflation convergence and the monetary independence. The importance of these issues arises from the existing exchange rate peg and the policy on capital flows. If the Nepalese monetary policy loses its independence completely, there is limited scope to analyze the monetary policy transmission. It is expected that the peg must result in the convergence of the Nepalese inflation to the Indian inflation. Moreover, the extent of monetary independence in consideration of the policy trilemma framework needs to be considered for the transmission of the Nepalese monetary policy.

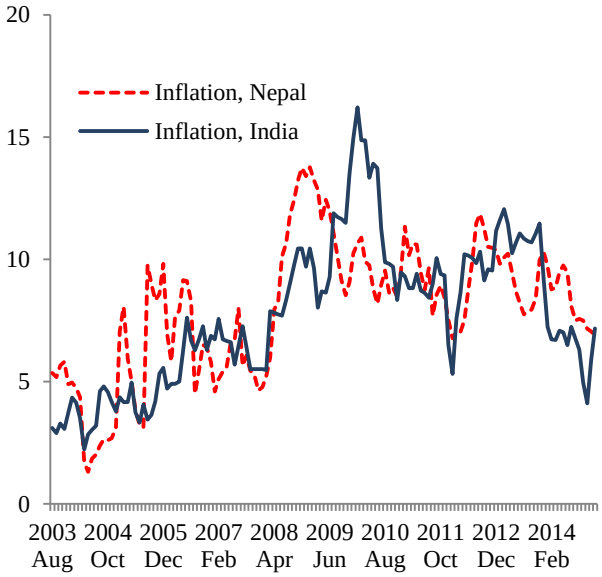
Inflation convergence

The existing exchange rate peg provides the easier nominal anchor to the NRB in order to achieve monetary stability. The convergence of Nepal's inflation rate to the Indian inflation is an expected outcome of the existing peg, given the high trade integration, the labor mobility, and the long-open porous border with India.[10] Some previous empirical literatures also show that about two thirds of Nepal's inflation is attributed to the Indian inflation (Nepal and Nepal, 2010), and the inflation in Nepal converges to the Indian inflation in the long-run (NRB, 2007; Ginting, 2007). Figure 2 also clearly shows the close movement of the Nepalese CPI inflation rate with th

[10] Historically, India is a Nepal's major trading partner, comprising about two thirds of Nepal's foreign trade. Likewise, geographical proximity and socio-cultural tie up are also facilitating high labor mobility with India though the labor movement to other emerging markets, particularly Gulf countries and East Asia, has been in the growing phase in recent years.

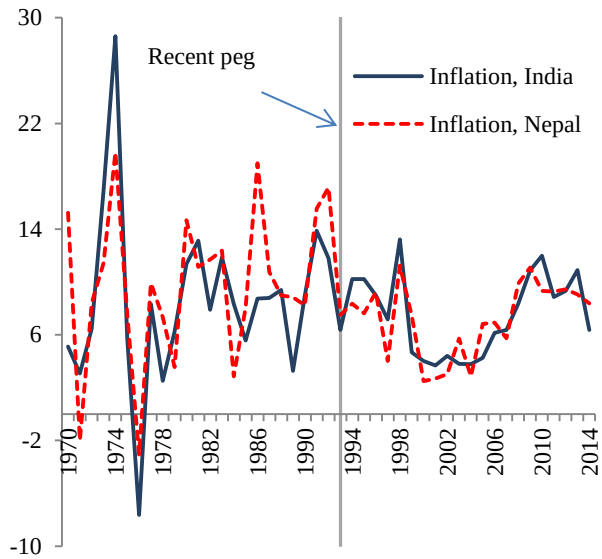
Indian CPI inflation, reflecting the convergence of the price level in Nepal to Indian price level in the long-run.

Figure 2a: Inflation in Nepal and India (Monthly in percent, 2003-2014)



Data source: IMF and NRB.

Figure 2b: Inflation in Nepal and India (in percent, 1970-2014)



Data source: IFS, IMF.

One of the ways to test the price level convergence across countries is to rely on the testing of the purchasing power parity (PPP) theory, which is based on the law of one price. The real exchange rate (q) by taking the Nepalese CPI (P_N), the Indian CPI (P_I), and the pegged nominal exchange rate $(\bar{s})$ can be written as: $q = \bar{s}.\frac{P_I}{P_N}$. And, the PPP theory, which argues that the prices of the goods expressed in common currency becomes equal in the long-run, allows us to write the real exchange rate equation as: $1 = \bar{s}.\frac{P_I}{P_N}$ where q=1 (Kuttner, 2015). By taking logarithms, the real exchange rate equation can be written in the following form:

$p_n = c + p_i$ …….. (1)

In equation (1), p_n stand for the log of the Nepalese CPI, p_i for the log of the Indian CPI, and c for a constant. One of the common ways to test the PPP given by equation (1) is to use the cointegration test, which examine the long-run equilibrium relationship between variables.

Using the monthly data for the period 1994-2014, the paper tests the cointegration relationship between the Nepalese price level and the Indian price level based on the equation (1). Both p_n and p_i are non-stationary or integrated of order one, as indicated by the ADF unit root test (Table 2). The non-stationarity of both variables allows us to examine the cointegration relation. For this purpose, the Johansen cointegration test has been employed (Table 3), and the lag length selection for the vector autoregression (VAR) is based on the SBC criteria. The λ_{max} statistic rejects the null hypothesis of no cointegratiing vectors at 5 percent significance level against the alternative of one or more cointegrating vectors. On the other hand, the λ_{trace} statistic cannot reject the null hypothesis of cointegrating vector at most one against the alternative of

cointegrating vector greater than one. This result clearly shows the evidence of a long-run equilibrium relationship between the Nepalese price level and the Indian price level. In fact, such long-run relationship is expected outcome in the context of the existing peg with high trade integration.

The next step is to estimate the short-run dynamics using the vector error correction model (VECM) based on the estimates of the cointegrating vector. Given the sensitivity of VAR estimates to the lag structure, the VECM is estimated based on both the SBC and AIC criteria of the lag-length selection. The VECM estimates show the ECM value of -0.07 (with AIC criteria of lag selection) and -0.12 (with SBC criteria of lag selection). These results indicate that the adjustment of the Nepalese price level towards the long-run equilibrium path is about 7 percent to 12 percent each month if there is any deviation of the price level in Nepal from Indian price level. This fact suggests that the pass-through period from the Indian price level to the price level in Nepal is about 4 to 8 months.[11] Such a high level of exchange rate pass through is a usual outcome of the open border, high import dependency, and the cross-border informal trade with India.

These empirical evidences on the relationship of the Nepalese inflation with the Indian inflation have important policy implications. Given the evidence that the Indian inflation plays a dominant role in determining the inflation in Nepal, the Nepalese monetary policy has a limited role to play in influencing the price level in the long-run. However, the monetary policy can be used in the short-run to correct deviations from the long-run equilibrium path with the Indian inflation. Despite the possible constraints on the monetary independence, the existing exchange rate peg has largely conferred the benefit in terms of monetary stability. In the context that India has entered into the inflation targeting regime since 2015, the exchange rate peg seems to serve as a better nominal anchor for the Nepalese monetary policy in future.

Monetary independence

The exchange rate peg with IC acts as a constraint on the independence of the Nepalese monetary policy.[12] As per the theory of impossible trinity or policy trilemma, it can be argued that the choice of the exchange rate peg and only partially liberalized capital flows[13] allows some space for the independence of the Nepalese monetary policy. But, the possibility of cross-border illicit financial flows along the long-open border with India may not allow the NRB to maintain the interest-rate differential for the long period of time. The partially open capital account with

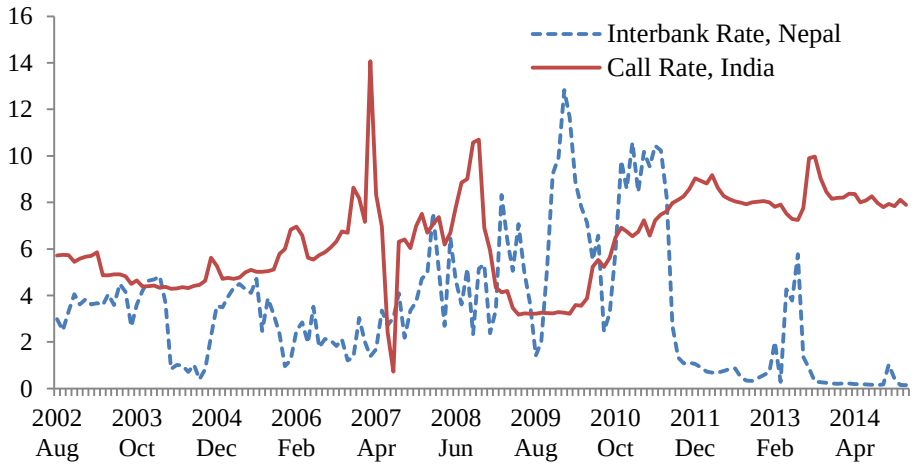
[11] The results of VECM estimates are not presented in the paper and available on request.

[12] In the exchange rate peg, the monetary policy becomes less effective since an increase (decrease) in money supply beyond the equilibrium level results in capital outflows (inflows) and, thus, puts downward (upward) pressure on the exchange rate peg. Such a link between the monetary policy stance, reserves, and the exchange rate becomes weak if a country is regulating or controlling capital flows. Imperfect capital mobility enables a central bank to sustain policy stance and thus gain a certain degree of policy autonomy over the certain time horizon.

[13] Though Nepal partially liberalized its capital account in 1993, allowing capital inflows in the form of foreign direct investment (FDI), the capital outflows and portfolio investment are completely restricted. Given the strict control over capital and financial account, only the FDI can enter in Nepal as well as Nepalese residents are not allowed to borrow from abroad (except a provision that residents can borrow up to USD 200, 000 for business purpose though no foreign currency is provided to pay interest for such loans) and also not allowed to take capital abroad.

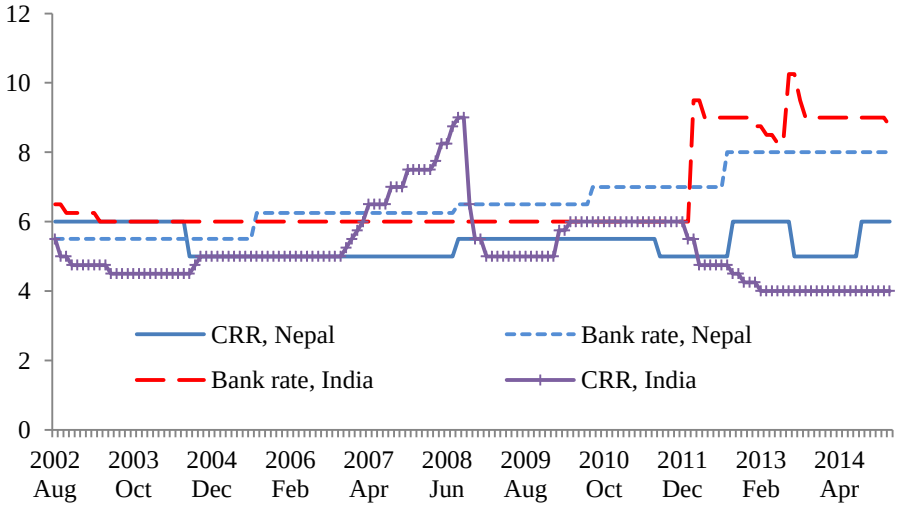
regulated flows enables the NRB to independently exercise the monetary policy over the medium run.

Figure 2: Money Market Rates in India and Nepal (2002-2014)



Data source: NRB and RBI.

Figure 3: Evolution of Policy Rates in Nepal and India (2002-2014)
(In percent)

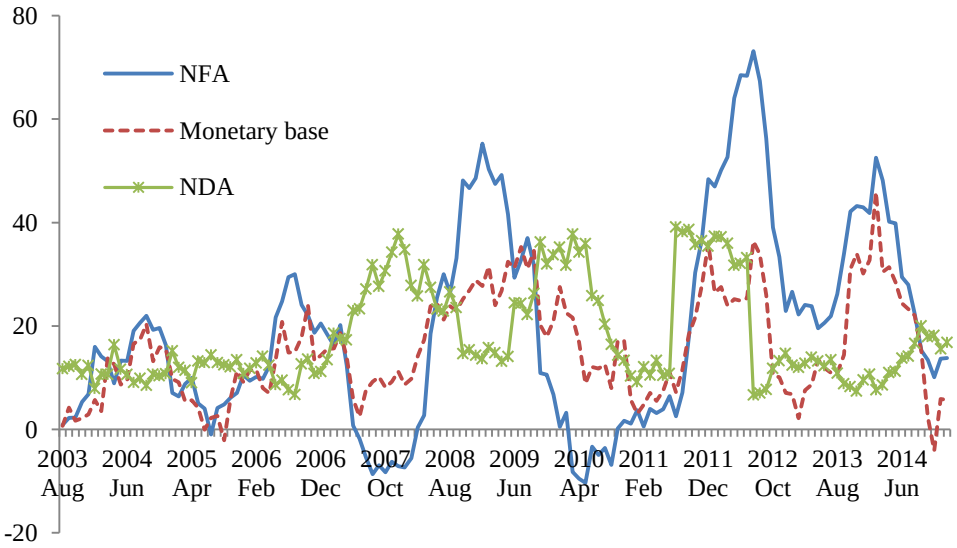


Data source: NRB and RBI.

In order to identify the monetary independence, the paper simply adopts the descriptive approach by comparing the policy rates and money market rates in Nepal and India. Since the NRB has been publically announcing monetary since 2002, the period of analysis covers only after 2002. If there exists the interest rate differentials and the policy actions of the NRB significantly differ from the Reserve Bank of India (RBI), it provides evidence for the independence of the Nepalese monetary policy. Figure 2 clearly shows that the money market rate in Nepal and India do not show the close movements in recent years. The interbank rate in Nepal shows the volatile

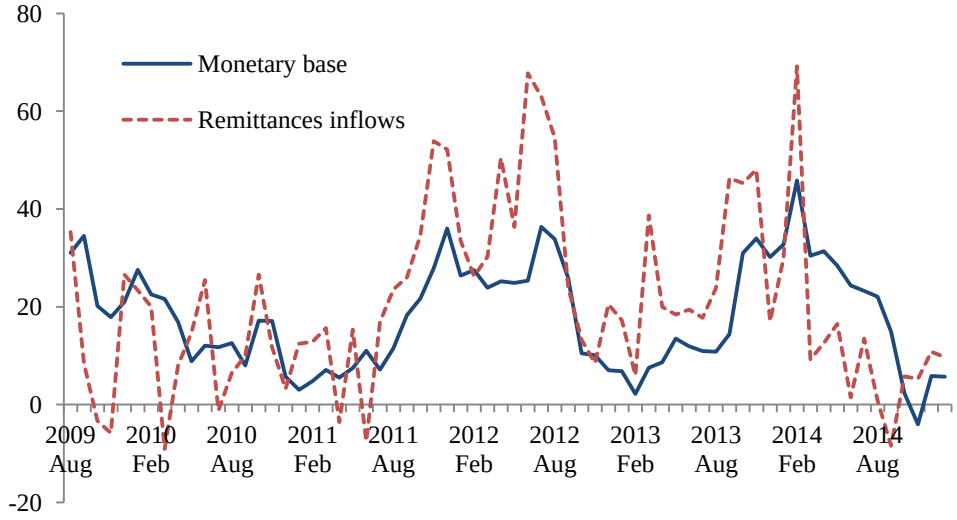
pattern, reflecting the volatility in liquidity in the money market, whereas the monetary market rate in India seems less volatile given the interest rate corridor adopted by the RBI. Since 2010, there is a wide divergence between the money market rates in Nepal and India. In addition, the policy action indicated by the cash reserve ratio (CRR) of Nepal is not following Indian monetary policy (Figure 3). Thus, if the monetary independence is analyzed based on the ability of the NRB to set nominal interest rate in the existing peg, there exist evidence on the monetary independence to a large extent.

Figure 4: NFA, NDA and Reserve Money Growth
(y-o-y, in percent)



Data source: NRB.

Figure 5: Growth of Remittance inflows and Monetary Base (2009-2014)
(y-o-y, in percent)



Data source: NRB.

Another way of testing monetary independence is to examine the links between the changes in net foreign assets (NFA) and reserve money (RM) as suggested in Veyrune (2007). This approach argues that, given the peg and need for foreign exchange intervention to maintain peg, the movements in NFA are largely reflected in the reserve money in the situation of unsterilized capital flows, curtailing the monetary policy autonomy. Figure 4 clearly shows that the monetary base is largely guided by the NFA in recent years.[14] This fact does not reveal the complete picture because of the fact that the movements in NFA are largely the results of the volatile large remittance inflows, but not of the capital flows (Figure 5 and 8). Thus, the testing of cointegration between NFA and RM as suggested in Veyrune (2007) is not appropriate in the Nepalese context in order to test the monetary independence. However, as an additional analysis, this paper examines the relationship between RM and remittances inflows. If the remittance inflows are unsterilized, the changes in remittances inflows are directly reflected in the reserve money.

The remittance inflows plays dominant role in determining the growth of the monetary base in recent years, as shown in Figure 5. After the volume of remittances crossed Rs 200 billion in 2009, amounting more than 20 percent of GDP, it becomes the guiding force in the reserve money growth. Thus, the paper tests the relationship between the remittance inflows and reserve money, on the assumption that the long-run equilibrium relationship exists between these two because of the unsterilized remittance inflows. Based on the monthly data for the period 2002-2014, the paper found the evidence of cointegration between remittance inflows and reserve money (Table 4).

These facts reflect the monetary independence exercised by the NRB to a large extent. The NRB can use its monetary policy instruments in order to influence the interest rate and thus the economic activity over the certain time horizon. Thus, the evidence of the monetary independence allows us to examine whether there is monetary policy transmission channels in Nepal.

IV. Monetary policy transmission: A narrative approach

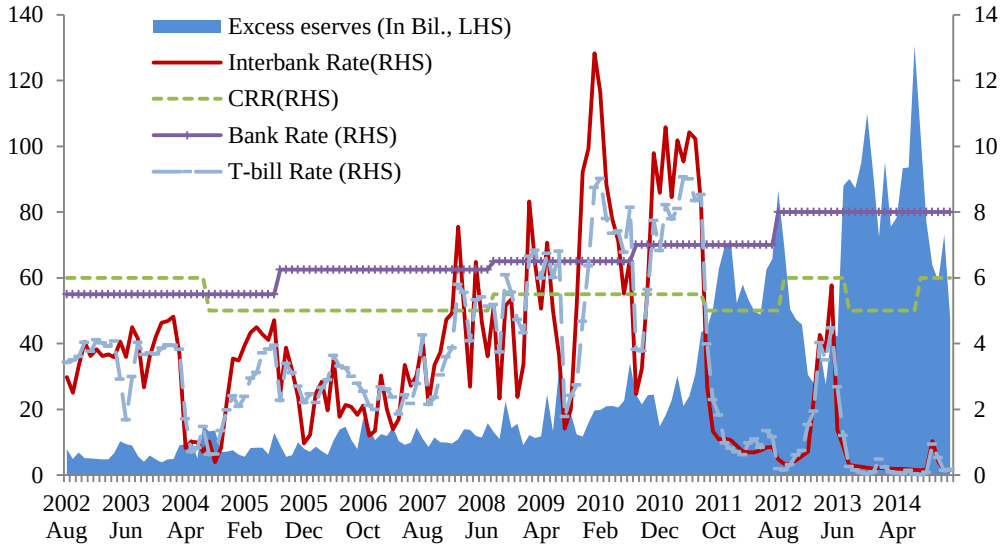
This paper follows a narrative approach to identify the monetary policy shocks and subsequent reactions of the economy. Basically, the paper follows the idea in Romer and Romer (1989), and Berg et al. (2013). The narrative approach focuses on the non-statistical approach to identify the monetary policy shock. Romer and Romer (1989) argues that the method involves " using the historical records … to identify episodes when there were large shifts in monetary policy or in the behavior of the monetary sector that were not driven by developments on the real side of the economy." This paper also considers the behavior of the Nepalese monetary sector in order to identify the monetary policy shock. In the current context that data are unavailable on most of the real sector variables, this approach serves better for analyzing monetary policy transmission in the Nepalese context. Thus, this section begins with the analysis of key development in Nepalese money market and the policy reactions during the period 2002-2014.

[14] The inclusion of the development banks and finance companies in broad monetary survey since 2011/12 has created the break in NDA data in fiscal year 2011/12.

Development in the Nepalese money market

The key development of the Nepalese monetary sector shown in Figure 6 clearly indicates that the Nepalese monetary sector witnessed the shocks and volatility after 2007. This period was associated with the acceleration of remittance inflows, the continuation of the peace process, and the financial crisis in the developed world. More importantly, the financial sector reform started in 2002 resulted in the rapid financial development and an increased role of the market during this period. The interbank rate and T-bill rate are volatile and move together closely (Figure 6). The money market rates and excess reserves of the commercial banks show the clear pattern as traditionally hypothesized in the market for bank reserves (See, for more discussion, Kuttner and Friedman, 2010). The volatility in the liquidity and money market rate indicates the issue of monetary policy implementation.

Figure 6: Money Market Rates and Excess Liquidity

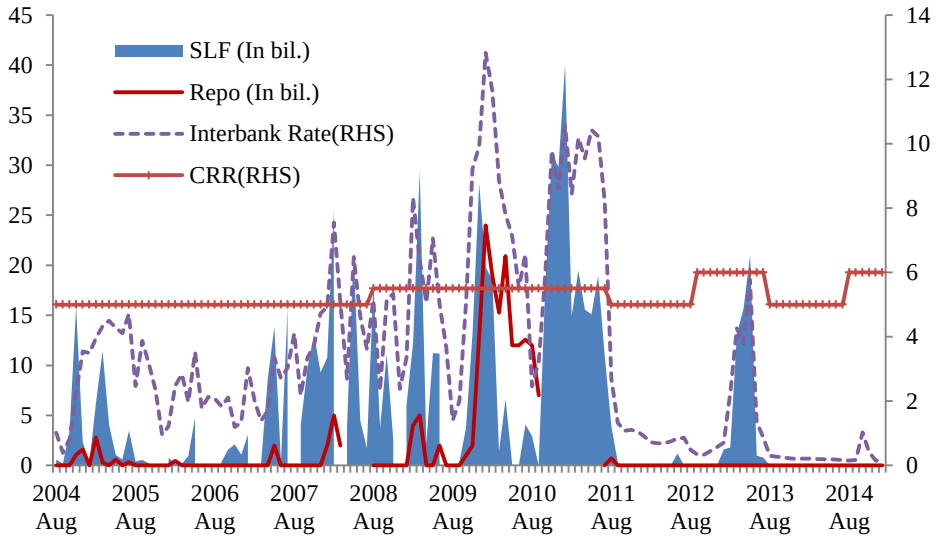


Data source: NRB.

The NRB monitors the excess liquidity of the banks and projects the future liquidity situation based on liquidity monitoring and forecasting framework (LMFF). However, the policy responses to economic disturbances involved lag and seem inadequate to some extent in some recent episodes. Such lags in responses are the results of data lags on major economic indicators[15] and high information asymmetry in the economy. During the period of liquidity shortage, the NRB provides liquidity support through discount window facility (SLF) and open market operations (Repo and outright purchase). The NRB responded to the liquidity shortage through repo until September 2010, but, for the later period of entire liquidity crunch until July 2011, the NRB did not respond through OMOs (Figure 7a).

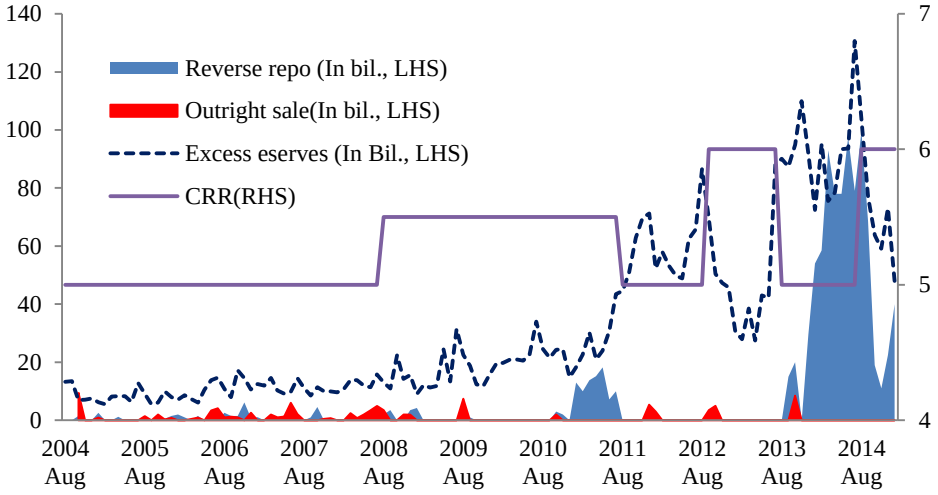
[15] Currently, data the gross domestic product are not regularly available on quarterly basis, which severely constrains the analysis of macroeconomic development, and the need for policy reactions.

Figure 7a: Monetary Policy Reactions



Data source: NRB.

Figure 7b: Monetary Policy Reactions



Data source: NRB

The NRB uses reverse repo and outright sale in order to absorb excess liquidity in the market, which is shown in Figure 7b. In the period of excess liquidity situation from March 2011 to November 2012, no instruments had been used to absorb excess liquidity. And, the NRB started using reverse repo and outright sale after August 2013 to mop up excess liquidity, but the small holdings of government securities by the NRB (about 15 billion during the period) was one of the limitations to stabilize the market through absorbing adequate liquidity. Figure 7b shows the cumulated amount of reverse repo in each month. The NRB also introduced the interest based deposit auction facility in 2014 to mop up structural liquidity surplus.

Identifying the episodes

The narrative approach begins with a task of defining and identifying the monetary policy shock. Broadly, McCallum (1999) defines policy shocks as "the random, unsystematic component of the monetary authorities' actions i.e., the portion that is not related to the state of the economy, current or past." More specifically, Romer and Romer (1989) consider an episode as a monetary policy shock in which a central bank undertakes contractionary actions in the economy to reduce the inflation. Such a narrow definition of policy shock used in Romer and Romer (1989) cannot be applied in the Nepalese context because of the recent history of monetary policy, less frequent changes in the policy rates, and the exchange rate peg (anchoring the price level). Thus, this paper takes a broad consideration of policy shocks, including both the expansionary and contractionary policy shocks, which are associated with the unusual (excessive) changes in remittance inflows and corresponding net liquidity injection in the Nepalese banking system.

In the context of Nepal, it is reasonable to define the monetary policy shock based on the unusual changes in remittance inflows and subsequent developments in the Nepalese monetary sector. The remittance inflows, which covers about more than 65 percent of inflows (total credits) in the Nepal's balance of payments and amounts about 25 percent of GDP[16], plays crucial role in driving the money market liquidity. If there is no sterilization of the remittance inflows, the increase in remittance inflows and, thus, net liquidity injection through foreign market operation by the NRB act as expansionary monetary policy shocks, which are purely exogenous, not driven by the development in the real sector of the economy. This paper tries to exploit the information from such episodes of excessive growth (unusual decline) of remittance inflows in order to identify the policy shock and its impact on the economy.

A number of things need to be considered in order to isolate the exogenous policy changes (due to unusual changes in remittances inflows) from the endogenous monetary policy responses to the real sector developments. Though the remittance inflow is a prime factor, driving liquidity in the banking system, other development in the money market needs to be considered during such episodes. For instance, the government budgetary operation is also seasonal in nature, influencing the liquidity in the Nepalese banking system. The Nepalese government usually spends a large portion of the budget in the end of a Fiscal year (about June and July), which also contributes to the growth of liquidity in the banking system during that period. The seasonality created by the festivals seasons and the credit growth are also important factors that need to be considered.

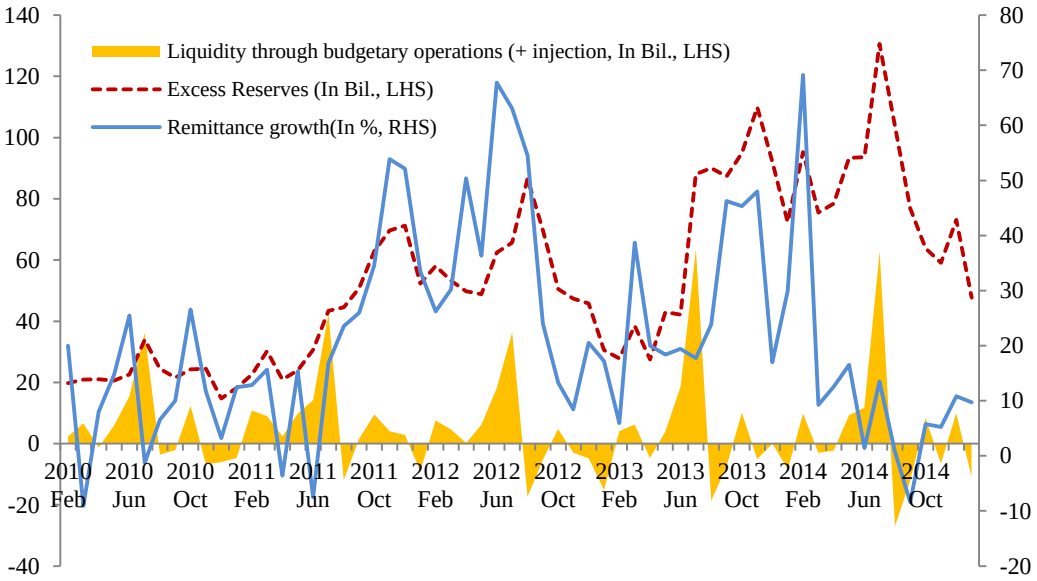
Given the development in the monetary sector, this paper considers the period only after 2009 which was associated with the large volume of remittance inflows, and high volatility in the money market. Figure 8 shows the growth of remittances, the liquidity changes due to budgetary operations, and the excess reserves of the commercial banks. The government budgetary operations[17] clearly show the seasonal pattern, which also contributes in the volatility of liquidity

[16] These figures are only the remittances from formal channels. If the remittances from informal channels (particularly, Hundi system) is taken into account, such figures will be higher with more impact on the banking system liquidity.

[17] The liquidity through government budgetary operations is computed by subtracting government revenue (the sum of revenue, internal loans, VAT fund account, and the Custom fund account) from its actual total expenditure on cash basis.

in the money market. The government budgetary operations also create the liquidity shock in some episodes due to the unexpected changes in expenditure though the NRB tries to forecast liquidity based on the projected government expenditure. The period from August 2011 to December 2011 involved excessively higher growth of remittance inflows and, thus, buildup of excess liquidity in the banking system. During the period, the influence of government budgetary operations on liquidity seems minimal. On the other hand, the sharp decline in remittance inflows and corresponding liquidity shortage in the banking system during the period from August 2012 to January 2013 can be considered as a kind of negative monetary policy shock. Likewise, the period August 2013-April 2014 was also highly guided by the remittance inflows and liquidity volatility. The remittance growth and subsequent net liquidity injection through foreign exchange (FX) purchase by the NRB explains the sources of volatility in liquidity and money market rate in Nepal in recent years.

Figure 8: Evolution of Excess Reserves, Remittances and Budgetary Operations



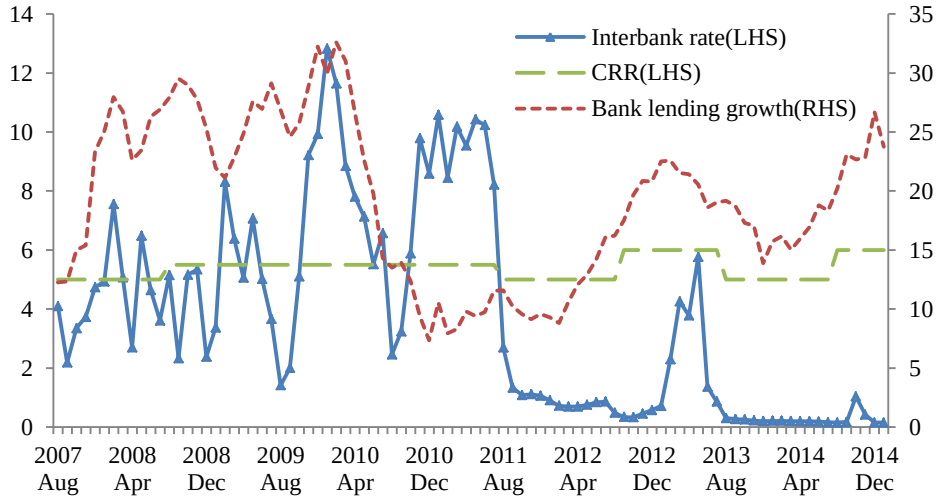
Data source: NRB.

The bank lending channel

The event analysis of policy changes in the period 2010-2014 provides the evidence on the working of bank lending channel in Nepal. The bank lending seems responding to the liquidity situation and the changes in the interbank rate (Figure 9). However, there is a lag of few months in the response of the bank lending growth to the changes in liquidity situation (and interbank rate). During the period of excess liquidity and decline in the money market rate, the bank lending shows the tendency to grow up. On the other hand, the liquidity shortage period contracts the bank lending growth. In addition, the data also reveals the short-time lag of the liquidity shortage to have impact on bank landing than the excess liquidity situation. For instance, the interbank rate went to a very low level in September 2011 and August 2013 after build-up of excess liquidity due to shocks, but the bank lending started to increase only after about four months. On the other hand, when there was a liquidity pressure in the banking system due to the sharp decline in the growth of remittance inflows in January 2013, the bank lending

started declining only after March 2013. The high information asymmetry and the adjustment costs in the Nepalese financial market is largely responsible for the lag in bank lending channel. Thus, the NRB can take the benefit of active bank lending channel through liquidity management and thus guiding the money market rate in desired path over the medium run.

Figure 9: Money Market Rates and Bank Lending Growth
(In percent)



Data source: NRB.

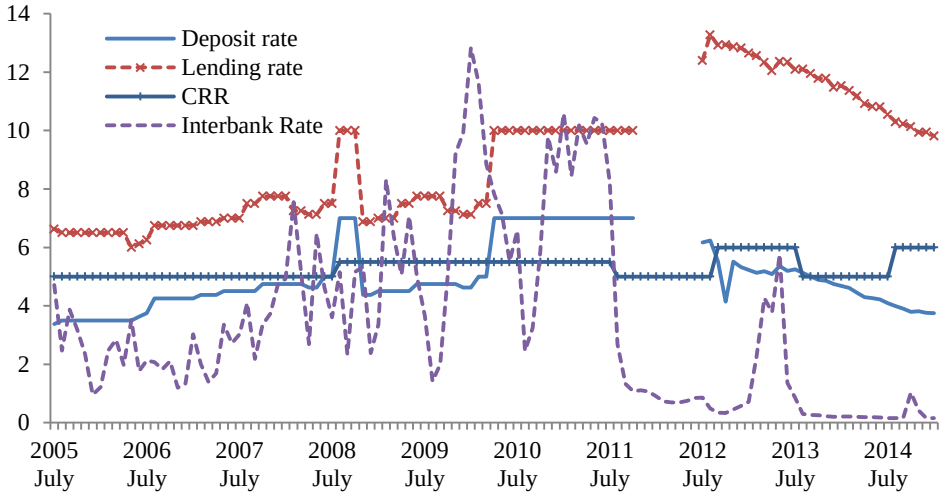
The interest rate channel

The interest rate channel of the Nepalese monetary policy is weak with delayed response of deposit and lending rate to the money market rate and liquidity situation. However, the analysis is highly limited by the data constraints on the interest rates. The data on weighted interest rates on deposits and bank lending are available only after 2012 July which limits the analysis of interest rate pass-through. The general tendency in the Nepalese money market is that the deposit rate and lending rate respond more to the liquidity shortage and rising money market rate than to the situation of excess liquidity and declining interbank rate. In other words, the downward adjustments in deposit and lending rate are slow and gradual than upward adjustment (Figure 10). Given the fact that NRB's operating procedure focuses more on the excess reserves of banks, the money market rate became more volatile with the changes in the NFA (primarily due to remittance inflows), and other factors affecting liquidity. One of the outcomes of such high volatility in money market rate is the stickiness of bank lending and deposit rates.

The major limitation on the interest rate pass through is the lack of data availability on deposit and lending rates for the long-time period. However, the paper simply estimates the correlation based on the available data for the period 2012-2015. The contemporaneous correlation between the deposit rate and the interbank rate is 0.24, and such correlation between the lending rate and the interbank rate is 0.20, which is lower than the estimated correlation for advanced and emerging economies (Mishra et al. 2010). The small value of the correlation of the lending rate with money market rate than deposit rate implies the higher level of rigidity of the lending rate in Nepal.

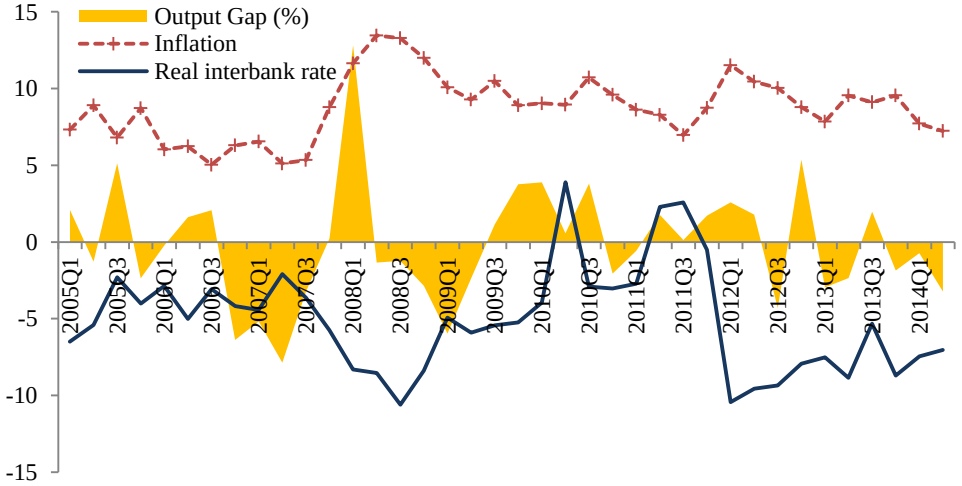
There is no clearly indicated relationship between the real economic activity and monetary conditions indicated by the real interbank rate, as shown in Figure 11. Output gap is estimated by using HP filter based on the deseasonalized quarterly data. Figure 11 show the output gap (in percent of GDP) and the real interbank rate, which do not reflect the clear relationship. However, this analysis may be severely constrained by the reliability of the GDP data.

Figure 10: Policy Rates and Other Interest Rates



Data source: NRB.
Note: Deposit and lending rates are averages of lower and upper bound rates until Oct. 2011.

Figure 11: Output Gap, Inflaiton and Real Interbank Rate



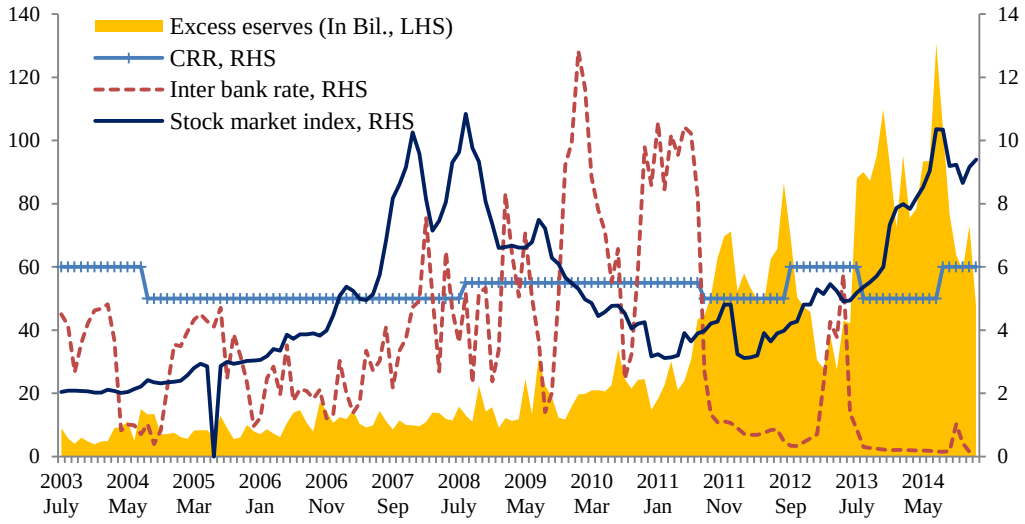
Data source: NRB and authors' estimates.

Asset price channel

Though the data on a broad set of assets prices are not available in Nepal, the inference on the working of asset price channel can be obtained by linking the stock prices and bank lending (a major portion diverted into real estate sector in the past episodes). The working of asset price

channel is indicated by the fact that the volatility of stock prices is clearly guided by the liquidity situation in the money market since 2011 (Figure 12). For instance, in the situation of the excess liquidity in August 2011-December 2011, and August 2013-January 2014, the stock price index increased sharply. But, the stock market boom during 2007-2008 (shown in Figure 12) was just a result of irrational exuberance of market players along with real estate price boom which was finally checked by NRB through monetary policy tightening and macro prudential tools.

Figure 12: Stock Market Index, Liquidity and Money Market Rates



Data source: NRB.
Notes: NEPSE index is normalized by dividing it by 100.

V. Identifying monetary policy chock: A SVAR approach

One of the widely used empirical approaches in measuring monetary policy is the use of structural VAR models which try to isolate exogenous monetary policy shocks from endogenous responses to macro variables by incorporating structural features of an economy in the model. This paper also attempts to identify the monetary policy transmission in Nepal by using the SVAR approach of Bernanke and Mihov (1998). Identification of the model is a major challenge in the SVAR, which requires reliable and valid assumptions about monetary policy procedure and the structural features of an economy. Bernanke and Mihov (1998) approach includes the use of reserve market and monetary policy operating procedure in order to identify the monetary policy shock. In consideration of the operating procedure of the Nepalese monetary policy, the approach in Bernanke and Mihov (1998) fits in the Nepalese context too. However, data limitation is a major weakness in the estimation of SVAR model in the case of Nepal.

This paper estimated the five variables SVAR model based on the quarterly data for the period 2005Q1-2014Q2. The variables include the GDP, CPI, total reserves (TR), non-borrowed reserves (NBR), and interbank rate (IR). GDP and CPI are macroeconomic variables/ non policy variables and other three are policy variables. All variables are expressed in log except interbank rate. The general description of the SVAR is given in Appendix B.

Identification of the model

Bernanke and Mihov (1998) use the market for commercial bank reserves and operating procedure of the Federal Reserve to identify the monetary policy shock. Their approach begins by stating $z_t = (Y_t, M_t)'$ and $\varepsilon_t = (\varepsilon_t^Y, \varepsilon_t^M)'$ where Y_t stands for a $N \times 1$ vector of macroeconomic (non-policy related) variables, M_t for a $N \times 1$ vector of policy related variables, ε_t^Y for a $N \times 1$ vector of non-policy related shocks and ε_t^M for a $N \times 1$ vector of the policy related shocks. The vector of macroeconomic variables in this paper includes the gross domestic product, and the consumer price index. Likewise, the policy variables include the money market rate, the total bank reserves and non-borrowed reserves.

The information on the stance of monetary policy is obtained from the reserve market. It is assumed that the macroeconomic (non-policy) variables in Y_t are not affected contemporaneously by policy related variables in M_t which enables us to impose restrictions on the corresponding part of the matrix A (See, Appendix B). On the other hand, the macroeconomic variables are allowed to affect the policy variables contemporaneously. More importantly, the relationship between VAR residuals and the structural shocks in the policy block is established by using the market for reserves. The reserve market of commercial banks as mentioned in Bernanke and Mihov (1998) can be represented by the following system of equations:

$$\mu_t^{TR} = -\alpha\mu_t^{IR} + \varepsilon_t^D \text{.....} (7)$$

$$\mu_t^{BR} = \beta(\mu_t^{IR} - \mu_t^{BN}) + \varepsilon_t^B \text{.....} (8)$$

$$\mu_t^{NBR} = \varphi^D\varepsilon_t^D + \varphi^B\varepsilon_t^B + \varepsilon_t^{MP} \text{.....} (9)$$

This system of equations links the residuals in reserves with the unobserved structural shocks. ε_t^d, ε_t^B and ε_t^{MP} are the structural shock to reserve demand, reserve borrowing and the monetary policy shock respectively. Equation (7) simply shows that the residuals in total reserves demand (TR) is determined by innovation in money market rate (IR) and the structural shock ε_t^d. As shown in equation (8), the residuals in borrowed reserves depend on the difference between money market rate and discount rate (Bank rate–BN) and the structural shock ε_t^B. The equation (9) explains the behavior of the central bank (open market operations) in the sense that the supply of non-borrowed reserves (NBR) by the central bank depends on the shocks to the demand for total reserve and borrowed reserves as well as monetary policy shock unrelated to reserve demand. The coefficients φ^d and φ^B shows the reaction of central bank to total reserves and borrowed reserve demand shock.

In order to express relation between the reduced form residuals to structural form shocks, Bernanke and Mihov (1998) assumes zero innovation in discount rate. With this assumption, the equation (7), (8) and (9) can be written as:

$$\begin{bmatrix} 1 & 0 & \alpha \\ 0 & 1 & 0 \\ -\frac{1}{\beta} & \frac{1}{\beta} & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{TR} \\ \mu_t^{NBR} \\ \mu_t^{IR} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ \varphi^D & 1 & \varphi^\beta \\ 0 & 0 & -\frac{1}{\beta} \end{bmatrix} \begin{bmatrix} \varepsilon_t^D \\ \varepsilon_t^{MP} \\ \varepsilon_t^B \end{bmatrix} \text{.....} (10)$$

In other words, we can solve the system assuming the condition that the equilibrium in the reserve market requires the equality between reserve demand and reserve supply, that is, TR=BR+NBR. Using the equilibrium condition, we can solve for μ_t^{IR} from equation (7), (8) and (9) as follows:

$$\mu_t^{IR} = -\frac{(1+\varphi^B)}{(\alpha+\beta)}\varepsilon_t^B + \frac{(1-\varphi^D)}{(\alpha+\beta)}\varepsilon_t^D - \frac{1}{(\alpha+\beta)}\varepsilon_t^{MP} \quad \text{..... (11)}$$

Thus, the reduced form equation for total reserve demand is given by the following equations:

$$\mu_t^{TR} = \frac{\alpha(1+\varphi^B)}{(\alpha+\beta)}\varepsilon_t^B + \left[1 - \frac{\alpha(1-\varphi^D)}{(\alpha+\beta)}\right]\varepsilon_t^D + \frac{\alpha}{(\alpha+\beta)}\varepsilon_t^{MP} \quad \text{..... (12)}$$

The system of equations linking the residuals from reduced form to structural form shocks can be written as:

$$\begin{bmatrix} \mu_t^{TR} \\ \mu_t^{NBR} \\ \mu_t^{IR} \end{bmatrix} = \begin{bmatrix} 1 - \frac{\alpha(1-\varphi^D)}{(\alpha+\beta)} & \frac{\alpha}{(\alpha+\beta)} & \frac{\alpha(1+\varphi^B)}{(\alpha+\beta)} \\ \varphi^D & 1 & \varphi^B \\ \frac{(1-\varphi^D)}{(\alpha+\beta)} & -\frac{1}{(\alpha+\beta)} & -\frac{(1+\varphi^B)}{(\alpha+\beta)} \end{bmatrix} \begin{bmatrix} \varepsilon_t^D \\ \varepsilon_t^{MP} \\ \varepsilon_t^B \end{bmatrix} \quad \text{..... (13)}$$

Following Bernanke and Mihov (1998), the monetary policy shock derived from the system (14) is given by:

$$\varepsilon_t^M = -(\varphi^D + \varphi^D)\mu_t^{TR} + (1+\varphi^B)\mu_t^{NBR} - (\alpha\varphi^D - \beta\varphi^B)\mu_t^{IR} \quad \text{..... (14)}$$

There are seven unknown parameters in system (13) which we need to estimate from six covariances. Thus, in order to identify the model, Bernanke and Mihov(1998) takes help of different type of monetary policy operating procedures of central banks. Given the reserve targeting procedure adopted by NRB, this paper examines only the case of non-borrowed reserve targeting to identify the model. Under this targeting procedure, the assumption is that non-borrowed reserves respond only to policy shocks which results in $\varphi^B = 0$ and $\varphi^D = 0$. As a result, the monetary policy shock in (14) is given by μ_t^{NBR}. With two additional restrictions, this model is over identified. The estimation approach includes the estimation of reduced form VAR by OLS and gets the coefficients. And, the second step is to match the second moments of the particular theoretical model to the covariance matrix of the policy sector VAR residuals (Bernanke and Mihov, 1998).

Estimated results

Table 1 shows the coefficient estimates for the reserve market parameters. Both the responsiveness of TR to IR (α) and the responsiveness of borrowed reserves to IR (β) have the expected sign as argued in theory though only the β is statistically significant. Figure 13 presents the accumulated impulse response of GDP, CPI, and IR to an expansionary monetary policy shock by the reduction in interbank rate by 100 basis points. After expansionary monetary policy shock, GDP increases in the beginning with peak impact about 3rd quarter and then impact decays to zero by about 8th quarter. Likewise, CPI also gradually increases after the expansionary monetary policy reaching its peak by about 6th quarter and finally impact decays by about 10th

quarter. In response to expansionary policy shock, the interbank rate continuously decreases over the period of time. The results of SVAR are suffered from a number of limitations. First, the short-time span is one of the limitations in the estimation of the SVAR. Second, the error bands have not been included in the impulse responses, which need to be added to check the significance of the estimates. Third, the use of monthly data, as used in Bernanke and Mihov (1998), may improve the results.

Table: 4: Estimates of Reserve Market Parameters

	α	β
Coefficients	0.23	0.02
p-value	0.16	0.00

Figure 13a: Impulse Responses of GDP and CPI to Monetary Policy Shock

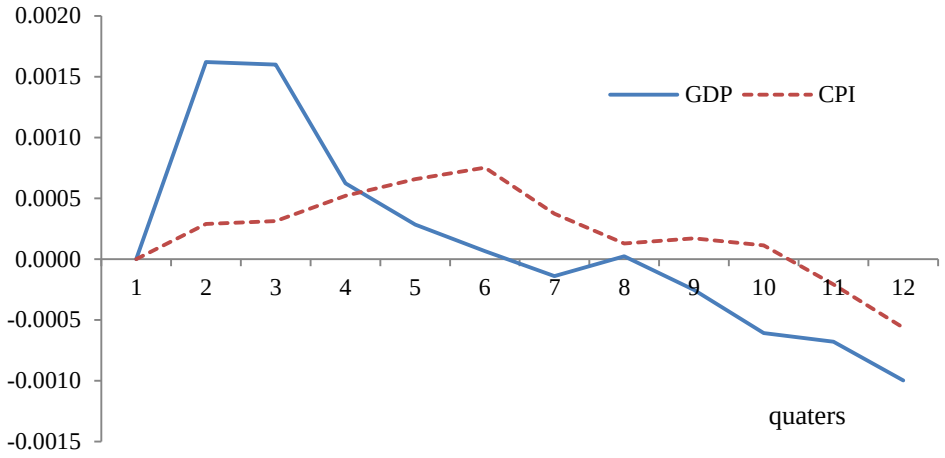
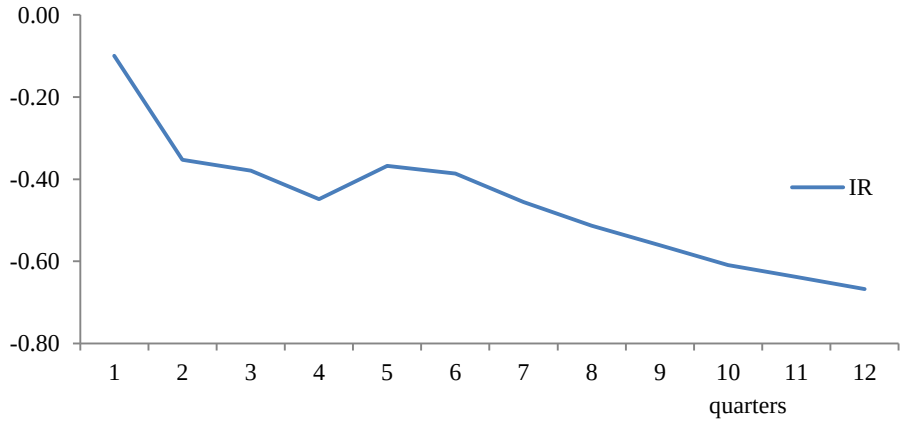


Figure: 13b: Impulse Responses of IR to Moneary Policy Shock



VI. Conclusion

The paper has attempted to analyze the transmission of monetary policy in Nepal using the narrative approach and the SVAR approach based on the data for the period 2002-2014. Moreover, the paper examines whether the Nepalese inflation converges to the Indian inflation, and the Nepalese monetary policy has gained independence in the context of the exchange rate peg of the Nepalese Rupee with the Indian Rupee. Given the data unavailability on the GDP for the long-period, the paper mainly relies on the narrative approach to identify the monetary policy transmission. In addition, the paper also discusses the monetary policy development, and the money market development in recent years.

The analysis of monetary policy transmission is important for the appropriate design and implementation of the Nepalese monetary policy. Thus, it is important for the NRB to identify the transmission channels of the Nepalese monetary policy, keeping in view the exchange rate peg and the capital account policy. Despite the importance of the topics, only very few of the empirical literatures addressed the issue of monetary policy transmission in Nepal. This paper tries to fill the gap in the research and also provides the foundations for further research on the Nepalese monetary policy. Thus, the paper considers the time period only after the announcement of the Nepalese monetary policy since 2002 and attempts to use the number of macro indicators and alternative approaches in order to identify the transmission channels.

The results of the paper show the evidence of the monetary policy transmission in Nepal. First, the paper shows that, given the peg, the monetary stability largely depends on the India due to the convergence of the price level in Nepal to the Indian price level in the long-run. The pass-through from Indian inflation to the Nepalese inflation takes about 4-8 months. Second, despite the peg, the Nepalese monetary policy is relatively independent because of the partially liberalized capital account in recent years. There is divergence in the monetary market rates and policy rates in Nepal, and India. Third, the narrative approach of identifying monetary policy transmission shows that there exist the bank lending, asset prices, and the interest rate channel in Nepal. However, there is lag in policy transmission due to the high information asymmetry, adjustment costs and poor financial infrastructure. The weak correlation of lending rate and the deposit rate with the interbank rate shows the weak interest rate pass-through.

The SVAR approach of measuring monetary policy and the analysis of money market development also show the interesting results. The SVAR approach provides the evidence of the monetary transmission in Nepal. The analysis of the money market development shows that the volatility in the Nepalese money market is largely determined by the remittance inflows and subsequent change in net foreign assets in recent years. The volatility in the money market liquidity and thus the interbank rate clearly raises the question over the operating procedure and the implementation aspects of the Nepalese monetary policy.

In addition, it also indica Moreover, other important considerations in the Nepalese monetary policy are the price-based operating target (money market rate) instead of the quantity based (excess liquidity of the commercial banks), and the improvement in institutional framework by introducing the monetary policy committee.

This paper contributes to the area of Nepalese monetary policy and provides new dimension for the research on Nepalese monetary policy. The evidence of the monetary transmission channels indicates that the NRB can use its policy to achieve the specified objectives for a certain time horizon. Likewise, the analysis of the money market reflects that the NRB need to review its operating procedures and the implementation aspects of the monetary policy in order to enhance the effectiveness of the monetary policy. Despite these implications, some limitations need to be considered. The short-time span and the data on GDP is one of the limitations in the SVAR approach. In addition, some additional improvement still remains to be done in the estimation of the SVAR. Despite the limitations, this paper has made contribution in the area of the Nepalese monetary policy.

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Table 1: Targets vs Actuals of Nepalese Monetary Policy

Variables		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Inflation (%)	Projected	4.0	4.3	4.0	6.0	6.0	7.5	7.0	7.0	7.0	7.5	8.0	8.0	8.0
	Actual	3.8	6.0	4.9	6.5	6.5	6.9	14.1	9.2	12.1	7.4	9.7	9.1	-
Broad Money growth (%)	Target	12.0	11.2	12.5	13.0	16.1	15.6	18.5	17.0	15.0	15.0	16.0	16.0	16.0
	Actual	9.8	12.8	8.3	15.6	14.0	25.2	27.3	14.1	12.3	22.7	16.3	12.4	-
Foreign exchange adequacy (in months)	Target	-	-	-	-	-	-	-	6.0	6.0	8.0	8.0	8.0	8.0
	Actual	-	-	-	-	-	-	-	7.4	7.3	10.3	10.1	10.0	-
Balance of Payment Surplus (Rs. in billions)	Target	3.5-4.0	2.0	5.5	4.5	16.0	8.0	12.0	18.0	9.0	5.0	-	-	-
	Actual	4.4	16.0	5.7	25.6	5.9	29.7	44.8	-3.6	2.9	127.7	-	-	-

Table 2. Results of ADF Unit Root Tests

Variables	Level	First Difference
p_i	0.89(0.99)	-8.89(0.00)*
p_n	0.96(0.99)	-3.15(0.02)**
$lnRM$	0.69(0.98)	-6.65(0.00)*
$lnREM$	-0.15(0.97)	-15.39(0.00)*

Notes: 1. * and ** denote the statistical significance at the 1% and 5% level respectively.
2. The numbers within the parentheses for the ADF statistics are the p-values.

Table 3: Results of Johansen Cointegration Test

No of CEs	Trace test		Maximum Eigenvalue test	
	Statistic	5 % critical value	Statistic	5 % critical value
None	24.58*	15.49	24.58*	14.26
At most 1	0.002	3.84	0.002	3.84

Note: * denotes the statistical significance at the 1 % level.

Table 4: Results of Johansen Cointegration Test

No of CEs	Trace test		Maximum Eigenvalue test	
	Statistic	5 % critical value	Statistic	5 % critical value
None	21.22*	15.49	21.18*	14.26
At most 1	0.005	3.84	0.005	3.84

Note: * denotes the statistical significance at the 1 % level.

Appendix A: Variables, Data and Sources

Gross domestic product (GDP)	Quarterly National Accounts of Nepal, Central Bureau of Statistics (CBS), Nepal
Interbank rate	Quarterly Economic Bulletin (QEB), NRB.
Call rate (India)	Database on Indian Economy, Reserve Bank of India.
Cash reserve ratio (CRR)	QEB (Various issues), NRB.
Bank rate	QEB (Various issues), NRB.
Cash reserve ratio (India)	Database on Indian Economy, RBI.
Bank rate (India)	Database on Indian Economy, RBI.
Consumer price index	International Financial Statistics, IMF.
Consumer price index(India)	International Financial Statistics, IMF.
Inflation rate	QEB (Various issues), NRB.
Inflation rate(India)	International Financial Statistics, IMF.
Monetary base	QEB (Various issues), NRB.
Net foreign assets(NFA)	QEB (Various issues), NRB.
Net domestic assets(NDA)	QEB (Various issues), NRB.
Remittance inflows(REM)	Balance of Payment Division, NRB.
T-bill rate	QEB (Various issues), NRB.
Excess reserves	Computed from various issues of QEB, NRB.
Repo, reverse repo, and outright sale	QEB (Various issues), NRB.
Standing liquidity facility	QEB (Various issues), NRB.
Liquidity through budgetary operations	Handbook of Government Financial Statistics, NRB.
Bank lending growth	QEB (Various issues), NRB.
Interest rates(Deposits and lending)	QEB (Various issues), NRB.
Output gap	Estimated using HP filter based on the CBS data.
Stock market index	Current Macroeconomic Situations (Various issues), NRB.
Borrowed reserves of the banks	QEB (Various issues), NRB.
Total reserves of the banks	QEB (Various issues), NRB.

Appendix B: Description of the SVAR

The starting point of measuring monetary policy using structural VAR in general includes the model of the following form:

$Az_t = C(L)z_{t-1} + B\varepsilon_t$……. (2)

Or, $[A - C(L)]z_t = B\varepsilon_t$

Where z_t is a $N \times 1$ vector of endogenous variables with $z_t = z_{1t}, \dots, z_{nt}$, ε_t is a $N \times 1$ vector of structural shocks with $var(\varepsilon_t) = \Omega_\varepsilon$. C(L) is a $N \times N$ matrix of lag polynomial, A is an invertible $N \times N$ matrix showing the contemporaneous relations among the variables and B is a $N \times N$ matrix with non-zero off-diagonal elements showing the direct effects of some shocks on more than one endogenous variables. ε_t are orthogonal white-noise structural disturbances.

The reduced form VAR corresponding to (2) can be written as

$z_t = R(L)z_{t-1} + \mu_t$……. (3)

Where μ_t is a $N \times 1$ vector of residuals of the variables with $var(\mu_t) = \Omega_\mu$. The identification of the model requires imposing some restrictions on the matrix A and B.

Bernanke and Mihov (1998) identify the model taking into account the operating procedure of the monetary policy by central bank and thus imposing restrictions correspondingly. In this approach, there are non-zero off-diagonal elements in matrix B. Given the non-zero off diagonal elements of B, orthogonality assumption of structural innovations and denoting short-run contemporaneous matrix by A, the relation between structural and reduced form is given by the following equations:

$B\varepsilon_t = A\mu_t, \quad \varepsilon_t = B^{-1}A\mu_t$ …….. (4)

$R(L) = -A^{-1}C(L)$…….. (5)

$\Omega_\mu = A^{-1}B\Omega_\varepsilon B'A^{-1'} = A^{-1}BB'A^{-1'}$…….. (6)

The identification of model in this approach is to impose restrictions on both matrixes A and B in equation (6). Both A and B are $N \times N$ matrix which implies $2n^2$ total unknown elements. The left hand side of equation (6) shows only $n(n+1)/2$ independent equations. Thus, the identification of the model is achieved by imposing $2n^2 - n(n+1)/2$ additional restrictions on the matrix A and B. Setting diagonal elements of A to unity lefts us to impose $2n^2 - n - n(n+1)/2$ additional restrictions to identify the model.