Impact of Monetary Policy on Sectoral GDP through Sectoral Lending: A Study of Lending Channel of Monetary Transmission

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ABSTRACT

This study investigates the impact of monetary policy changes on different economic sectors covering the period from 2011/12Q1 to 2019/20Q4. More specifically, the study deals with how changes in interest rate and money supply caused by monetary intervention impact the different economic sectors in Nepal. Quarterly disaggregated data of commercial banks and sectoral real GDPs data are used to assess the impact. The study tests monetary policy effect on sectoral bank lending according to bank type using fixed effect balanced panel regression. And sectoral bank lending effect on sectoral GDP was further assessed. The evidence shows that banks credit disbursement is significantly affected by monetary policy and change in sectoral loan disbursement affects sectoral GPD. The monetary policy effect has been found contributing to the growth of different economic sectors through bank lending. The study has important implications for the strength and effectiveness of the monetary policy for the growth of different sectors of the economy.

I. Introduction

This paper addresses simple and very old question namely: how monetary policy affects different economic sectors? Using 10 years of quarterly panel data on banks, this study has found the effect of monetary policy on different economic sectors. Beginning from the period of classical economists there are several studies on monetary transmission. Four different channels of monetary policy have been found in different economic literature till date. These channels are interest rate channel, lending channel, exchange rate and firms balance sheet channel. This paper intends to make contribution on the lending channel of monetary transmission. Bernanke and Gertler (1995) finds negative impact of contractionary monetary policy on bank lending. According to this paper

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contraction in monetary policy leads to increase in external finance premium for firms, making firms unattractive for borrowing money from banks. Kashyap and Stein (2000) made a significant contribution by testing whether bank specific characteristics like liquidity, size and capital affects transmission mechanism. Kakes and Sturm (2002) studies on whether lending channel differs for different bank types. The study segregated bank type on five different categories like commercial bank, specialised bank, saving bank, credit cooperative and universal bank. Gambacorta (2005) mentions inconclusive evidence in Europe as a gap and conducts a study taking disaggregated data of Italian banks using the models of Kashyap and Stein (2002) and concludes the existence of heterogeneity in the monetary transmission. There are other several studies in Europe on lending channel of monetary transmission. Studies like Ehrmann et al. (2003), Altunbas et al. (2002) and Favero et al. (1999) are well known studies based on the data from European countries. Though there are numerous literatures on lending channel, a very little is known about monetary policy on sectoral GDP through sectoral lending.

Nepal Rastra Bank (NRB), the monetary authority brings monetary policy usually in mid-July in Nepal after 1.5 months of budget. Government takes growth target, frame necessary policies and present budget on May 29 of each year (apart from few exceptions). Maintaining macro-economic stability and supporting growth target of nation are primary objective of monetary policy in Nepal. Depending upon the GDP growth and inflation target of government, central bank prepares its action plan and sets its financial target accordingly. It facilitates government by ensuring the adequate supply of money and making financial environment favourable for targeted growth. Commercial Banks (CB) uses money supply and interest rate as a tool for maintaining macro-economic stability. Does monetary policy affect real sector? If it affects than how it affects has been a very important questions these days. The motivation of this research is to assess the impact of monetary intervention on sectoral GDP. When central bank intervenes with its monetary instruments, it not only affects macroeconomic variables like inflation, interest rate and other it also affects bank's balance sheet and loan portfolio. Change in lending composition not only impacts banks business but also it affects the productivity of different sectors of the economy affecting whole financial system.

Examining monetary policy impact on GDP has become very important as financial institutions are the major supplier of funds to the real sector. NRB reports total credit/GDP ratio to be 103.2% with Rs. 4069 billion loan portfolios in May 2021. There are various published studies on similar issue, however evidence from previous researches is not conclusive. Similarly, most of the earlier studies on credit channel have been conducted using time series data comparing the relationship between bank lending and real sector. It is widely agreed by most of the researchers that time series data can generate misleading conclusion. The study also shows that time series data are not helpful in assessing the credit channel. Aggregate data on bank balance sheet items do not allow to differentiate between demand and supply factors that affects bank loan disbursement. However, disaggregated bank wise data effectively capture the distributional effects of monetary transmission. Similarly, previous studies have segregated bank type on the basis of liquidity, market capitalisation and asset size. There is gap in the existing body of knowledge from four fronts, i.e, empirical,

contextual, methodological and population gap. There are conflicts in the findings from several studies. Kashyap and Stein (1994) concludes bank lending channel did exist. By the late 1980s, however, evidence for this causal relationship appears to have disappeared, suggesting that the bank lending channel was no longer operative through commercial/industrial loans. Studies conducted by Loupias, Savignac and Sevestre (2002), Matosek and Sarantis (2009), Golodniuk (2006), Gunji and Yuan (2010) find mixed evidence. They concludes that lending of small banks is affected by monetary policy however large banks are not affected. Similarly, Brissimis (2005) finds that in US and UK the lending channel is not operative whereas lending channel is still operative in Japan however in Germany, France and Italy the lending channel is losing its potency. Suzuki (2004), Dave, Dressler and Zhang (2013), and Gonzalez and Grosz (2007) support the existence of lending channel. Similarly, Demello and Mauro (2010) and Cingano (2016) also concludes the existence of lending channel. On the other hand, Perez (1998) reports inconclusive findings. In summary, it can be said that findings from earlier studies are not uniform and inconclusive. There is also contextual gap in this issue, previous studies were conducted on the countries where the financial institutions have access to foreign fund. Access to foreign fund helps financial institutions to absorb the shock by borrowing funds from abroad. Limiting the study to the Nepalese data would contribute to the body of knowledge because the financial dynamics is completely different comparing with other countries. Nepalese banks do not have access to foreign funds. Furthermore, previous studies have tried to resolve endogeneity issue using lag of the dependent variable. As suggested by Bellemare, Masaki and Pepinsky (2017) uses genuine exogenous variable to deal with the endogeneity concern. Similarly, coverage of major economic sector is also a contribution of this study which is under researched or under-served by previous studies. And this study has numerically presented the complete channel of monetary transmission differentiating it from the earlier studies.

The remainder of the paper is organised as follows: Section II deals with the review of literature. Section III presents the details of the data and research methodology. Section IV presents the study results, findings and discussion. Finally, section V concludes the study with implication.

II. Literature Review

There are several theories explaining the relationship between monetary intervention and real sector. Quantity theory of money is the earliest theory of money. The classical theory of money is based on the quantity theory. Quantity theory of money states that supply of money and velocity of its circulation over the period of year determines GDP. Keynesian theory does not agree with the fundamental assumption of quantity theory of money. Keynesian theory states that expansionary monetary policy increases the loanable fund availability with the banks, increase in loanable fund causes decrease in interest rate, decrease in interest rate motivates increase in consumption and investment expenditure and increase in consumption and investment increases overall GDP of the nation. Similarly, monetary economist came with modification in quantity theory of money. In summary, either the change in short term interest rate or money stock causes changes in real variables.

Bernanke and Gertler (1995) notes that contraction of monetary policy leads to increase in external finance premium for firms, making firms unattractive for borrowing money from banks. Furthermore, there is also shift in lending of banks because of external finance premium. Karim et al. (2011) conducts similar study using dynamic panel data in Malaysia taking bank balance sheet data from 1993 to 2008 and using overnight interbank rate as a proxy of monetary policy. The study reveals that bank loan supply is significantly and negatively affected by contractionary monetary policy. The study claims that previous study conducted in Malaysia had misspecification error in their model. Agung (1998) introduces financial deregulation on bank lending channel. The study tried to assess whether monetary restrictions constrain credit disbursement and whether the effect is heterogeneous across different classes of lender. The study finds that because of access to foreign capitals and loan commitment, the monetary intervention does not constrain credit supply of large banks.

Brissimis (2005) contributes to the body of knowledge by introducing the impact of changes in financial markets in the potency of lending channel of 6 different industrial nations. The study finds that in US and UK the lending channel is not operative whereas lending channel is still operative in Japan however in Germany, France and Italy the lending channel is losing its potency. On the other hand, Cingano et al. (2016) measured the impact of liquidity shock on bank lending and bank lending shock on real sector using balance sheet data of 30000 non-financial firms from Italian Credit Registrar. This study notes unique negative consequences of contractionary monetary policy on firm level activity. Similarly, Demello and Pisu (2010) finds negative impact of interbank certificate deposit rate on bank lending suggesting the existence the lending channel. Similarly, the study also finds that equilibrium in interbank market can be obtained by changing interbank deposit certificate rate. Gunji and Yuan (2010) conducts study by segregating bank type as foreign, state owned, joint stock, city and credit cooperatives and found weaker evidence for larger banks and found no impact of capital on monetary transmission. Furthermore, the study also finds weaker evidence for profitable banks. Golodniuk (2006) investigates lending channel taking balance sheet data of 149 banks for the period 1998 to 2003 in Ukraine. The study concludes that small cap banks are more affected by monetary policies. Instead of taking supply side data, Gonzalez and Grosz (2007) uses demand side data of 3300 firms for assessing bank lending channel for Colombia and Argentina. The study finds that interbank interest rate affects lending indirectly through its interaction effect with capitalisation and liquidity. Existence of bank lending channel is found only for Colombia but not for Argentina.

Dave et al. (2013) conducts a study taking 4517 individuals using factor augmented vector auto regression. The study finds that bank's lending channel work through all sizes of banks. Similarly, bank lending channel is found prevalent than previously identified. Suzuki (2004) studies the existence of credit view in Japan by examining whether tightening of monetary policy affects real economy by shifting supply schedule of banks loan. The study considers GDP and CPI as dependent variable and short-term interest as independent variable as proxy of monetary policy. The results of this study support the credit review of lending channel.

Perez (1998) notes inconclusive finding as it found existence of lending channel for some firms and non-existence of lending channel for other firms. The evidence is weakest for Hungary. Hou and Wang (2013) notes different results for liquid and illiquid banks. Monetary policy impact is more sensitive for illiquid banks in comparison with liquid banks. Contrary with the finding of Kashyap and Stein (1995) and Kishan and Opiela (2000), this study did not find two other banks' characteristics size and capitalisation to have any effect on monetary transmission. Similarly, Nilsen (2015) conducts study taking disaggregated firm level data. The study considers money supply as proxy of monetary policy and bank lending as an independent variable. Similar, to earlier studies this study also supports lending channel. Furthermore, Kakes (2000) uses Johansen co-integration approach and vector error correction model to study lending channel of monetary transmission. The study uses quarterly data covering the sample period beginning from 1979:1 to 1993:4, this study finds non-existence of lending channel.

Fungacova et al. (2014) conducts a study on lending channel taking large sample panel data of European countries from the period 2002-2010. The study specifically investigates the role of bank competition on lending channel. The study finds weaker evidence for bank with extensive market power and strong evidence for bank with low market power before the financial crisis. Wide variation in market power leads to uneven effect of the single monetary shock. The study suggests that market power significantly impacts the effectiveness of monetary policy. Different from previous studies, Black and Rosen (2007) considers federal fund rate as a proxy of monetary policy to study both balance sheet and lending channel taking individual firm level data from the surveys. The study reports that bank adjust to the shock by reducing the maturity period of their loans. And banks reallocate the short-term supply of loan from small firms to large firm. Contrary with finding from other studies this study found strong evidence of monetary transmission for larger banks. Bottero, Lenzu and Mezzanotti (2020) on the other hand investigates the role played by bank's security portfolio in propagating the macro financial shock originated from outside of national border. The study assesses the impact of 2010 Greek bailout to Italian firms through credit contraction. The study finds that credit contraction was similar for smaller and large firms but found negative effect on investment and employment decisions for smaller firms.

Money supply and interest rate are the major monetary policy variable of monetary authority. All previous studies use either money supply or interest rate as a proxy of monetary policy to study bank lending channel. Studies like Kashyap and Stein (1995), Sengonul and Thorbecke (2005) and Ajung (1998) use short term interest rate as a proxy of monetary policy and finds existence of lending channel and studies like Palley (1991) and Kashyap and Stein (1995) uses money supply as a proxy of monetary policy and found positive impact on bank lending. As suggested by Black and Rosen (2007) and Brissimis and Magginas (2005) the study incorporates both money supply and interest rate and sectoral lending. Similarly, studying the lending channel using Nepalese data and numerical presentation of lending channel make this study different from earlier studies.

III. Data And Methodology

The study attempts to incorporate maximum number of banks and cover maximum time frame. Since commercial bank occupies more than 80% of loan disbursement, contribution to total loan portfolio from other categories like development, finance and micro credit institutions are negligible therefore the study dropped development, finance and micro credit banks. Similarly, commercial banks that came into operation after Oct 2011 and also the banks were acquired or cease to exist in between Oct 2011 to July 2020 were also dropped. After dropping few banks,

A total of 22 banks remained out of 27 commercial banks for the study. And sample time frame has been limited between 2011/12Q1 to 2019/20Q4 because of unavailability of quarterly sectoral lending data before Q1 of 2011/12. The study has collected sectoral lending data and other balance sheet indicators from the monthly statistics report of NRB. Monetary policy variables data have also been taken from NRB monthly macro-economic indicator and quarterly economic bulletin report. Similarly, the study took sectoral real GDP data from the official web source of CBS. The study has chosen the method that is most appropriate to test the hypothesis. In order to assess the impact of monetary intervention on different economic sectors, the study has run regression on two different steps:

1. First step: Monetary policy effect on bank sectoral credit.
2. Second step: Bank sectoral credit flow on sectoral GDP

The study used balanced panel fixed effect regression in order to remove omitted variable bias by measuring changes within groups across time. The study has used time fixed effect for controlling underlying observable and unobservable systematic differences between observed time units. And firm fixed effect for addressing time invariant unobserved firm heterogeneity. This study has performed Levin–Lin–Chu test for testing the stationarity of the data. Non stationary data have been transformed using natural log and first difference before running the regression.

a) Methodology to Assess Monetary Policy Effects through Bank Lending

The study has used the model of Kashyap and Stein (2000). And few more variables have been added as suggested by Ireland (2010), Karim, Saini and Karim (2011) and Cingano, Manaresi and Sette (2016). At first the equation on the assumption of only one bank, and only one monetary instrument in the economy. Bank loan is a function of monetary policy:

$$Ln\ \Delta SBL_{it} = f(MP) + X_{it} \dots\dots\dots\dots\dots \text{(i)}$$

Where S*BL* represents bank lending, MP represents monetary policy and represents other variables. Here, Xt represents bank specific and macro-economic variables which will be used as control variables. Based on Kashyap and Stein (2000) bank specific variable like "Liquidity", "Size" and "Capitalisation" has been incorporated as control variable. However, these variables cannot completely explain the variation in bank lending.

The extension of model assuming "k" number of banks with "i" type of lending:

$$Ln\ \Delta SL_{ik,t} = \beta_0 + \delta_{1*}MP_t + \cdots \beta_k * X_{ikt} + \varepsilon_t \dots \dots\dots\dots\dots\dots \text{(ii)}$$

Where, *SL* represents sectoral lending of type "i" for bank "k" at time "t". There are six lending categories corresponding to sectoral GDP. The lending categories are agriculture, production, electricity, gas & water, wholesale & retail lending, finance, insurance & real estate

and hotel & restaurant sector lending. represents monetary policy variables which are independent variables. The study has used short term interest rate (T-bill rate) and money supply as monetary policy variables. There are multiple sources which make identification difficult. In our case there is clear sign of simultaneity. The reason of increasing money supply could be GDP itself as monetary authority always tries to maximise the economic growth by ensuring adequate supply of money. As when GDP growth declines, monetary authority takes expansionary monetary policy by increasing money supply and by reducing short term interest rate to accelerate the GDP growth. As increase in money supply and decline in short term interest rate increases the aggregate consumption and aggregate investment in the economy which finally helps to increase aggregate output in the economy. Since monetary policy triggers GDP and GDP triggers monetary policy This is the case of reverse causality. Similarly, the study has also performed Durbin–Wu–Hausman (DWH) test and detected endogenous regressors. The study used GDP as regressor as an instrument.

$$Ln\ \Delta SL_{ik,t} = \beta_0 + \delta_1.MP_t + \delta_2.\Delta LnSGDP_{it} + \cdots \beta_k * X_{ikt} + \varepsilon_t \quad \text{……………(iii)}$$

There are multiple sources which make identification difficult. In our case there is clear sign of simultaneity. The reason of money supply using repo could be GDP itself as monetary authority always tries to maximise the economic growth by ensuring adequate supply of money. As when GDP growth declines, monetary authority takes expansionary monetary policy by increasing money supply and by reducing short term interest rate to accelerate the GDP growth. As increase in money supply and decline in short term interest rate increases the aggregate consumption and aggregate investment in the economy which finally helps to increase aggregate output in the economy. Since monetary policy triggers GDP and GDP triggers monetary policy. This is the case of reverse causality. Similarly, the study also performed Durbin–Wu–Hausman (DWH) test and detected endogenous regressors. The study used lag of GDP as regressor as an instrument. Bellemare, Masaki and Pepinsky (2017) however claims that lag of dependent variable doesn't completely captures the endogeneity, therefore genuine exogenous variable that strongly correlates with endogenous regressor is required to deal with the endogeneity concern.

Therefore, the study used major policy departure milestone in interest rate corridor (IRC) to construct an instrument variable. The instrument thus constructed is:

$$SL_{t_1}(t - t_1)I_{t_1 \le t \le t_2} + \sum_{k=2}^{3} SL_{t_k}(t - t_k)\left(I_{t_k < t \le t_{k+1}}\right) + SL_{t_4}(t - t_1)I_{4 < t}$$

The above has been developed combining major policy departures in 2016, 2018, 2019 and 2020. The expression has three components. They are: policy base year SL, time trend and indicator variable. This exploits the trend generated by the new policy and achieves the variation in the instrument by multiplying the trend variable by base value of interbank rate. This expression was used by Burgess and Pande (2005). In August 2017, IRC was introduced with upper band of 7% and lower band of 3%. In July 2018 upper band was reduced to 6.5% and lower band was increased to 3.5%. In July 2019 the lower band of the IRC was reduced to 3%. In July 2020 upper band was reduced to 6% and lower band was kept at 3%.

b) Methodology to Assess Sectoral Lending Effects on Sectoral GDP

The simplest form of equation representing sectoral lending effect on sectoral GDP assuming only one sectoral lending and sectoral GDP type is like this:

$$\Delta LnSGDP_{it} = f(SL) + X_{it} \quad \text{.................... (iv)}$$

Where, *SGDP* represents sectoral gross domestic product, SL represents sectoral bank lending and represents other control variables. The extended version of the above equation assuming multiple sectoral lending and multiple sectoral GDP is:

$$\Delta LnSGDP_{it} = \beta_0 + \Omega_{1*}\Delta LnSL_{it} + \cdots \beta_k * X_{ikt} + \varepsilon_t \quad \text{.................... (v)}$$

Where, *SGDP* represents sectoral gross domestic product of type "i" for time "t". There are 6 sectoral GDP variables. represents type of sectoral lending of type "i" for time "t". And represent control variables like capital expenditure, inflation and exchange rate. Since it has been evident from the past studies that monetary policies trigger the bank lending therefore monetary policy variables like tbill rate and money supply have been used as instrumental variables.

$$\Delta LnSGDP_{it} = \beta_0 + \delta_{2*}\Delta LnSL_{it} + \delta_{1*}MP_t + \cdots \beta_k * X_{ikt} + \varepsilon_t \quad \text{.................... (vi)}$$

Table I

Description of the Variables

Variables	Unit	Short Form	Description
T-bill rate	%	Tbill	Tbill rate at time "t".
Money supply	Rs. Billion	MS	Money supply volume at time "t".
Agriculture sector lending	Rs. Billion	ASL	Loan disbursed by bank "i" at time "t" on agriculture sector
Production sector lending	Rs. Billion	PSL	Loan disbursed by bank "i" at time "t" on production sector
Electricity, gas and water lending	Rs. Billion	ESL	Loan disbursed by bank "i" at time "t" on electricity, gas & water sector
Wholesale and retail lending	Rs. Billion	WRL	Loan disbursed by bank "i" at time "t" on wholesale & retail sector
Finance, insurance and real estate lending	Rs. Billion	FIRL	Loan disbursed by bank "i" at time "t" on finance, insurance & real estate sector
Hotel & restaurant sector lending	Rs. Billion	HRL	Loan disbursed by bank "i" at time "t" on hotel and restaurant sector
Agriculture sector gdp	Rs. Billion	AG	Agriculture sector gdp of Nepal at time "t".
Production sector gdp	Rs. Billion	PRO	Production sector gdp of Nepal at time "t".
Electricity, gas and water sector gdp	Rs. Billion	EG	Electricity, gas and water sector gdp of Nepal at time "t".

Wholesale and retail sector gdp	Rs. Billion	WR	Wholesale & retail sector gdp of Nepal at time "t".
Finance, insurance and real estate gdp	Rs. Billion	FIR	Finance, insurance & real estate sector gdp of Nepal at time "t".
Hotel & restaurant sector gdp	Rs. Billion	HR	Hotel & restaurant sector gdp of Nepal at time "t".
Size	%	Size	Size of bank "i" at time "t"
Liquidity	%	Liq.	Liquidity of bank "i" at time "t"
Capitalization	%	Cap.	Capitalisation of bank "i" at time "t"
Capital expenditure	Rs. Billion	Capex	Capital expenditure at time "y"
Exchange rate	Rs.	ER	Capital expenditure at time "T"
Inflation	%	Inf	Inflation at time "T"

IV. Results, Findings and Discussions

Table II illustrates the descriptive statistics of real GDP on six different categories. Overall, the agriculture sector had the highest contribution to the Nepalese economy with average of Rs. 60.8 billion/quarter and standard deviation of Rs. 4.7 billion. The 15th five-year plan of government has taken target to significantly change the composition of GDP by 2100/01 in its sustainable development target. The lowest contribution can be seen in hotel & restaurant sector with average of Rs. 3.12 billion and Stdev. of Rs. 0.5 billion. The quarterly GDP contribution of wholesale & retail trade and finance, insurance & real estate was Rs. 25.9 billion and Rs. 22.9 billion respectively between the period of 2011 to 2020. On an average production and electricity, gas & water sector contributed Rs. 12.3 billion and Rs. 4.3 billion respectively to the total GDP. Wholesale and retail trade sectors of GDP has been found most volatile with standard deviation of Rs. 4.8 billion/quarter.

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Table II
Descriptive Statistics of Quarterly Real GDP of Nepal

Real GDP's	Mean	Std. Dev.	Min	Max
Agriculture	60.8	4.7	52.8	68.7
Production	12.3	1.3	10.2	14.9
Electricity, gas and water	4.3	0.8	3.4	6.3
Whole sale and retail trade	25.9	4.8	19.2	33.6
Finance, insurance and real estate	22.9	3.1	17.0	28.1
Hotel and restaurant	3.12	0.50	2.16	4.55

*All the figures in RS. billion

Table III

Descriptive Statistics of Sectoral Lending per Bank

Variable	Mean	Std. Dev.	Min	Max
Agriculture	15.88	14.37	0	61.3
Production	44.46	37.60	0	147.1
Electricity, gas & water	15.73	13.45	1.29	58.7
Wholesale and retail trade	52.49	32.91	0	123.1
Finance, insurance and real estate	17.18	40.64	0	172.3
Hotel and restaurant	12.79	10.27	0.93	37.3

All the figures in RS. Crore

Table III depicts descriptive statistics of quarterly loan disbursement per bank on six different loan categories. Among all, wholesale & retail trade sector has the highest loan disbursement with average of Rs. 52.49 crore per bank in a quarter. Production sector occupies second highest space which is followed by finance, insurance & real estate, agriculture and electricity, gas & water sector lending. Finance, insurance & real estate is the most volatile sector with standard deviation of Rs. 40.6 crore. In some of the quarters the average loan disbursement was zero for some categories. Between the period of 2011 to 2020 the production and finance, insurance & real estate were the most volatile.

Table IV

The Response of Sector Lending to Tbill rate

The table 4 reports the regression estimates as per the following specification: …(ii), where, represents sectoral lending of bank i for time t. is treasury bill rate for time "t". represents control variables that are Size, Liquidity and Capitalization. is bank fixed effect and is time fixed effect. AGL, PSL, EGWSL, WRSL, FIRL and HRSL are dependent variables. AGL represents agriculture sector lending, PSL represents production sector lending, WRSL represents wholesale & retail sector lending, finance, insurance & real estate sector lending and HRSL means hotel and restaurant sector lending. The policy departure instrumental variable was used to deal with endogeneity concern in 2SLS regression.

Variables	ΔLn AGL		ΔLn PSL		ΔLn EGWSL		ΔLn WRSL		ΔLn FIRL		ΔLn HRSL	
	BPR	2SLS	BPR	2SLS	BPR	2SLS	BPR	2SLS	BPR	2SLS	BPR	2SLS
ΔT-bill rate	-0.77*	-0.92**	-1.35**	-1.60**	-0.29***	-0.44**	-0.34	-0.41	-0.25	-0.31	-0.33**	a-0.58**
	(0.37)	(0.43)	(0.69)	(0.81)	(0.11)	(0.10)	(0.27)	(0.24)	(0.21)	(0.27)	(0.12)	(0.27)
Size	0.72	0.96	0.51	0.63	0.65	0.73	0.65	0.68	0.19	0.21	0.31	0.31
	(0.61)	(0.67)	(0.41)	(0.51)	(0.46)	(0.57)	(0.58)	(0.74)	(0.08)	(0.06)	(0.66)	(0.73)
Liq.	0.34	0.38	0.55	0.64	0.58	0.58	0.26	0.38	0.5	0.70	0.52	0.58
	(0.31)	(0.40)	(0.58)	(0.68)	(0.49)	(0.55)	(0.21)	(0.31)	(0.44)	(0.62)	(0.32)	(0.39)
Cap.	0.21	0.28	0.15	0.22	0.62	0.74	0.80	0.96	0.31	0.43	0.30	0.32
	(0.14)	(0.13)	(0.14)	(0.16)	(0.44)	(0.54)	(0.65)	(0.75)	(0.33)	(0.46)	(0.26)	(0.32)
ΔLnGDP	0.3**	0.33**	0.53**	0.6**	0.63**	0.75**	0.99*	1.21**	0.42	0.61	0.67**	0.80**
	(0.11)	(0.12)	(0.21)	(0.24)	(0.29)	(0.38)	(0.51)	(0.51)	(0.39)	(0.37)	(0.13)	(0.28)
Constant	1.81**	2.26	1.85**	2.20*	1.92**	2.31	2.34**	2.89**	2.43**	2.89**	1.76**	2.22**
	(0.79)	(0.96)	(0.74)	(0.91)	(1.58)	(1.93)	(1.06)	(1.29)	(1.17)	(1.46)	(0.55)	(0.68)
Adj R sqr	0.27	0.38	0.79	0.93	0.8	0.84	0.88	0.91	0.42	0.47	0.43	0.48
F stat	22.9	27.51	74.9	89.9	75.9	91.08	82.9	102.2	37.9	45.3	38.9	46.6
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	792	792	792	792	792	792	792	792	792	792	792	792

Note. Standard error in parenthesis *, **, *** means significant at 10%, 5% and 1%. *Here, BPR means balanced panel regression and 2SLS represent two stage least square regression*

Table IV shows the impact of monetary policy variables on sectoral loan disbursement. The F-stat of all the regression equations presented in Table 4 are above 10 which indicates that the given model provides better fit to the data. The adjusted R-sqr is 0.27, in the first column of the table when Tbill rate is regressed with agriculture sector lending which means that the % change in agricultural loan disbursement can be explained by % change in Tbill rate by 27%. The size Adj-R sqr for all the models are above 10% which is acceptable as per Chin (1998) and Hair et al. (2011). In 2nd column of the table in 2SLS regression the coefficient of ∆T-bill rate is -0.92 which means that increase ∆T-bill rate by 1% leads to decrease in agriculture loan disbursement by 0.92%. The coefficient of 2SLS regression is statistically significant and greater than coefficients obtained from balanced panel regression for all the lending categories, which indicates the significance of exogenous variable incorporated in the model by combining major policy departure in Interest Rate Corridor (IRC).

As expected, the coefficients of T-bill rates in 2SLS regression are negative and significant at 5% level of significance. The coefficient of ∆T-bill rate in 2 SLS regression is -1.6, -0.44, and -0.58 respectively when tbill rate is regressed with PSL, EGWSL and HRSL which means that on an average 1% increase in ∆T-bill rate leads to decrease in sectoral lending by 0.77%, 1.35% and 0.33% respectively for production, electricity, gas & water and hotel & restaurant sector lending. The finding is similar with the study Suzuki (2004), Dave, Dressler and Zhang (2012) Gonzalez and Grosz (2007) completely support the existence of lending channel which completely supports the existence of lending channel however different from the findings of Perez (1998), which finds inconclusive evidence.

Surprisingly, wholesale & retail and finance, insurance & real estate sector lending are not statistically significant. The probable reason for non-significance of these two sectors could be central bank's policy intervention for increasing productive sector lending. Central banks thresholds limit of 25% for productive sector loan disbursement might have caused banks to divert their loan disbursement to agriculture, energy and tourism sector. Bank specific variable like liquidity, size and capital are not statistically significant indicating not significance role of bank specific variable on sectoral loan flows. As expected ∆LnGDP has been found statistically significant.

Table V

The Response of Sector Lending to Money Supply

The table 5 reports the regression estimates as per the following specification: …(ii), where, represents sectoral lending of bank i for time t. is money supply for time "t". represents control variables that are Size, Liquidity and Capitalization, is bank fixed effect and is time fixed effect. AGL, PSL, EGWSL, WRSL, FIRL and HRSL are dependent variables. AGL represents agriculture sector lending, PSL represents production sector lending, WRSL represents wholesale & retail sector lending, finance, insurance & real estate sector lending and HRSL means hotel and restaurant sector lending. The policy departure instrumental variable was used to deal with endogeneity concern in 2SLS regression.

Variables	ΔLn AGL		ΔLn PSL		ΔLn EGWSL		ΔLn WRSL		ΔLn FIRL		ΔLn HRSL	
	BPR	2SLS	BPR	2SLS	BPR	2SLS	BPR	2SLS	BPR	2SLS	BPR	2SLS
Δ Ln Money supply	1.12**	1.32**	0.95**	1.1**	0.74**	0.72**	1.08	1.2	0.41	0.36	0.51**	0.6**
	(0.52)	(0.6)	(0.47)	(0.48)	(0.33)	(0.38)	(0.89)	(0.96)	(0.42)	(0.36)	(0.19)	(0.27)
Size	0.28	0.36	0.36	0.36	0.48	0.48	0.54	0.6	0.25	0.24	0.25	0.24
	(0.24)	(0.24)	(0.28)	(0.36)	(0.47)	(0.48)	(0.45)	(0.48)	(0.22)	(0.24)	(0.14)	(0.12)
Liq.	0.52	0.6	0.26	0.24	0.22	0.24	0.22	0.24	0.65	0.84	0.69	0.84
	(0.43)	(0.48)	(0.21)	(0.12)	(0.21)	(0.12)	(0.21)	(0.24)	(0.52)	(0.6)	(0.83)	(0.96)
Cap.	0.58	0.6	0.64	0.72	0.66	0.84	0.37	0.36	0.61	0.72	0.48	0.48
	(0.44)	(0.48)	(0.47)	(0.6)	(0.57)	(0.72)	(0.32)	(0.36)	(0.47)	(0.48)	(0.36)	(0.48)
ΔLnGDP	0.15	0.24**	0.86**	0.96**	0.49*	0.48**	0.86**	0.96**	0.25	0.24	0.56*	0.6**
	(0.16)	(0.12)	(0.39)	(0.36)	(0.26)	(0.24)	(0.41)	(0.46)	(0.17)	(0.24)	(0.29)	(0.24)
Constant	2.11**	2.52**	2.28**	2.64**	2.01*	2.4*	1.73**	2.04**	2.1*	2.4*	1.78**	2.16**
	(1.06)	(1.2)	(0.83)	(0.84)	(1.1)	(1.32)	(0.88)	(0.96)	(1.2)	(1.32)	(1.17)	(1.04)
Adj R sqr	0.4	0.55	0.77	0.84	0.48	0.63	0.61	0.75	0.4	0.67	0.51	0.69
F stat	35.9	43.08	72.9	87.48	43.9	52.56	56.9	68.28	35.9	43.08	46.9	56.16
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	792	792	792	792	792	792	792	792	792	792	792	792

Note. Standard error in parenthesis *, **, *** means significant at 10%, 5% and 1%. *Here, BPR means balanced panel regression and 2SLS represent two stage least square regression*

In Table V, the monetary policy variable money supply has been regressed with six different sectoral lending categories. The F-stat of all the regression equations presented in Table IV are above 10 which indicates goodness of fit of the model. The adjusted R-sqr are above 10% and within the acceptable range. As expected, the coefficients of money supply are positive and significant at 5% level of significance except for FIRL and HRSL. The coefficient of Δ Ln Money supply in 2 SLS regression is 1.32 in the 2nd column of the table 5, which means that 1% increase in money supply leads to increase in agricultural loan disbursement by 1.32%. The coefficient of 2SLS regression is greater than coefficients obtained from balanced panel regression for all the lending categories, which indicates the significance of exogenous variable incorporated in the model. Different from the findings of Kashyap and Stein (2000) bank specific variable like liquidity, size and capital are not statistically significant indicating not significance role of bank specific variable on sectoral lending. This might happen because unlike foreign large banks Nepalese banks do not have enough financial capacity to absorb monetary shock.

As expected, the coefficients of Δ Ln Money supply in 2SLS regression are positive and significant at 5% level of significance except for WRSL and FIRL. The coefficient of Δ Ln Money supply in 2 SLS regression is 1.1, 0.72 and 0.6 respectively when Δ Ln Money supply is regressed with PSL, EGWSL and HRSL which means that on an average 1% increase in ΔT-bill rate leads to decrease in sectoral lending by 1.1 %, 0.72% and 0.6% respectively for production, electricity, gas & water and hotel & restaurant sector lending. As expected, the finding is similar with the study conducted by Gonzalez and Grosz (2007) different from the results obtained by Perez (1998)

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Table VI

The Response of Sectoral GDP to Sectoral Lending of Commercial Banks

The table 6 reports the regression estimates as per the following specification: , where, is sectoral GDP for time t. represents sectoral lending and is control variable like exchange rate, inflation and capital expenditure. is bank fixed effect and is time fixed effect. AG, PRO, EGW, WR, DIR and HR are dependent variables. AG represents agriculture sector GDP, PRO represents production sector GDP, EGW represents electricity, gas and water sector GDP, WR represents whole and retail sector GDP and HR represents hotel and restaurant sector GDP.

Variables	ΔLnAG GDP	ΔLnPRO GDP	ΔLnEGW GDP	ΔLnWR GDP	ΔLnFIR GDP	ΔLnHR GDP
ΔLn AGL	1.04* (0.65)					
ΔLn PSL		1.27*** (0.48)				
ΔLn EGWSL			0.87** (0.33)			
ΔLn WRSL				1.18** (0.39)		

					0.25	
ΔLn FIRL					(0.17)	
ΔLn HRSL						0.99**
						(0.38)
ΔLn CAPEX	0.96	0.48	1.52	0.66	0.96	1.27
	(0.61)	(0.27)	(1)	(0.52)	(0.7)	(0.92)
ΔINF	0.71	0.57**	1.08	0.96*	0.9	1.26
	(0.51)	(0.25)	(0.67)	(0.56)	(0.58)	(0.86)
ΔER	-0.58	-0.27	-0.54	-0.34	-0.71	-0.18
	(0.41)	(0.23)	(0.39)	(0.22)	(0.52)	(0.13)
Constant	0.85*	1.36**	0.53**	1.64**	1.52**	1.5**
	(0.45)	(0.71)	(0.21)	(0.58)	(0.8)	(0.74)
Adj R sqr	0.43	0.71	0.61	0.55	0.73	0.4
F stat	38.9	66.9	56.9	50.9	68.9	35.9
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
N	792	792	792	792	792	792

*Note: Standard error in parenthesis *, **, *** means significant at 10%, 5% and 1%.*

Table VI presents regression results of sectoral lending on corresponding sectoral GDP. The study obtained Adj-R-Sqr of 0.43, 0.71, 0.55, 0.73 & 0.4 for total, agriculture, production, electricity, gas & water, wholesale and retail and finance, insurance and real estate, hotel & restaurant sector GDP when regressed with sectoral lending which means that the variation in sectoral GDP can be explained by variation in sectoral lending by 43%, 71%, 61%, 55%, 73% and 40% respectively. The coefficients of sectoral lending are positive and significant as expected. We obtained the coefficient of 1.04, 1.27, 0.87, 1.18 and 0.99 which means that growth of sectoral lending by 1% leads to growth in sectoral GDP by 1.04%, 1.27%, 0.87%, 1.18% and 0.99% respectively for agriculture, electricity production, gas & water, wholesale and retail, insurance and real estate sector and hotel & restaurant sector lending. The study has also reported the standard error in parenthesis and the reported standard error do not erode the significance of the coefficient. In other words, the coefficients are found significant at 5% level of significance. Though sign is positive finance, insurance and real estate lending is not significant. The probable reason could be strict regulation of NRB for curbing unproductive sector lending and increasing productive sector lending. Banks might have diverted their resources from unproductive sector lending to productive sectoral lending like agriculture, production, electricity and hotel & restaurant sector lending. The finding is similar with the Vaithilingam, Guru and Shanmugam (2003) which concludes bank lending as the major economic driver in Malaysia. Similarly, the finding completely contrasts with the results obtained by Tang (2005).

V. Conclusion and Implication

The study has investigated monetary policy impact on sectoral GDP through sectoral lending using disaggregated quarterly data from the period 2011/12Q1 to 2019/20Q4. In contrast to earlier studies, this study performs the test on different lending categories across different banks types to capture the full dimensions of the functioning of the lending channel. The study finds strong evidence of monetary transmission through lending channel. The result suggest that monetary shock transmits to the real sector through bank sectoral lending. An important question is whether monetary policy affects all economic sectors. The effect is heterogeneous across different economic sectors. The strength of the channel has been found different across different sectoral lending and sectoral GDP types. The evidence shows that agriculture, production and hotel and restaurant sectors are more responsive to monetary policy. And these sectoral lending triggers their corresponding sectoral GDP. In other words, expansionary monetary policy increases loan supply to different economic sectors and increase in bank loan supply to different economic sectors increases their respective sectoral GDP. Similarly, contractionary monetary policy contracts the bank lending and decline in bank lending causes decrease in overall economic activity and economic growth. The study concludes by noting that monetary policy affects real economy through bank credit.

The study shows significant impact of monetary policy intervention on sectoral GDP growth of the country. So, it can be inferred from the findings that monetary authority needs to maintain stability in money supply and interest rate in order to facilitate the growth of different economic sectors through smooth loan disbursement. Similarly, from commercial banks perspective since, monetary decision impact banks profitability, bank should increase its risk absorption capacity so that it can absorb the probable monetary shock. As monetary decisions affect microeconomic behaviour of banks and financial institutions, monetary decisions should be such that it ensures balance in banking activities. NRB should monitor overall banking system for financial stability as well as for effective monetary transmission in order to help government to achieve its growth target through growth of major economic sectors. The findings of this study show weaker evidence of monetary transmission through wholesale and retail and finance, insurance and real estate sector lending, monetary authority can modify their policy instruments to increase effectiveness of lending channel through wholesale and retail and finance, insurance and real estate sector lending too.

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