## Chapter 4

# EFFECTIVENESS OF SELECTED MACROPRUDENTIAL TOOLS IN MONGOLIA

By

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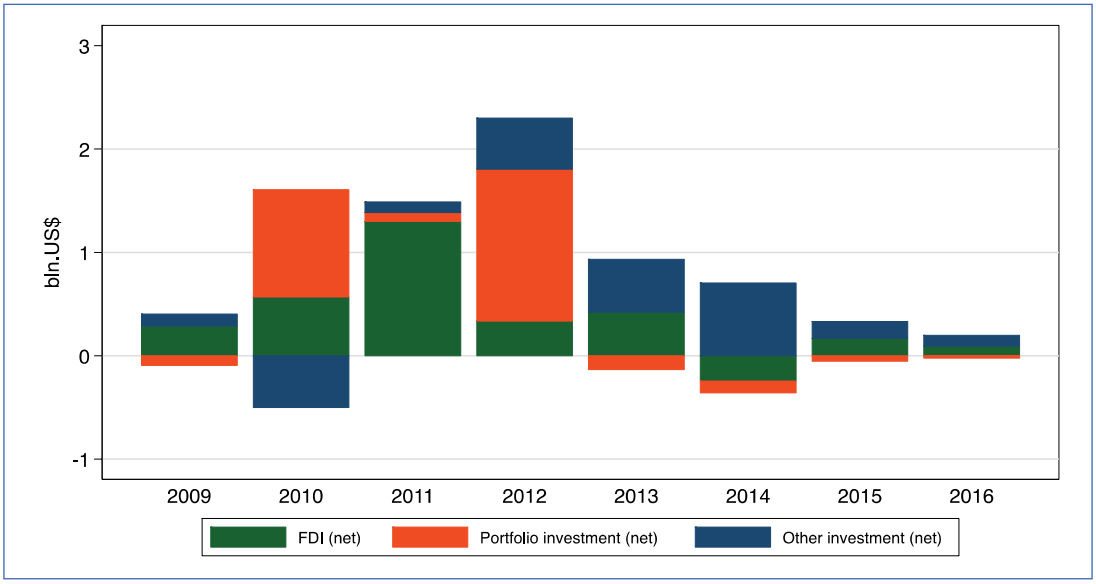
## 1. Introduction

Mongolia, a country known for its abundance of mineral resources, has a little experience with utilizing macroprudential policies to mitigate systemic financial risk. The Bank of Mongolia, the central bank of the country, tends to mainly respond to financial instability and vulnerabilities in domestic financial system through its active monetary policy instruments including policy rates. However, long-term prospects of Mongolia and its sensitivity to commodity prices raise a validity to manage systemic risks in the financial sector using an alternative policy tools such as macroprudential measures. Following the global financial crisis (GFC) of 2008/09, Mongolia faced overheating pressures from surges in capital inflows (Figure 1) and procyclical macroeconomic policy, e.g., loose fiscal policy (Figure 2).

**Figure 1: Net Capital Flows**




Source: Bank of Mongolia.

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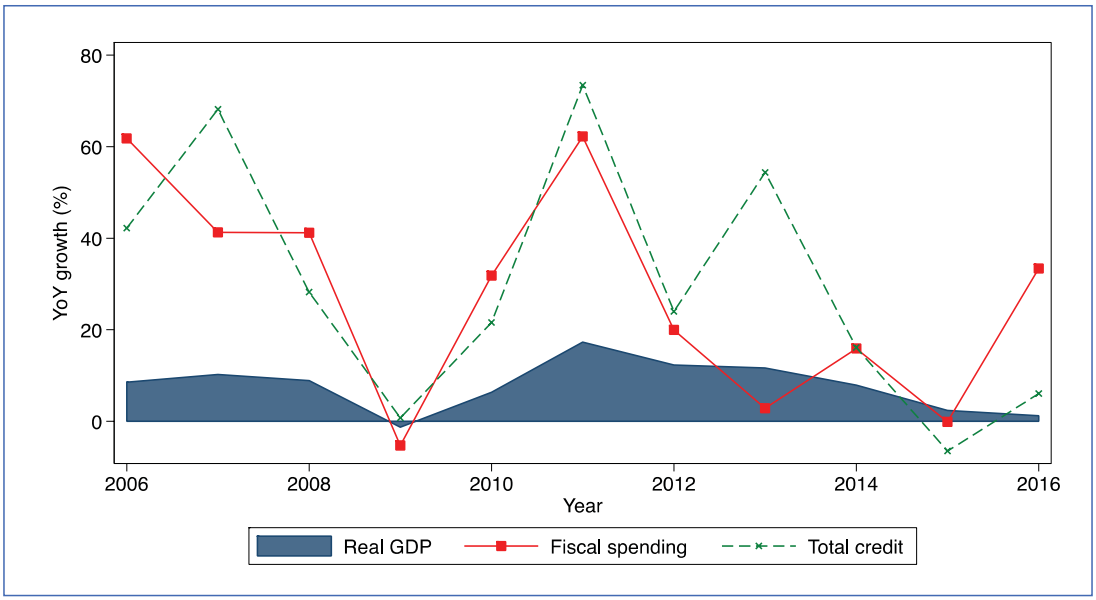
However, the economic situation worsened and growth contracted in the aftermath of China's slow-down and the sharp drop in commodity prices in the global market. The commodity price decline mainly caused a sudden stop of capital flows into Mongolia (Sukhee and Byambasuren, 2016). It has been also challenging to reverse the expansionary macroeconomic policies implemented during the good years, which have caused public debt to accumulate and international reserves to decline, which consequently led the authorities to approach the International Monetary Fund (IMF) for an economic and financial assistance program, the so called Extended Fund Facility (EFF). The IMF approved a three-year EFF arrangement on May 2017 to support the country's economic recovery.

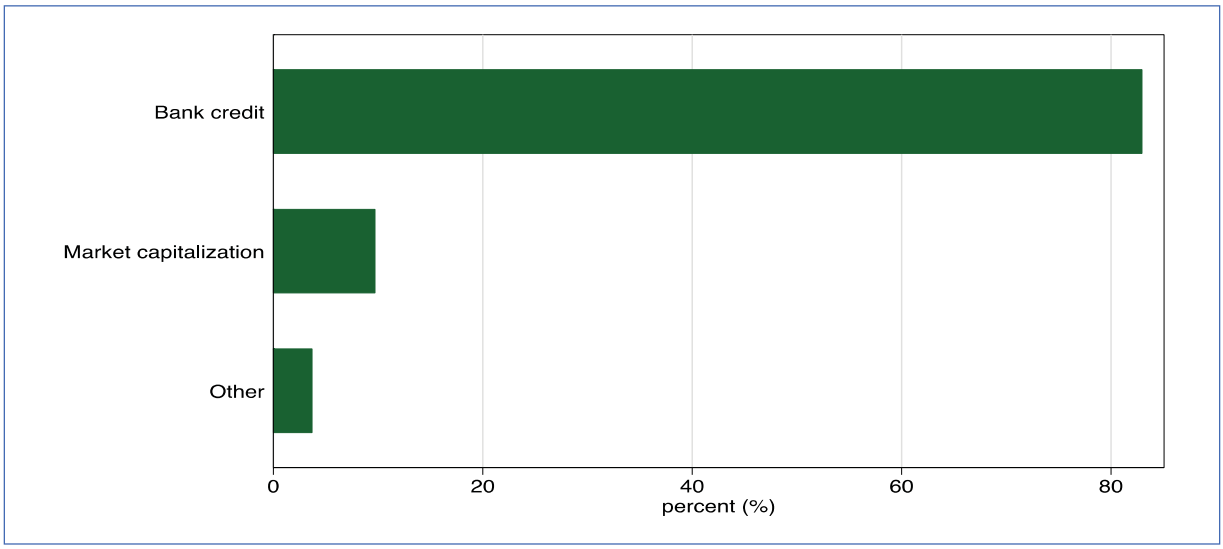
**Figure 2: Procyclical Fiscal Policy**




Source: Bank of Mongolia, Ministry of Finance.

Given the country's large mineral resources, the economy is significantly susceptible to external shocks (e.g., volatile capital flows and terms of trade shocks). Policymakers recognized the risks accompanied by surge in capital inflows and began taking certain actions to implement prudential policies. However, it is questionable whether those prudential measures are effective and if so, it is also uncertain as to what extent they affect bank lending to sensitive sectors and demand for commercial loans. To answer these questions, we analyze the effectiveness of macroprudential policies in dampening credit cycles in Mongolia by assessing policy actions implemented by the Bank of Mongolia using a panel data regression and an event study, which are widely used methods in policy analysis.

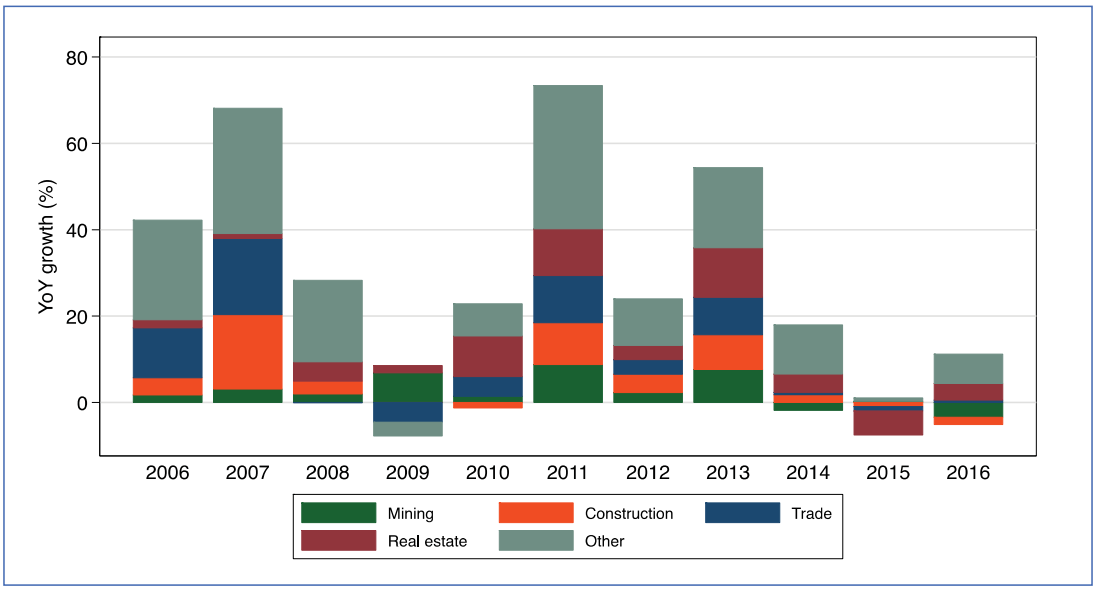
**Figure 3: Credits to the Private Sector by Source of Funding**




Source: Bank of Mongolia.

Since the establishment of a two-tiered banking system in 1991, the Mongolian financial system has been dominated by the banking sector accounting for 95% of total assets in the financial system. In terms of credits to the private sector, 83% of total credit supply to private sector has been provided by the banking sector (Figure 3). The banking sector is also very concentrated with five large banks holding 87% of total banking credits and 91% of total bank deposits. Additionally, construction, real estate (i.e., mortgage), and wholesale and retail loans are the major sources of credit growth in Mongolia (Figure 4).

**Figure 4: Credit Growth by Sectoral Contribution**




Source: Bank of Mongolia.

The rest of the paper is organized as follows. Section 2 presents a brief background and recent developments of macroprudential policies in Mongolia, reviews the related literature, and desbribes the data. Section 3 lays out the empirical strategy and Section 4 presents model estimation results. Section 5 concludes.

## 2. Background and Data

In this section, we first review macroprudential policies implemented to address systemic risk in Mongolia's financial system and provide a very brief review of existing related literature. We then present our data.

### 2.1 Macroprudential Policies in Mongolia

Mongolian regulators are in the early stages of providing a legal framework and introducing a set of macroprudential instruments to mitigate systemic risks. In particular, limitations are evident in the availability of instruments for the time-dimensional systemic risks. Table 1 reports common macroprudential instruments in Mongolia, specifically, instruments that are currently available under Mongolian jurisdiction. Although some positive changes have been made in the institutional framework for macroprudential policies, there are still huge gaps to be filled to strengthen the policy toolkits that are helpful for reducing systemic financial risks.

**Table 1: Common Macroprudential Instruments**

| | Time dimension | Cross-sectional dimension |
|---|---|---|
| Capital | • Counter-cyclical capital buffers<br>• Dynamic risk weights<br>• *Dynamic provisioning*<br>• Limits to profits distribution | • *SIFI capital surcharges*<br>• SIFI liquidity surcharges<br>• Levy on non-core liabilities<br>• *Sectoral risk weights* |
| Credit | • Limits to credit growth<br>• Time varying caps on LTV or DTI<br>• Dynamic leverage ratio | • *Limits on concentration of counter-party risk*<br>• Limits to foreign currency lending |
| Liquidity | • *Reserve requirement*<br>• *Liquidity ratio* | • Caps on FX lending<br>• *Limits on net open FX mismatches*<br>• Limits on maturity mismatches |

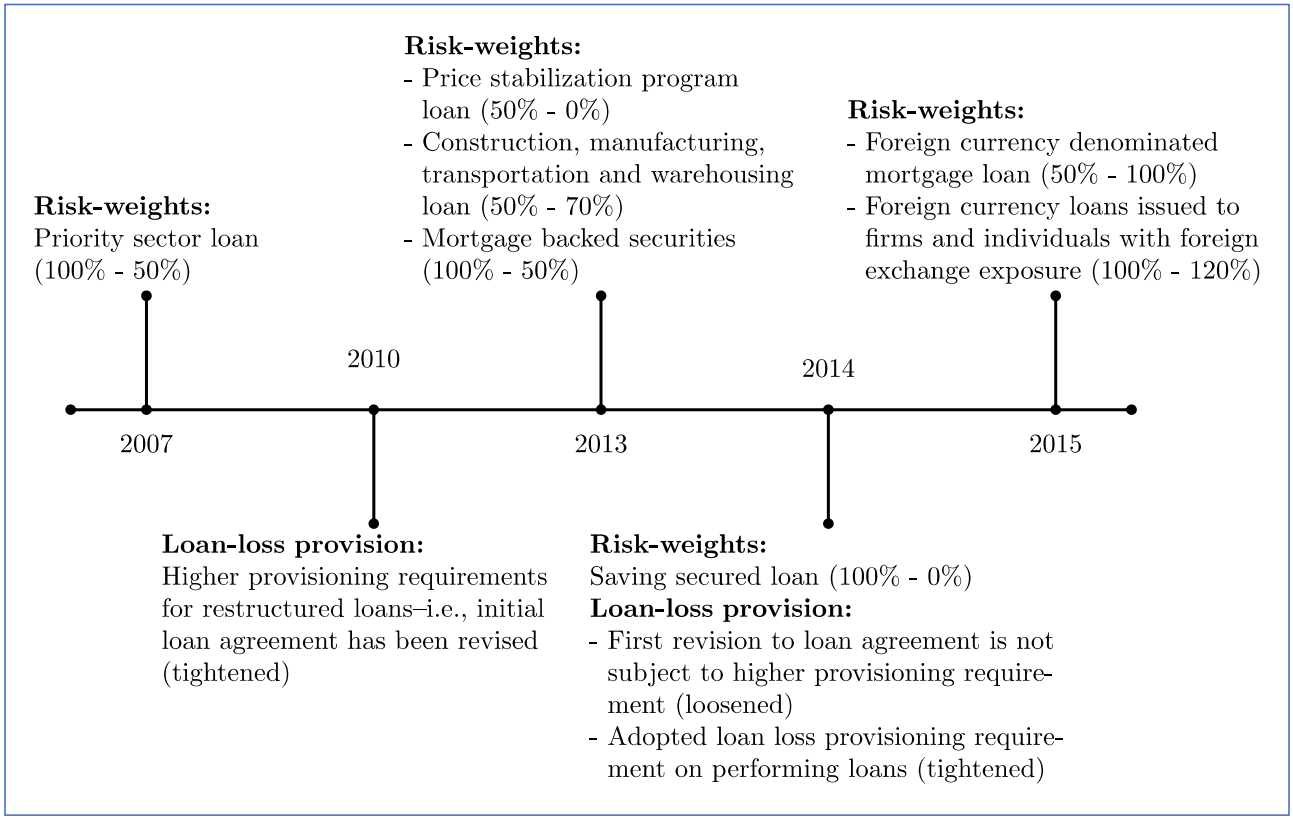
*Notes*: Currently available instruments are expressed in *italics*. SIFI = systemically important financial institution, LTV = Loan-to-Value, DTI = debt service-to-income, FX = foreign currency.

A dynamic provisioning was recently adopted in the revised regulation on asset classification and provisioning and its disbursements.[2] Moreover, reserve requirement is one of the main monetary policy instruments the Bank of Mongolia uses for monetary policy implementation. In general, reserve requirement is considered as a monetary policy toolkit, but it is also classified as one of the commonly used macroprudential policy instruments (Board, 2011). However, it has been hardly used for macroprudential purposes in Mongolia, while proposed changes to regulation on reserve requirement includes stipulating the right to use the instrument for macroprudential purposes.

2. "The regulation on asset classification and provisioning and its disbursements," June 2017.

Risk-weights and dynamic provisioning requirements have been occasionally changed in Mongolia. Aside from systemic risk concerns, most of the changes were made for different reasons. For example, the Bank of Mongolia decreased the risk-weights on priority sector loans to support those sectors in 2007. The Bank of Mongolia introduced the so-called "Price Stabilization Program", a quasi-fiscal stimulus program intended to moderate the prices of consumer goods and services in 2013. The risk weights on loans issued as part of this program were reduced, following a decline in the risk weights on mortgage backed securities aimed at promoting the secondary mortgage market.

**Figure 5: Measures on Risk Weights and Provisioning Requirements**




In the last decade, three changes in risk-weights and dynamic provisioning requirements have had some macroprudential implications. The Bank of Mongolia increased provisioning requirements on restructured loans in 2010. According to this measure, if the initial loan agreement has been revised, the loan classification is required to be downgraded, and this is translated into higher loan-loss provisioning. This measure was slightly relaxed in 2014 and the first revision to the loan agreement is not currently subject to higher provisioning. However, the second revision requires the bank to downgrade the loan classification twice. Moreover, the Bank of Mongolia recently adopted a new tightening measure of 1% provisioning on performing loans. In terms of risk weights, some measures on foreign currency lending was tightened in 2015. Figure 5 summarizes the actions taken for risk weights and provisioning requirements.

**Table 2: Measures on Foreign Currency Loan**

| Policy action | Implementation date |
|---|---|
| The authorities increased the risk weights on foreign currency denominated mortgage loans from 50 to 100 percent in July 2014. Along with this measure they also increased the risk weights from 100 to 120 percent on foreign currency loans issued to firms and individuals with foreign exchange exposure. | Effective since January 1, 2015 |

The Bank of Mongolia changed risk-weight on foreign currency loans in July 2014. Table 2 summarizes the event and its implementation period.

## 2.2 Related Literature

The large banking sector generates credit risk in the Mongolian financial system and strong banking interconnectedness fuels the build-up of cross-sectional systemic risks (Maino, Imam and Ojima, 2013; Bukh-Ochir, 2014).

In recent years, Mongolia has also been experiencing a large volatility in credit growth due to the commodity price boom-bust cycles. Sukhee and Byambasuren (2016) provides some background on macroprudential policies implemented in Mongolia to mitigate financial instability induced from capital flow volatility and interprets their effectiveness in the short-term. Estimating a vector error correction model (VECM) based on quarterly data of Mongolia for the period 2006–2012, Maino, Imam and Ojima (2013) suggest that dynamic loan loss provisioning contributes to mitigating procyclicality in real credit growth. They also find that bank credit growth in Mongolia is unaffected by changes in the monetary policy rate by using the recursive vector autoregressive (VAR) analysis and simple regressions. Except for these few studies, macroprudential policies in Mongolia tend to be highly neglected while the Bank of Mongolia has been emphasizing its importance for financial and economic stability.

The use of macroprudential policies to mitigate systemic financial risks have spread in emerging market economies (EMEs). However, their effectiveness is not very clear. There are few studies that assess the effect of macroprudential policy tools on some financial measures such as asset prices, leverages, risk premia, or credit growth. For example, Claessens, Ghosh, and Mihet (2013) analyzes the response of balance sheets of 2,800 banks in 48 countries over 2000–2010 to specific macroprudential regulations – such as caps on loan-to-value and debt-to-income ratios, limits on credit growth and foreign currency lending, reserve requirements, limits on profit distribution, and dynamic provisioning. They show that these borrower-targeted measures and countercyclical buffers are effective in mitigating banking systems vulnerabilities. Covering more instruments, countries, and time-periods, Cerutti, Claessens, and Laeven (2017) suggests that the effectiveness of macroprudential policies are weaker in financially developed and open economies than less developed EMEs.

### 2.3 Data

The data set (nearly 450 observations) covers the bank-specific variables for all 14 banks that are currently operating in Mongolia and country-level macroeconomic and policy indicators over the period from the beginning of 2005 to the mid- 2017 in a quarterly frequency.

We are examining the effect of macroprudential policies measures including risk-weights, dynamic provisioning and reserve requirement, while macroeconomic variables included in our model comprise real exchange rate depreciation, current account to GDP, capital openness, real GDP growth, inflation, and interest rate differential. Table 3 reports the description of the data.

**Table 3: Data Description**

| Variables | Definition | Source |
|---|---|---|
| A. Dependent variables: | | |
| *Total loan supply* | Log of total loan supply by a particular bank $i$ | BoM |
| *Sectoral loan supply* | Log of loan supply by a particular bank $i$ to a particular sector $s$ | BoM |
| B. Independent variables (macroprudential measures & bank's performance/response to policy changes): | | |
| *Risk-weights* | Dummy variable that represents two events of increasing risk-weights on foreign currency denominated mortgage loans and foreign currency loans issued to firms and individuals with foreign exchange exposure; takes value of 1 since the beginning of 2015 | BoM |
| *Reserve requirement* | Bank's performance to reserve requirements (RR) on domestic and foreign currency liabilities, which indicates how banks react to policy changes; takes value greater than 1 when bank over satisfy the requirement, otherwise takes value less than or equal to 1 | BoM |
| *Provisioning* | Total amount of provisions calculated by the bank's exposure in each risk category multiplied by the respective provisioning coefficient | BoM |
| C. Independent variables (country-level macroeconomic indicators): | | |
| *Real FX rate* | Log of real MNT/US$ rates | BoM |
| *Current account* | Current account balance (% of GDP) | BoM, NSO |
| *Capital openness* | Index of openness to capital flows* | authors' calc. |
| *Real GDP growth* | Growth (YoY) of cumulative real GDP | NSO |
| *CPI inflation* | Growth (YoY) of consumer price index | BoM |
| *Interest rate differential* | Weighted average of domestic currency lending rates minus weighted average of domestic currency deposit rates | BoM |

*Notes*: BoM = Bank of Mongolia, NSO = National Statistics Office, MNT = Mongolian Tugrik, YoY = Year-on-Year, GDP = Gross Domestic Product

* See Becker and Noone (2009) for a definition/formula of calculating an index of openness to capital flows as a proxy for capital openness; refer to Sukhee and Byambasuren (2016) for previously calculated index of capital openness in Mongolia.

Table 4 presents the correlations between the candidate variables to investigate the data prior to any further empirical estimation that we will analyze in the following section. This helps us to correctly define the specification of our model.

**Table 4: Correlation Matrix**

| Variable | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) Log of total loan supply | 1.00 | | | | | | | | | |
| (2) Risk-weights dummy | 0.15 | 1.00 | | | | | | | | |
| (3) Res. requirement | −0.51 | −0.15 | 1.00 | | | | | | | |
| (4) Provisioning | 0.57 | 0.40 | −0.19 | 1.00 | | | | | | |
| (5) Log of real FX rate | −0.01 | 0.41 | 0.05 | 0.17 | 1.00 | | | | | |
| (6) Current account | 0.03 | 0.52 | 0.05 | 0.22 | 0.76 | 1.00 | | | | |
| (7) Capital openness | 0.03 | 0.40 | 0.02 | 0.15 | 0.46 | 0.65 | 1.00 | | | |
| (8) Real GDP growth | −0.05 | −0.53 | 0.02 | −0.22 | −0.71 | −0.75 | −0.49 | 1.00 | | |
| (9) CPI inflation | −0.06 | −0.57 | 0.03 | −0.28 | −0.48 | −0.41 | −0.18 | 0.45 | 1.00 | |
| (10) Int.rate differential | −0.11 | −0.19 | 0.14 | −0.09 | 0.43 | 0.35 | 0.38 | −0.42 | −0.05 | 1.00 |

The correlation matrix shows that risk-weights dummy and provisioning requirement are positively correlated with log of total loan supply, while reserve requirement is negatively correlated with the dependent variable. Moreover, the country-level control variables are negatively correlated with the log of total loan supply except for current account balance and capital openness. We also observe that the risk-weights dummy and provisioning requirements are moderately correlated with each other. We thus exclude the provisioning variable from our regression to overcome the endogeniety issue.

## 3. Empirical Strategy

In this section, we first describe the empirical specification for the relationship between the set of macroprudential policies and the total and sectoral credit supply. We then discuss the method used for estimating the effect of risk-weights on foreign currency loans.

### 3.1 Credit Supply-Macroprudential Policy Relationship

To understand the effectiveness of macroprudential policies in Mongolia, we estimate the panel regression model using both bank-specific balance sheet data and country-level macroeconomic variables. Since the effect of macroprudential measures on an individual bank and its response to a change in macroprudential policies might be different from one another, it is preferable to use the panel framework to examine the effectiveness of macroprudential instruments. In addition to this benefit of controlling for individual heterogeneity, panel data models are favorable in numerous ways, which can be found in Baltagi (2013), Hsiao (2003) and Klevmarken (1989).

In particular, the fixed effect model is estimated because banks tend to be relatively different from each other such as in terms of their ownership, location, bank size, loan size and business strategy. The time-invariant fixed effect model is described in the following general form:

$$Y_{i,t} = \alpha + \lambda * MaPP_{i,t-j} + \beta^{jump} * \mathbf{1}(t > t^*) + \varphi * X_t + \varepsilon_{i,t} \quad (1a)$$

$$Y_{i,s,t} = \alpha + \lambda * MaPP_{i,t-j} + \beta^{jump} * \mathbf{1}(t > t^*) + \varphi * X_t + \varepsilon_{i,s,t} \quad (1b)$$

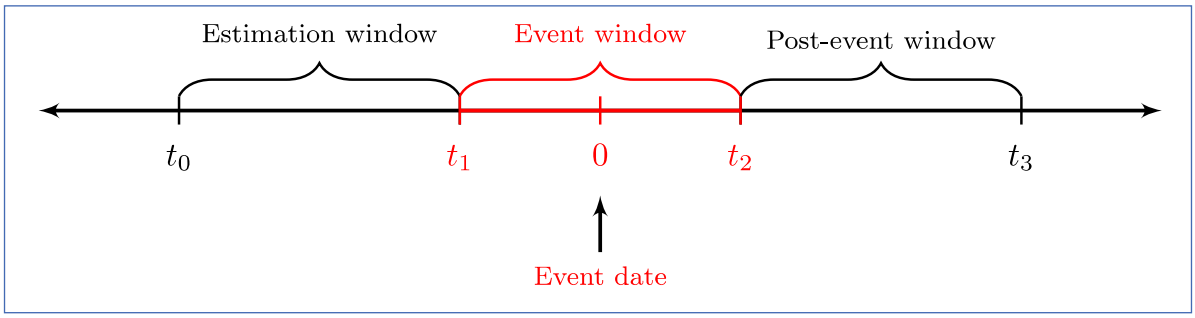
where $Y_{i,t}$ and $Y_{i,s,t}$ represent the total and sectoral credit supply by a particular bank $i$ at time $t$, respectively, $\alpha$ denotes the fixed effects that capture the heterogeneity across banks (i.e., company cultures or business practices), a vector of lagged variables $MaPP_{i.t-j}$ consists of a set of macroprudential policies (dynamic provisioning and reserve requirement), $t^*$ is the date on which risk-weights of some distinctive loans increased (Table 2), a vector $X_t$ includes the country-level aggregate macroeconomic indicators, and $\varepsilon_{i,t}$ and $\varepsilon_{i,s,t}$ are the error-terms. The coefficient estimate $\beta^{jump}$ represents the change in the outcome following the event, an increase of risk-weights on foreign currency denominated mortgage loans and foreign currency loans issued to firms and individuals with foreign exchange exposure (Table 2).

Using this model specification, we evaluate the impact of a changes in macroprudential policies on total loan supply of banking system and sectoral lending by individual banks using pooled OLS regression and the panel fixed effect methodology for comparison.

### 3.2 Foreign Currency Loans-Risk Weights Relationship

The event study is one of the most frequently used analytic tools in financial research and has many applications. In this section, we provide some interpretation of this simple method that we use to examine whether changes in risk-weights on foreign currency loans are associated with changes in growth of foreign currency loans. The main reason why we use this approach is that there is hardly a dynamic change in macroprudential policies (i.e., risk-weights, loan-loss provision, and reserve requirement) in Mongolia while individual banks tend to actively respond to policy changes and economic swings.

**Figure 6: Typical Timeline of an Event Study**




The purpose of our event study is to find the abnormal growth attributable to the event by removing the systemic part of the movement in the credit growth. The event study starts with the definition of an event, and then proceeds by the specification of an event window and estimation window. The timeline of an event study consists of two periods. An estimation window is a period over which parameters are estimated, while an event window is a period over which the estimated parameters are used to estimate abnormal growth.

In general, we follow the market model, one of the several statistical approaches proposed by MacKinlay (1997) to analyze an event study. Abnormal growth is the event-specific non-systematic growth component of the credit growth which is simply calculated by the following equation:

$$AG_{it} = G_{it} - E(G_{it}|X_t) \tag{2}$$

where $G_{it}$ is the actual growth, $E(G_{it}|X_t)$ represents the normal growth in the absence of an event, and $X_t$ captures the variable used to extract systemic growth component. It is possible to use a number of models to calculate the normal growth and this paper uses the market model, a commonly used model for estimating the normal growth:

$$G_{it} = \alpha_i + \beta_i G_{st} + \epsilon_i$$
$$E[\epsilon_{it}] = 0 E[\epsilon_{it}] = 0 \qquad var[\epsilon_{it}] = \sigma^2_{\epsilon_i} var[\epsilon_{it}] = \sigma^2_{\epsilon_i} \tag{3}$$

where $G_{it}$ and $G_{st}$ represents a growth associated with the credit and the system, respectively, $\epsilon_{it}$ is the error term with zero-mean and $\sigma^2_{\epsilon_i}$ variance, and $\alpha_i$ and $\beta_i$ are the parameters of the market model.

In this analysis, we try to eliminate the systemic part of the foreign currency credit growth through two groups of variables. A group of variables on external factors of credit growth which include real GDP growth and foreign currency non-performing loan growth. Another group of variables on domestic factors of credit growth which include foreign direct investment and portfolio and other investments. The composition of capital flows is particularly important because the portfolio and other flows have relatively short maturities. Thus, credit booms which ended in credit busts were characterized by having large portfolio and other flows (Elekdag and Wu, 2013).

## 4. Estimation Results

We first present the OLS and fixed effect model estimation results for Equations (1a) and (1b), and then present the estimates of the market model described in Equations (2) and (3).

### 4.1 The Effects of Risk-Weights and Reserve Requirements

Table 5 presents the empirical results from the estimation of pooled OLS regression and the fixed effect model. The first column of Table 5 reports results from a specification including only the event dummy that indicates both policy changes of increasing risk-weights on foreign currency denominated mortgage loans and foreign currency loans issued to foreign exchange exposed firms. The second adds the performance of banks on reserve requirement as a policy variable, the third includes the country-level macroeconomic determinants of bank credit supply, the fourth adds bank-specific fixed effects as a control, and the fifth specifies the event dummy to take a value of 1 since the policies have become effective (July 2014). Meanwhile, the first column specifies the event dummy which takes a value of 1 for the policy announcement date (January 2015). Specifying an event dummy for the two-different time frames (announcement versus effective dates) enables us to distinguish the effects of expected and real policy shocks, while including bank-specific fixed effects allows unobserved heterogenetiy across banks to be identified. The last column of Table 5 sets the policy variables with four lags (four quarter lags).

We find that macroprudential policy instruments we are investigating in this paper affect the total loan supply at a sufficient level of significance. The effects of risk-weights and reserve requirement are consistent with the theoretical hypothesis, e.g., when the monetary authority or central bank increases the risk-weights and reserve requirement, banks reduce their loan supply because their available sources of lending will be decreased in response to these policy changes. Note also that the coefficients of policy variables are persistent when changing the model specification. Thus, we consider our estimates to be robust (Table 5).

We use the exact same specification of the event dummy variable for policy impact analysis put forth by Lafortune et al. (2016).[3]

**Table 5: Effect of Macroprudential Policies on Total Loan Supply**

| | (1) OLS | (2) OLS | (3) OLS | (4) FE | (5) FE | (6) FE |
|---|---|---|---|---|---|---|
| Risk-weight events dummy (announced) | −0.29 | −0.59** | −0.64*** | −0.12 | | |
| | (0.22) | (0.25) | (0.18) | (0.07) | | |
| Bank's performance to RR | | −0.00*** | −0.01*** | −0.00 | −0.00 | |
| | | (0.00) | (0.00) | (0.00) | (0.00) | |
| Log of real FX rate (MNT/US$) | | | −1.90 | −0.97** | −0.82* | −0.44 |
| | | | (1.52) | (0.41) | (0.39) | (0.32) |
| Current account (% of GDP) | | | 0.02*** | 0.00 | 0.00 | 0.00 |
| | | | (0.01) | (0.00) | (0.00) | (0.00) |
| Capital openness | | | −0.00* | −0.00 | 0.00 | −0.00 |
| | | | (0.00) | (0.00) | (0.00) | (0.00) |
| Real GDP growth (YoY %) | | | 0.01 | −0.01** | −0.02*** | −0.01 |
| | | | (0.01) | (0.01) | (0.01) | (0.01) |
| CPI inflation | | | 0.01 | 0.01*** | 0.01** | 0.01** |
| | | | (0.01) | (0.00) | (0.00) | (0.00) |
| Interest rate differential (MNT, WA) | | | −0.01 | −0.04*** | −0.06*** | −0.03** |
| | | | (0.05) | (0.01) | (0.01) | (0.01) |
| Risk-weight events dummy (effective) | | | | | −0.29*** | |
| | | | | | (0.09) | |
| Risk-weights events dummy (effective, lagged) | | | | | | −0.34*** |
| | | | | | | (0.06) |
| Bank's performance to RR (lagged) | | | | | | −0.00* |
| | | | | | | (0.00) |
| Number of observations | 613 | 601 | 438 | 438 | 438 | 438 |
| Adjusted $R^2$ | 0.06 | 0.29 | 0.25 | 0.96 | 0.96 | 0.97 |

*Notes*: Robust standard errors in parentheses.
OLS = Ordinary Least Squares, FE = Fixed effect, RR = reserve requirement, MNT = Mongolian tugrik, GDP = Gross Domestic Products, YoY = year-on-year, Interest rate differential = Lending rate − Deposit rate, WA = weighted average
*, **, and *** indicate significance at the 10%, 5%, and 1% level respectively.

Note that the two events (increases in risk-weights on foreign currency denominated mortgage loans and loans issued to foreign currency exposed firms and individuals) are represented by a single dummy variable. We estimated the regression by including separate two dummy variables for each of

3. See also Jacobson, LaLonde and Sullivan (1993) for classical event study.

the individual policy changes at the same time. However, one of the dummy variables was automatically omitted due to perfect collinearity. Therefore, we combine these two macroprudential policy actions and treat them as one event, implying that the coefficient estimate expresses the combined effects. To look at the individual effect, we also estimate the regression including the individual event dummy variables one at a time. By comparing the estimate of the combined event dummy in columns (4) and (5), we can observe that banks respond to real policy shock much stronger than the expected shock because the statistical significance and value of the coefficient on risk-weight events dummy are improved when we set the dummy following the effective date.

Moreover, we find quite significant negative impact of the exchange rate on banks' loan supply before we specify our policy variables with lags, suggesting that the banks generally tend to reduce their loans due to real depreciation of the domestic currency against the US dollar. However, we lost the effect of exchange rates on banking credit supply when we include the lagged policy variables. This is inconsistent with the fact that banks reduce their foreign currency loans to avoid the exchange rate risk on their loan portfolio. The banks are also likely to consider an inflation and interest rate spread as their economic fundamentals for decisions on lending. However, we could not find any evidence for any statistically significant effect of the foreign trade condition (proxied by current account balance), capital openness and economic growth on loan supply. It should be noted that the statistical significance of country-level variables is not so important and we should only focus on the macroprudential policy variables of our interest, risk-weights dummy and performance of banks on reserve requirement.

**Table 6: Effect of Macroprudential Policies on Individual Sector Loan Supply**

| | (1) Agr. | (2) Mining | (3) Man. | (4) Const. | (5) Trade | (6) Food |
|---|---|---|---|---|---|---|
| Risk-weights dummy (effective, lagged) | −0.304* | −0.030 | −0.257** | −0.515*** | −0.216* | −0.568*** |
| | (0.142) | (0.532) | (0.095) | (0.121) | (0.117) | (0.141) |
| Bank's performance to RR (lagged) | −0.000 | 0.000 | −0.000 | −0.001 | −0.001** | 0.000 |
| | (0.001) | (0.000) | (0.000) | (0.001) | (0.000) | (0.001) |
| Log of real FX rate (MNT/US$) | −0.851 | −0.243 | −0.441 | 0.663 | −0.484 | −0.537 |
| | (0.710) | (0.737) | (0.541) | (0.798) | (0.426) | (0.995) |
| Current account (% of GDP) | −0.005 | −0.004 | −0.003 | −0.012 | −0.002 | −0.002 |
| | (0.003) | (0.008) | (0.004) | (0.007) | (0.003) | (0.005) |
| Capital openness | 0.002 | −0.002 | 0.002 | 0.001 | 0.000 | 0.000 |
| | (0.001) | (0.001) | (0.002) | (0.001) | (0.001) | (0.001) |
| Real GDP growth (YoY %) | −0.009 | −0.007 | −0.020* | −0.021 | −0.017* | 0.014 |
| | (0.010) | (0.015) | (0.010) | (0.019) | (0.009) | (0.017) |
| CPI inflation | 0.004 | 0.003 | −0.001 | 0.016 | 0.024*** | 0.009** |
| | (0.008) | (0.007) | (0.011) | (0.009) | (0.008) | (0.004) |
| Interest rate differential (MNT, WA) | 0.012 | 0.010 | −0.057 | −0.123** | 0.004 | 0.041 |
| | (0.029) | (0.025) | (0.042) | (0.046) | (0.039) | (0.026) |
| Number of observations | 403 | 407 | 415 | 433 | 434 | 420 |
| Adjusted $R^2$ | 0.87 | 0.85 | 0.93 | 0.88 | 0.93 | 0.81 |

*Notes*: Robust standard errors in parentheses.
Agr. = Agriculture, Man. = Manufacturing, Const. = Construction, RR = reserve requirement, MNT = Mongolian tugrik, GDP = Gross Domestic Products, YoY = year-on-year, WA = weighted average, Interest rate differential = Lending rate − Deposit rate
*, **, and *** indicate significance at the 10%, 5%, and 1% level respectively.

We then evaluate the effect of macroprudential policies on sectoral lending by an individual bank using the fixed effect model. We use our last model specification with fixed effects presented in column (6) of Table 5, but we change the dependent variable of total loan supply to loan supply to a particular economic sector. We then estimate these panel regressions separately, with all other explanatory variables remaining the same. Nine main economic sectors and loans issued to each of these sectors are considered. However, we find that the risk-weights and reserve requirements are effective only for six sectors including agriculture, mining, manufacturing, construction, trade, and accomodations and food services. Table 6 presents the combined results from the individual sector estimations.

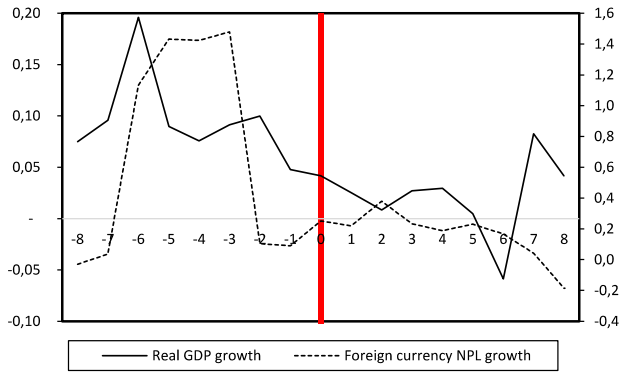
We observe that events of increasing risk-weights successfully reduce the credit supply to the individual sectors except mining. This result illustrates the decisions for banks' portfolio allocation. In other words, commercial banks do not reduce credits to the mining sector even when the risk-weights tightened. With an increase in risk-weights, we find that the banks prefer maintaining mining loans while reducing loans to other sectors more. On the other side, we find from the effect of reserve requirement on performance of banks is that only trade credits are affected. This result is actually expected since the effect of reserve requirement on total loan supply is almost negligible.

Similar to the estimation of total credit supply, we could not find any causality of exchange rates on sectoral lending. This could be explained by the fact that we expressed the exchange rate in real terms. In other words, if we use the nominal exchange rate instead of real exchange rate, we may find some effect of exchange rates on bank credits to these sectors. The estimation results also suggest that interest rate spread or the difference between lending rates and deposit rates only affects the loans to the construction sector, while the inflation rate is effective for increasing loan supply to trade and food industries. Other country-level macroeconomic indicators hardly affect the sectoral loan supply. In general, we can observe that, across all other sectors, trade credits closely reflect the changes in macroprudential policies and macroeconomic condition.

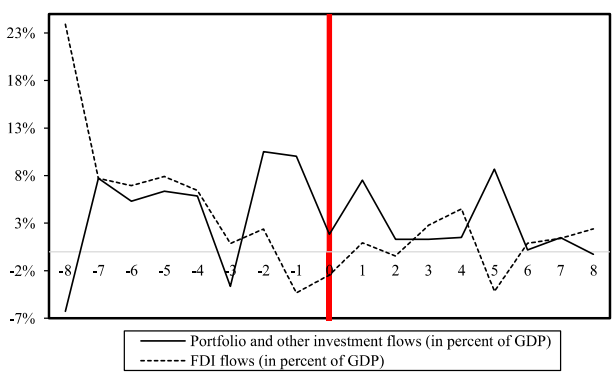
## 4.2 The Effects of Changing Banks' Risk-Weights

The estimation window covers 28 quarters over the 2006–2012 period, whereas the event window covers eight quarters prior and after the policy announcement; time 0 is the event period, i.e., period when policy is implemented.

**Figure 7: Driving Factors of Foreign Currency Credit Growth**



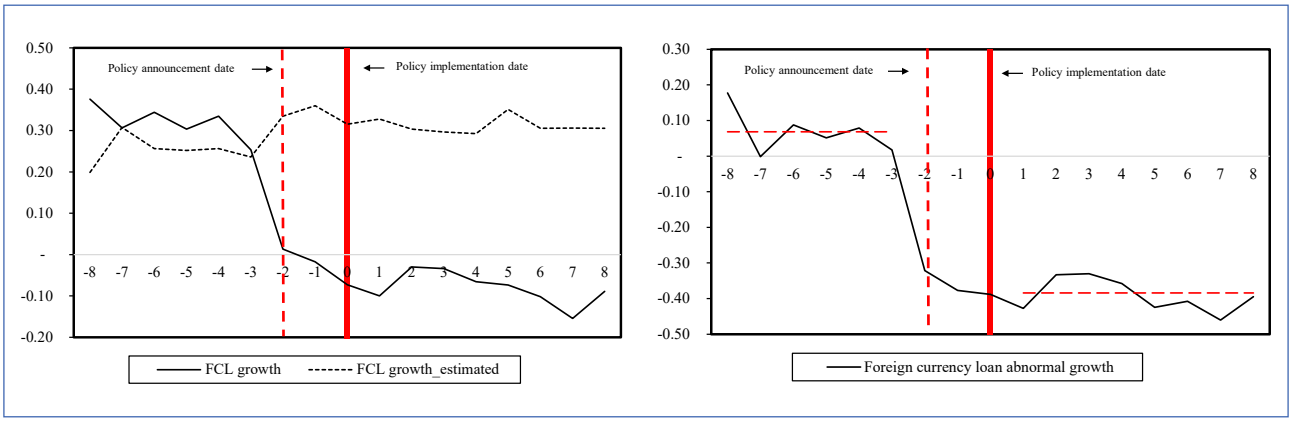

(a) Domestic factors




(b) External factors

Figure 7 shows the pattern of domestic and external factors that affect the foreign currency credit growth. The real GDP growth and growth of foreign currency non-performing loans (NPL) tend to decline throughout the event window, while the real GDP growth is positive for most of the period. The inflows of foreign direct investment (FDI) into Mongolia was at an all-time high point at the beginning of the event window.

**Figure 8: Growth of Foreign Currency Loans**




(a) Normal growth (b) Abnormal growth

On the other hand, Figure 8 shows the normal and abnormal growth of foreign currency loans. Foreign currency loans started to decline two quarters prior to the event, which is consistent with the announcement date of policy changes. There is a persistent decline in foreign currency loans for two quarters prior to the event date until the end of an event window. Foreign currency loans showed an average annual decline of 8% in the post-event window.

## 5. Conclusion

This paper examines the effect of a set of macroprudential policies including risk-weights, loan-loss provisioning and reserve requirements on bank credit supply in Mongolia, a country with a little experience for implementing macroprudential policies. Using aggregate and individual bank-specific quarterly data for 14 banks in Mongolia over the 2005–2016 period, the effect of macroprudential measures on total credit supply, sectoral lending, as well as some specific type of loans such as foreign currency loans, is analyzed.

To better understand the effectiveness of macroprudential policies, we estimate the effect of risk-weights and reserve requirements on total and sectoral lending, using an event study research design in the spirit of Lafortune et al. (2016) and the panel framework. Controlling for endogeneity, we find that macroprudential instruments (i.e., risk-weights and reserve requirements) are effective in dampening credit cycles at sufficient levels of significance in Mongolia. The event study specification models the events of increasing risk-weights on foreign currency denominated mortgage loans and loans issued to foreign exchange exposed firms as permanent and immediate (jump) shifts. The coefficient estimate of the risk-weights dummy was statistically significant and robust. Thus, we argue that these foreign exchange related macroprudential policies help to reduce foreign currency lending, indicating the ex-ante nature of macroprudential measures. In addition, we find that the real (effective date) policy shock of increasing risk-weights on foreign currency denominated mortgage loans and loans issued to foreign currency exposed firms is much stronger than the expected (announced date) policy shock. We also postulate that reserve

requirement measures on the performance of banks is generally effective for reducing total banking credit supply based on its statistical significance. Therefore, we argue that risk-weights and reserve requirement act as countercyclical buffers to mitigating increases in bank leverage in Mongolia. For sectoral lending, bank credit supply to wholesale and retail trade closely reflects the changes in macroprudential instruments across other main economic sectors.

The effect of increasing risk-weights is confirmed by estimating the market model proposed by MacKinlay (1997). After removing the systemic part of the movement in foreign currency credit growth, we find that an increase in risk-weights on foreign currency mortgage loans and loans issued to borrowers with foreign exchange exposure was effective in reducing foreign currency credit growth. It is shown that the growth of foreign currency loans consistently declines by about 8% following the build-up of risk-weights on foreign currency loans.

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