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Does bank efficiency affect the bank lending channel in China?

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Abstract

This work examines the impact of bank efficiency on the bank lending channel in China. Using a sample of 175 Chinese banks over the period 2006–2017, we investigate how the reaction of the loan supply to monetary policy actions depends on a bank's efficiency. While bank efficiency does not exert an impact on the effectiveness of monetary policy transmission overall, it does favor the transmission of monetary policy for banks with low loan-to-deposit ratios. In addition, the expansion of shadow banking activities has been associated with a positive impact of bank efficiency on monetary policy transmission. These results suggest that bank efficiency may influence the bank lending channel in certain cases.

Keywords: Chinese banks, monetary policy, bank efficiency, bank lending channel.
JEL: E52, G21.

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1 Introduction

Bank lending channel is crucial for the monetary policy transmission. Through this channel monetary policy influences the supply of bank loans due to the imperfect substitutability between bank lending and bonds. An easing of monetary policy, for example, reduces the opportunity cost of holding deposits, causing an increase in bank lending in line with the enhancement of funding sources, and thereby incentivizes banks to expand their loan supply. How a particular bank behaves depends on certain characteristics already investigated in the relevant literature including its size, capitalization and liquidity (Kashyap and Stein, 1995, 2000).

In this paper we aim to examine the possible role the bank's level of efficiency plays in the transmission of monetary policy through the bank lending channel[1]. Two competing hypotheses can be offered to explain how bank efficiency affects the transmission of monetary policy.

According to the first hypothesis, increased bank efficiency *improves* the effectiveness of monetary policy, i.e. the lending of efficient banks is more sensitive to changes in monetary policy. As changes in monetary policy influence the cost of funding for banks, efficient banks transmit policy best.

Under the second hypothesis, increased bank efficiency *hampers* the transmission of monetary policy. Because efficient banks have better access to alternative funding sources than their less efficient counterparts, they are less sensitive to shifts in monetary policy. Specifically, access to alternative funding sources is dependent on individual bank characteristics that include efficiency, an attribute associated with good bank management.

Somewhat surprisingly, the role of bank efficiency in the transmission of monetary policy has been largely overlooked in the literature. The important exception, the study of Jonas and King (2008), examines how bank efficiency influenced the transmission of monetary policy in the US between 1983 and 2005. It backs the first hypothesis, concluding that greater bank efficiency fosters effective transmission of monetary policy.

While this question to our best knowledge has not been investigated in other frameworks, the implications of bank efficiency should be particularly interesting in China's case. Numerous studies note China's low bank efficiency relative to Western countries (e.g. Berger, Hasan, and Zhou, 2009; Fungáčová, Pessarossi, and Weill, 2013), which raises the possibility that the low efficiency of Chinese banks may affect the effectiveness of monetary policy transmission.

[1] We consider the role of bank efficiency in addition to the bank characteristics that have already been studied in the literature (bank size, capitalization and liquidity) and thus bank efficiency is complementing these variables.

In this investigation of the influence of bank efficiency on the transmission of monetary policy in China, we analyze the reaction of loan supply to monetary policy actions using the methodology of Kashyap and Stein (1995, 2000), an approach often used in studies of the bank lending channel (e.g. Ferri, Kalmi, and Kerola, 2014; Fungáčová, Solanko, and Weill, 2014). By interacting bank characteristics, including bank efficiency, with monetary policy indicators in an equation explaining loan growth, we identify how various kinds of banks react to shifts in monetary policy. Bank efficiency is measured with the same stochastic frontier approach applied to estimate efficiency scores of Chinese banks in e.g. Berger, Hasan, and Zhou (2009), Dong et al. (2016), and Fungáčová, Klein, and Weill (2020). We consider cost efficiency, measuring the difference between bank's actual cost and its optimal cost when producing the same bundle of outputs. We complement Bankscope (2006 – 2015) and Fitch (2016 – 2017) bank-level financial statement data of Chinese banks with hand-collected data taken from annual reports of individual banks posted online.

This paper confirms the findings of many studies concerning a bank lending channel in China (e.g. Gunji and Yuan, 2010; Nguyen and Boateng, 2013; Chen, Ren, and Zha, 2018; Cheng and Wang, 2020). Our first contribution to the literature, however, is that we go beyond the widely scrutinized effectiveness of monetary policy instruments on the bank lending channel to consider how bank efficiency affects the transmission of monetary policy. Unlike many of the previous studies our dataset does not only focus on listed banks and consists of 175 individual banks for the years 2006 to 2017. It covers the bulk of Chinese banking sector assets.

The second contribution of this study is its analysis of Chinese bank efficiency. Numerous papers have studied the level of efficiency of Chinese banks with a focus on differences in efficiency between bank types and their evolution over time (Berger, Hasan and Zhou, 2009; Fungáčová, Pessarossi, and Weill, 2013; Dong et al., 2016; Fang et al., 2019; Fungáčová, Klein, and Weill, 2020). We extend this literature by analyzing how the level of efficiency of a bank affects monetary policy transmission to shed light on the macroeconomic consequences of bank efficiency in China.

The rest of the article is structured as follows. Section 2 describes Chinese monetary policy. Section 3 discusses the data. Section 4 develops the methodology. Section 5 presents the findings. Section 6 concludes.

2 Monetary policy in China

China's monetary policy framework is different from those of advanced economies in many aspects (Huang, Ge, and Wang, 2020). First, the People's Bank of China (PBoC) is not independent but practices monetary policy under the leadership of the State Council and the Monetary Policy Committee plays an advisory role at best. Among different monetary policy instruments, it seems that PBoC has somewhat more discretion over the reserve requirement ratio (Ma, Yan, and Liu, 2013).

Moreover, while the sole objective of monetary policy specified under Chinese law is maintaining exchange rate stability to foster economic growth, the government simultaneously pursues multiple monetary policy agendas. Among other things, the PBoC is tasked with maintaining price stability, boosting economic growth, promoting employment, and broadly maintaining the balance of payments (Zhou, 2016). Finally, quantitative instruments dominate the monetary toolkit even if China's monetary framework has been migrating slowly toward price-based policies.

After abolition of credit plans in 1998, the PBoC moved from direct credit control with quotas for credit and cash toward indirect control of liquidity. As the Chinese financial system was dominated by commercial banks, bank credit and money supply, which were seen to reflect underlying economic conditions, became the main intermediate targets of monetary policy (Huang, Ge, and Wang, 2020).

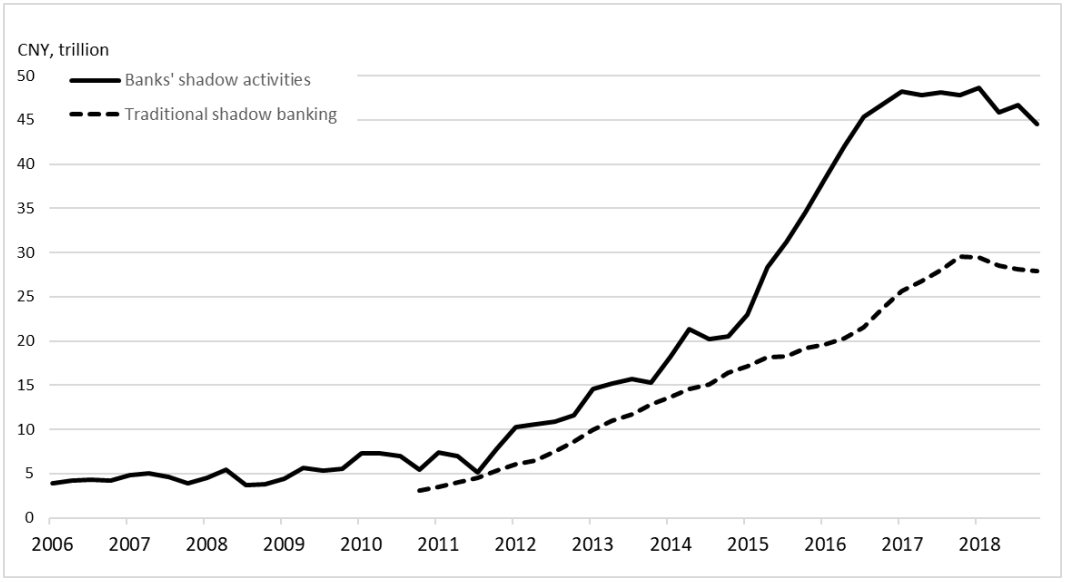
During the 2010s, the regulation in the banking sector was strengthened as Chinese authorities introduced macroprudential policies (Sun, 2019). This shifted money creation towards non-traditional channels. Real estate and other sectors suffering from excess capacity were targeted with specific credit regulations. Banks moved away from traditional lending to shadow banking instruments designed to meet the financing needs of real estate developers and local government financing vehicles (Sun, 2019).

Unlike in advanced economies, Chinese shadow banking system is primarily bank-based. Figure 1 shows that banks' shadow activities[2] took off in the fourth quarter of 2011, rising from CNY 7.2 trillion to nearly CNY 50 trillion over the next five years. By 2017, banks' shadow activities accounted for 30 % of total money creation. Traditional shadow banking (i.e. credit creation by non-bank financial institutions) also soared to CNY 28 trillion over the same period. This

[2] Sun (2019) defines *banks' shadow* as banks' money creation through accounting treatments that generate liabilities from assets, whereas *traditional shadow banking* refers to credit creation by non-bank financial intermediaries through money transfer. As both provide funding to the real sector, only banks' shadow activities create new supply of money and affect the intermediate monetary policy objective.

surge in rapid money creation outside traditional bank lending poses a variety of challenges for monetary policymakers (Sun, 2019).

Figure 1 Development of traditional shadow banking and the shadow activities of banks



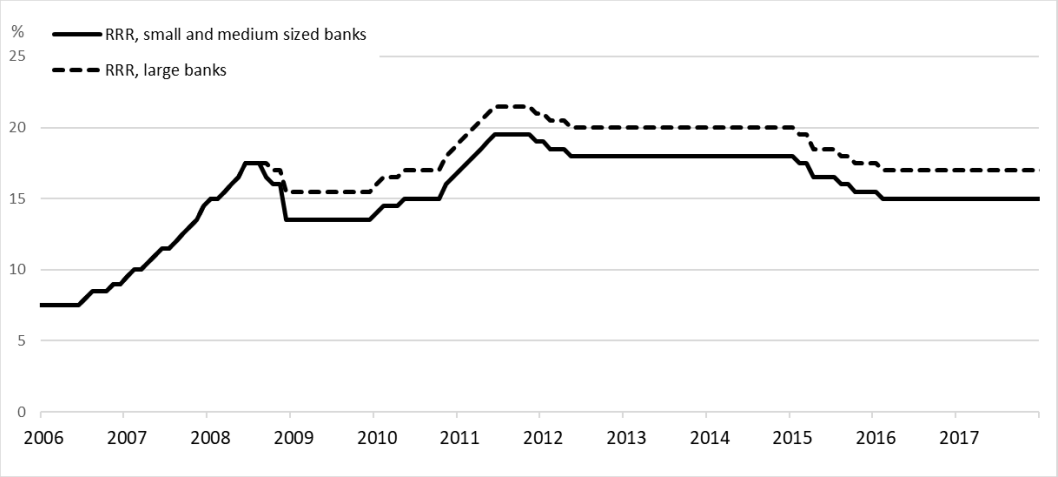
(Source: Sun, 2019).

Perhaps the best-known quantitative tool in the PBoC's extensive monetary policy toolkit is the required reserve ratio (RRR). The PBoC began to engage in frequent adjustment of RRRs around 2005–2006 (Huang, Ge, and Wang, 2020).[3] Provided that a bank had no reserves in excess of the required amount, any increase in a bank's RRR diminished its lending capacity. In 2008, the central bank began to differentiate between large banks and small and medium-sized banks[4]. Notably, the RRRs of small and medium-sized banks have remained consistently lower than those of large banks since 2009 (Figure 2).

[3] Other quantitative tools include e.g. central bank bills, central bank lending, and use of treasuries on open market operations (OMOs).

[4] Further, in 2011, the PBoC introduced a "dynamically differentiated RRR" scheme where RRRs can be adjusted individually based on e.g. banks' credit portfolios, soundness, and systemic importance (Fungáčová, Nuutilainen and Weill, 2016).

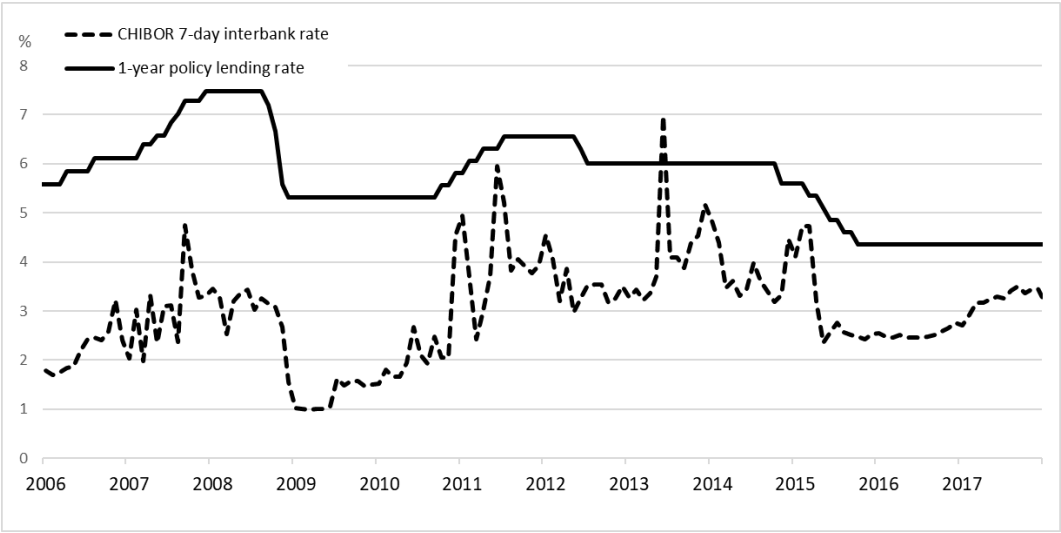
Figure 2 China began to differentiate among banks in application of the required reserve ratio, or RRR, in 2008



(Sources: PBoC and Macrobond).

The weighted average of borrowing rates among banks, the China Interbank Offered Rate (CHIBOR), was established in 1996 together with a unified interbank lending market. Interbank lending terms range from overnight to four months, the most liquid being the overnight and one-week maturities. Bank deposit and lending rates were largely regulated throughout our estimation period. The PBoC sets benchmark deposit and lending rates for domestic currency deposits and loans of different maturities. In 2004, the PBoC removed lending rate ceiling and deposit rate floor, so banks were given permission to freely adjust lending rates upward and deposit rates downward from the benchmark rate. The 2013 liberalization of lending rates was followed by a liberalization of deposit rates in 2015. Even with the removal of interest-rate ceilings and floors, however, rates remain largely regulated through measures such as PBoC "window guidance" and advisories from regulatory bodies (Huang, Ge and Wang, 2020).

Figure 3 7- day CHIBOR interbank rate and 1-year policy lending rate, 2006–2018



(Sources: PBoC and Macrobond.)

The Chinese banking sector is dominated by four massive state-owned commercial banks: the Bank of China, the China Construction Bank, the Industrial and Commercial Bank of China, and the Agricultural Bank of China. These four banks are also the world's largest banks measured by total assets[5]. Adding in the Bank of Communications, we fill out the complement of China's giant state banks, the so-called "Big Five." While these large banks provide nationwide wholesale and retail services, they focus on serving state-owned enterprises (SOEs). According to the China Banking and Insurance Regulatory Commission (CBIRC), Big Five assets represented 37 % of total banking sector assets at the beginning of 2018. At that same time, the twelve joint-stock commercial banks providing nationwide banking services accounted for 18 % of the total banking sector assets.

City commercial banks and rural commercial banks operate regionally. City commercial banks (134 in 2017) were originally established to carry out local government lending operations. Some are still owned by local governments. These banks are important in that they finance small and medium- sized enterprises (SMEs). In addition to the several hundred rural commercial banks that mainly serve rural communities and businesses, China has around 2,000 small rural cooperative banks, rural credit cooperatives, or village and township banks.

Foreign banks (39 in 2017) are generally allowed to offer the same services as domestic banks, but their market share (and hence importance) has remained small. The value of total bank assets of the Chinese banking sector increased from USD 5.1 trillion in 2006 to USD 31 trillion in 2017. The total number of banking institutions was around 4,500 in 2017. The Big Five, joint-stock commercial banks, and city commercial banks accounted for the majority of sector assets, even if they were vastly outnumbered by small and medium-sized banks.

3 Data and methodology

3.1 Data

We use bank-level financial statement data that has been compiled by Bankscope, a database maintained by Bureau Van Dijk. For years 2016 and 2017 we complement them with data by Fitch. We further augment these statements with hand-collected data from the annual reports of individual bank posted on their websites. Thus, our dataset is an unbalanced panel covering 212 individual Chinese banks for the period 2006–2017. Due to data limitations on input and output costs, we can only compute an efficiency score (our main variable of interest) for 175 banks.

[5] Based on S&P Global Market Intelligence's annual global bank ranking for 2019.

Descriptive statistics of the main variables are presented in Table 1. The average bank in our dataset has total assets of CNY 655 billion. Bank size varies substantially across bank groups. Each Big Five bank on average has nearly CNY 12 trillion in total assets. Foreign banks are smallest, with an average of CNY 58 billion in total assets. Throughout our estimation period, city commercial and joint-stock commercial banks experience the strongest loan growth and foreign banks the weakest. Foreign banks, however, are much better capitalized and tend to have more liquid assets than other bank groups. For the overall time period on average, joint-stock commercial banks are the most efficient, followed closely by rural commercial banks. Big Five banks are least efficient on average. In the regressions, all bank-specific variables are normalized with respect to the full sample mean.

As discussed, there is no single measure for the monetary policy stance as the PBoC employs a large monetary toolkit. Thus, we narrow our examination to changes in three key monetary policy measures: the annual average 7-day interbank rate (CHIBOR[6]), the annual average 1-year policy lending rate, and the annual average required reserve ratio (RRR) across bank types. We use the yearly changes of these variables in the estimations to proxy changes in the monetary policy stance. The data are taken from PBoC publications and Macrobond.

In the estimations we distinguish five different types of banks: Big Five banks, joint-stock commercial banks, city commercial banks, rural commercial banks and foreign banks. This division follows the classification by China Banking and Insurance Regulatory Commission (CBIRC).

3.2 Bank efficiency

Cost efficiency measures the difference between a bank's actual cost and its optimal cost for producing the same bundle of outputs. This difference gives information on production inefficiencies and the optimality of the chosen mix of inputs. Frontier efficiency techniques provide several approaches to estimate cost efficiency and allow estimation of the efficiency frontier on which the optimal cost is provided for each level of output.

We adopt the stochastic frontier approach widely adopted in the literature, which includes several works on Chinese banks (e.g. Berger, Hasan, and Zhou, 2009; Fungáčová, Pessarossi, and Weill, 2013; Fang et al., 2019). This approach decomposes the distance from the efficiency frontier into an inefficiency term and a random error, which represents random disturbances reflecting luck or measurement errors. We assume a normal distribution for the random error and a half-normal distribution for the inefficiency term.

[6] Being a market-based rate, CHIBOR differs from the other two measures in that it is not directly controlled by the central bank. However, CHIBOR reflects changes in the monetary policy and is thus a commonly used measure of the monetary policy stance.

In line with former literature (Berger, Hasan and Zhou, 2009; Fungáčová, Pessarossi and Weill, 2013), we adopt the intermediation approach for the specification of banking inputs and outputs. This approach assumes that the bank collects deposits to transform them into loans with capital and labor. We consider two outputs in the cost function: loans and investment assets. We use three input prices: the price of funds calculated as the interest rate paid on borrowed funds, the price of labor defined as personnel expenses divided by total assets, and the price of physical capital calculated as the ratio of other operating expenses to fixed assets. Total cost is the sum of the costs incurred for borrowed funds, labor, and physical capital. We employ the commonly used translog form to model the cost frontier of banks. The cost frontier is estimated as follows:

$$\ln\left(\frac{TC}{w_3}\right) = \beta_0 + \sum_m \alpha_m \ln y_m + \sum_n \beta_n \ln\left(\frac{w_n}{w_3}\right) + \frac{1}{2}\sum_m\sum_j \alpha_{mj} \ln y_m \ln y_j + \frac{1}{2}\sum_n\sum_k \beta_{nk} \ln\left(\frac{w_n}{w_3}\right)\ln\left(\frac{w_k}{w_3}\right) + \sum_n\sum_m \gamma_{nm} \ln\left(\frac{w_n}{w_3}\right)\ln y_m + u + v \quad , \qquad (1)$$

where TC is total cost, y_m is the m^{th} bank's output (m = 1, 2), w_n is the n^{th} input price (n = 1, 2), w_3 is the price of borrowed funds, u the inefficiency term, and v the random error. For simplicity of presentation, the indices for each bank are dropped. Homogeneity conditions are imposed by normalizing total costs and prices of labor and physical capital by the price of borrowed funds. The model is estimated for all years so that we estimate a common cost frontier over the entire observation period. We include time dummy variables in the cost frontier.

Table 2 presents the computed annual efficiency scores for all banks and each bank group separately. Looking first at the full sample, efficiency on average decreases during global financial crisis and increases thereafter. For all banks on average, efficiency is somewhat higher at the end of our estimation period compared to 2006. This is true for joint-stock commercial banks, city commercial banks, and rural commercial banks. Rural commercial banks, in particular, increase their efficiency most during the estimation period. In contrast, the Big Five banks clearly become less efficient.

3.3 Methodology

In order to investigate whether bank efficiency affects the lending channel in China, we rely on the methodology developed by Kashyap and Stein (1995, 2000), commonly used in the literature focusing on monetary policy transmission through bank lending. They suggest that if the lending view is correct, one should expect loan portfolios of banks with different characteristics to respond differently to changes in monetary policy stance. The estimated equation has the form:

$$\Delta \log(L_{i,t}) = \alpha_i + \beta_i \Delta MP_t + \gamma_i \Delta GDP_t + \delta_i X_{i,t-1} + \theta_i X_{i,t-1} \Delta MP_t + \varepsilon_{it} \ , \quad (2)$$

where L denotes total loans to private sector by bank i at time t, ΔMP denotes change in the monetary policy measure, and ΔGDP is real GDP growth. X_i are the bank-specific variables lagged by one period to overcome possible endogeneity problems and α_i is the bank-specific fixed effect.

As MP, we use three monetary policy measures: the 7-day interbank rate (CHIBOR), the 1-year policy lending rate, and the average RRR of large and small and medium-sized banks. We always use the on-year change in the average measure. The bank-specific variables that the existing literature finds to have the greatest effects on loan supply are capitalization (equity to total assets), liquidity (liquid assets to total assets) and size (log of total assets). All these characteristics impact the access of banks to external funding and are reflected in their ability to issue lending. In addition to these three bank-specific variables, we include the efficiency score, our main variable of interest, estimated using a stochastic frontier approach. More formally, the four bank-specific variables are defined as:

$$Size_{it} = \log(Total\ assets_{it}) - \frac{1}{N_t}\sum_i \log(Total\ assets_{it})$$

$$Liquidity_{it} = \frac{Liquid\ assets_{it}}{Total\ assets_{it}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \left(\frac{Liquid\ assets_{it}}{Total\ assets_{it}} \right) \right)$$

$$Capitalization_{it} = \frac{Equity_{it}}{Total\ assets_{it}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \left(\frac{Equity_{it}}{Total\ assets_{it}} \right) \right)$$

$$Efficiency_{it} = Efficiency_{it} - \tfrac{1}{T}\textstyle\sum_t \left(\tfrac{1}{N_t}\sum_i (Efficiency_{it}) \right),$$

where i = 1,…, N denotes the bank and t = 1,…,T the time (years). The bank-specific variables liquidity, capitalization, and efficiency are normalized with respect to their sample means. Variable size is normalized with respect to the sample mean for each period to remove any persistent upward trend in the value of total assets.

As monetary policy tightens (i.e. interest rates increase or RRR becomes larger), banks decrease the amount of loans supplied. We thus expect a negative coefficient β. The presence of the bank lending channel is identified when the parameter θ for the interactions of bank-specific characteristics (capitalization, liquidity, and size) and monetary policy indicator are significant and positive in line with the view that banks with a lower access to external funding (proxied by lower capitalization, liquidity, and size) are expected to react more to monetary policy variations.

As we lack access to loan-level data, we do not control for loan demand. Our approach merely assumes that all banks face the same loan demand proxied by GDP growth. We further

make the safe assumption that lending growth in a given year does not impact lending growth the following year, allowing us to exclude any lagged value of the dependent variable. Following the approach of Fungáčová, Solanko, and Weill (2014) used on annual euro area bank data, we estimate the equation in a standard fixed-effects panel regression framework.

4 Results

This section presents the results for the impact of bank efficiency on the transmission of monetary policy via the lending channel. After considering the main estimations, we focus on estimations for different types of banks. We continue by showing the estimations by separating banks based on their loan-to-deposit ratios, the estimations accounting for the period of shadow banking growth and end with a robustness test.

4.1 Main estimations

In investigating the influence of bank efficiency on the transmission of monetary policy through the bank lending channel, we consider alternatively the three monetary policy instruments and report the results in Tables 3 to 5 for reserve requirements, the interbank rate, and the policy rate, respectively.

Three specifications are presented in each table. We first provide the benchmark estimation for the bank lending channel without including efficiency and the interaction term between monetary policy and efficiency, i.e. the estimation only includes the usual specification of variables for the bank lending channel with capitalization, size, liquidity, and their interaction terms with monetary policy. We then add efficiency and the interaction term between monetary policy and efficiency but drop the three other interaction terms with monetary policy. Finally, we perform the estimation by including all variables. Both latter specifications should provide evidence that bank efficiency influences the bank lending channel.

First, we observe that the effect of monetary policy changes on loan growth has the expected negative sign. The coefficient of monetary policy is significant and negative in all estimations, in line with the view that an increase (decrease) in reserve requirements or interest rates leads to a decrease (increase) in loan growth rate.

Second, we find some evidence supporting the existence of a bank lending channel in China. The bank lending channel predicts significantly positive coefficients for the interaction terms between monetary policy and capitalization, liquidity, and size. We only find a significantly positive coefficient in all estimations, however, for the monetary policy interaction term for liquid-

ity. For the rest, the coefficients for the monetary policy interactions terms are respectively significantly negative for capitalization and not significant (with one exception) for size in all estimations.

These results are quite similar to those obtained by Fungáčová, Nuutilainen, and Weill (2016) for the bank lending channel in China. They also identify monetary policy interaction terms that are not significant with size and significantly negative with capitalization. Our only difference concerns the fact that they also obtain a non-significant coefficient for the interaction term between monetary policy and liquidity as we find it to be significant and positive.

Third, the monetary policy interaction term with bank efficiency is only significant (and positive) when reserve requirement ratio is used as proxy for monetary policy (Table 3). In case of the other two monetary policy instruments we find no significant results. The results hold true irrespective of if we include or exclude the monetary-policy interaction terms for the other bank-specific characteristics. Hence, overall our results show that bank efficiency does not exert a strong influence on the transmission of monetary policy.

We therefore find no clear support for either of the competing hypotheses for the influence of bank efficiency on the transmission of monetary policy. Based on the interaction term between monetary policy and bank efficiency, we neither observe that more efficient banks have a persistently larger loan response to changes in monetary policy, nor do we find that they are less sensitive to monetary policy changes.

In analyzing the other variables in our estimations, it is notable that well-capitalized, highly liquid, and small banks achieve higher loan growth. The coefficients of capitalization and liquidity are significant and positive while they are significant and negative for size in all the estimations. Interestingly, efficient banks have lower loan growth, i.e. the coefficient of bank efficiency is significantly negative in all estimations. This could indicate that lending in China often serves goals other than profit maximization, which would mean that more efficient banks lend less.

4.2 Estimations by bank type

The Chinese banking industry is composed of several types of banks in terms of prevailing ownership, type of clients and areas of operations. Does the impact of bank efficiency on the transmission of monetary policy differ by bank type?

Several studies suggest that bank type can affect the reaction of banks to monetary policy. In the case of China, Fungáčová, Nuutilainen, and Weill (2016) find evidence that the impact of changes in reserve requirements on loan growth differs across types of banks. Looking at Indian banks, Bhaumik, Dang, and Kutan (2011) show that ownership influences the reaction of banks to monetary policy. For the euro area, Ferri, Kalmi, and Kerola (2014) find evidence that locally

oriented banks that are more likely to engage in relationship lending and operate in a limited geographical area, are less sensitive to monetary policy shocks and more likely to smooth credit availability conditions for their customers. Similarly, Bertay, Demirgüç-Kunt and Huizinga (2015) find that lending by publicly owned banks is less procyclical than lending by private banks. Wu, Luca, and Jeon (2011) find consistent evidence that foreign-owned banks are less responsive to monetary shocks in host countries and adjust their loan portfolios and interest rates to a lesser extent than domestic private banks. It is therefore worth determining whether bank type influences how bank efficiency affects transmission of monetary policy.

To investigate this question, we redo our estimations by adding four interaction terms. We create dummy variables corresponding to five bank types: Big Five, joint-stock banks, city commercial banks, rural commercial banks, and foreign banks. We perform separate estimations by considering each bank type separately as the bank type dummy variable. We add an interaction term between monetary policy and bank type, as well as interaction variables between monetary policy, the four bank characteristics (capitalization, liquidity, size, efficiency), and bank type. Since our focus is on bank efficiency, we perform two estimations for each bank type. The first specification includes only the interactions between bank efficiency and monetary policy, and efficiency together with monetary policy and bank type. The second specification includes interaction terms with all bank-specific variables (capitalization, liquidity, size and efficiency). We can then check whether the interaction term between monetary policy, bank efficiency, and bank type is significant for a particular bank type. This variable informs us about how the influence of bank efficiency on the bank lending channel varies across bank types.

The results are reported in Tables 6 to 8 for reserve requirements, interbank rate, and policy rate, respectively. With two exceptions, we find that overall the interaction term between monetary policy, bank efficiency, and bank type is not significant.

The interaction term is significantly positive in both specifications for foreign banks with two monetary policy instruments (reserve requirements and policy rate). It is not significant with the interbank rate. Thus, bank efficiency dampens the transmission of monetary policy for foreign banks. In other words, efficient foreign banks hinder the transmission of monetary policy. Nevertheless, we need to keep in mind that the foreign banks only account for less than 2 percent of the banking sector assets in China and therefore their role in the banking system is limited.

The interaction term is significantly negative for city commercial banks with two monetary policy instruments (reserve requirements and policy rate). We find this result only in the specification that excludes the three interaction variables between monetary policy, the three other bank-specific characteristics (capitalization, liquidity, size) and bank type. Simultaneously, the

interaction term between monetary policy and bank efficiency is significantly positive. These findings provide limited support that bank efficiency influences the transmission of monetary policy in the case of city commercial banks.

Hence, these estimations provide limited evidence that the impact of bank efficiency on the bank lending channel in China differs depending on bank type.

4.3 Estimations by loan-to-deposit ratio

So far, our findings have generally suggested that bank efficiency does not affect the bank lending channel. However, it may be that the transmission of monetary policy differs across banks due to their structure of activities. Depending on their efficiency, banks with a higher loan-to-deposit ratio might be differently affected by changes in monetary policy. Differences in the funding structure and the composition of assets can influence the way bank efficiency affects the transmission of monetary policy.

To test this hypothesis, we redo our estimations to consider two groups of banks based on their loan-to-deposit ratios. The first group of banks have loan-to-deposit ratios higher than the median, while the second group has loan-to-deposit ratios below the median value of our sample. We only consider a specification that includes all monetary policy interaction terms. Table 9 reports the estimations.

Any evidence that bank efficiency favors the transmission of monetary policy relates to banks with lower-than-median loan-to-deposit for two out of three measures of monetary policy. With policy rate and interbank rate, we show that the interaction term between monetary policy and bank efficiency is significantly negative for banks with a low loan-to-deposit ratio and significantly positive for banks with a high loan-to-deposit ratio. With reserve requirements, the interaction term between monetary policy and bank efficiency is never significant, although the coefficients are of the same sign as the coefficients in the estimations with policy rate and interbank rate.

These findings support the view that the loan-to-deposit ratio plays a role in the impact of bank efficiency on the bank lending channel. We can interpret this result according to either hypothesis on the influence of bank efficiency on the bank lending channel. On the one hand, a low loan-to-deposit ratio means that the bank is more sensitive to the cost of funding since deposits play a greater role in financing. For such banks, higher efficiency is associated with a bigger reaction in loan growth to changes in monetary policy. On the other hand, a high loan-to-deposit ratio means that the bank is less dependent on deposits to finance its activities, and therefore less sensitive to monetary policy variations. Thus, for these banks, greater efficiency fosters access to alternative funding sources and thus hampers the transmission of monetary policy.

4.4 The influence of shadow banking expansion

The Chinese banking system underwent major changes during the observation period. Among these many changes, the growth of shadow banking is of particular importance as it has been shown to affect monetary policy transmission. Chen, Ren, and Zha (2018) find that the rise of shadow banking loans during 2009–2015 reduced the effectiveness of monetary policy. Cheng and Wang (2020) confirm this finding through an investigation of the lending behavior of Chinese listed banks over the period 2011–2018.

As these findings suggest that the bank lending channel might have also been influenced, we examine whether the expansion of shadow banking affected the bank lending channel, and more specifically, how this channel may have been influenced by bank efficiency. To this end, we create the dummy variable *Shadow* equal to one if the year is from 2012 to 2016, and zero otherwise. As discussed in Section 2 (see also Figure 1), these are the years when traditional shadow banking and banks' shadow activities increased at an accelerating pace. We interact *Shadow* with all variables to check whether the bank lending channel has evolved over the period of study.

Table 10 reports the results. For each monetary policy instrument, we perform the same set of three estimations as in the main estimations. This enables us to directly compare the findings. The first column presents the estimation for the bank lending channel without efficiency and the interaction term between monetary policy and efficiency. The second column adds efficiency and the interaction term between monetary policy and efficiency but drops the three other interaction terms with monetary policy. The third column displays the estimation with all variables. Two main conclusions emerge.

First, we do not observe evidence that the bank lending channel was hampered by the rise of shadow banking. The interaction terms between monetary policy, bank-specific variables (capitalization, liquidity, size) and *Shadow* are not significantly positive in any systematic way. This suggests that monetary policy transmission through bank lending channel has not been hampered during the period of ballooning shadow banking activities in 2012–2016 when compared to the rest of the time span.

Second, we find evidence that the effect of bank efficiency on monetary policy transmission has changed with the expansion of shadow banking. The interaction term *MP×Efficiency×Shadow* is significantly negative in all estimations with reserve requirements and the interbank rate. With the policy rate, the findings are less clear since the interaction term is not significant in the second column and significantly positive in the third column (at the 10% level).

These results seem to suggest that the expansion of shadow banking reinforced the transmission of monetary policy among the more efficient banks, but why? More efficient banks may have had smaller increases in their shadow banking activities at the expense of bank loans because

they had lower incentives to do so. Greater efficiency means they are under less pressure to boost profitability by venturing into more lucrative shadow banking activities. Thus, if more efficient banks are expected to engage less in shadow banking activities than other banks, higher bank efficiency could be associated with more effective monetary policy transmission as shadow banking activities are increasing.

4.5 Alternative efficiency measurement

To check the validity of our empirical findings, we adopt an alternative approach to measure efficiency. While in the main estimations we have utilized the stochastic frontier approach to estimate the cost frontier as it is standard in the literature, the literature on banking efficiency offers a wide range of techniques for estimating cost efficiency (e.g. Bauer et al., 1998).

As our alternative technique for calculating efficiency scores, we use the time-varying WITHIN model proposed by Cornwell, Schmidt, and Sickles (1990). This technique has been applied in several works on bank efficiency (e.g. Esho, 2001), and notably by Fungáčová, Pessarossi, and Weill (2013) as a robustness check to measure efficiency of Chinese banks. It also relies on panel data, so the WITHIN model does not require distributional assumptions on the inefficiency term and the random error. The term φ_{it} is modeled as follows:

$$\varphi_{it} = \theta_{1i} + \theta_{2i}\, t + \theta_{3i}\, t^2, \tag{3}$$

where $\varphi_{it} = \varphi - u_{it}$, i indexes bank, t represents time, φ the intercept in the cost function, and the θs are cross-section bank-specific parameters.

We report the results of estimations including efficiency scores computed with the WITHIN model in Tables 11 to 13 for reserve requirements, the interbank rate, and the policy rate, respectively. With each monetary policy instrument, we adopt the same three specifications as in the main estimations.

We find that the monetary policy interaction term with bank efficiency is not significant in half of the cases. We obtain positive and significant coefficient for the specification with all variables for reserve requirements. For interbank and benchmark policy rate the efficiency interaction coefficients for specification without other bank characteristics are negative and significant. Therefore, we cannot find any clear effect of bank efficiency on the monetary policy transmission. This is in line with our main conclusion, obtained with efficiency scores based on a stochastic frontier approach. Our result is thus confirmed using an alternative approach to measure cost efficiency.

For the rest, these estimations show the same findings for the other variables. On the one hand, the effect of monetary policy changes on loan growth has the expected negative sign in accordance with the fact that an increase (decrease) in reserve requirements or interest rates leads to a decrease (increase) in loan growth rate. On the other hand, we do find no evidence supporting the existence of a bank lending channel in China. We only obtain a significant positive coefficient for the monetary policy interaction term for liquidity in all estimations.

5 Conclusion

In this paper, we examine how bank efficiency influences the bank lending channel in China. Our main finding is that bank efficiency does not exert an impact on the effectiveness of monetary policy transmission. This supports the view that better performance of banks in minimizing costs does not affect monetary policy transmission. This conclusion is robust to various monetary policy indicators, a set of explaining variables, and an alternative specification of the efficiency frontier.

We confirm this result for all types of banks in China with the exception of foreign banks for which higher efficiency dampens monetary policy transmission. Given the small balance sheets of these banks relative total banking sector assets, their relative importance in affecting monetary policy transmission in China is minor.

However, we do obtain two intriguing results that suggest bank efficiency may influence the bank lending channel in certain cases. First, we observe that bank efficiency favors the transmission of monetary policy for banks with low loan-to-deposit ratios. Thus, the transmission of monetary policy is facilitated by higher bank efficiency when banks have a structure of activities with a lower share of loans relative to deposits. Respectively, for banks with high loan-to-deposit ratios, higher bank efficiency is acting as a dampening factor in the transmission of monetary policy. Second, we find that the influence of bank efficiency on the bank lending channel increased during the period of 2012 – 2016 as the shadow banking activities became more prevalent. During these years, more effective banks were reinforcing the monetary policy transmission.

The policy implications are that measures implemented to favor bank efficiency in China as a whole have likely done little to facilitate monetary policy transmission. However, targeted measures can work if they are directed at banks with different levels of loan-to-deposit ratios. Furthermore, the beneficial impact of such measures on the effectiveness of monetary policy transmission appears to have only increased during the time when new credit has been created increasingly more outside the traditional bank lending.

Our work opens avenues for further research. First, it will be of interest to investigate whether the increase of shadow banking activities in China contributes further to bank efficiency

and enhances the effectiveness of monetary policy transmission in the years ahead. Second, this investigation of bank efficiency could be extended to other bank characteristics to help policymakers better identify which characteristics influence monetary policy transmission in China. Third, the impact of bank efficiency on monetary policy transmission should be investigated for many countries. This study on China and the work of Jonas and King (2008) on the US are the only two such studies on this question. Future studies will doubtless help us refine our understanding of the impact of bank efficiency on monetary policy transmission in a variety of national contexts.

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Tables

Table 1 Descriptive statistics

All banks

Variable	# of obs	Mean	Std.dev.	Min	Max
Loan growth	1.775	0.179	0.263	-3.489	3.728
Total assets (CNY mln)	2.013	655105.5	2424091	0	26100000
Capitalization	2.010	0.090	0.083	-0.064	0.947
Liquidity ratio	1.456	0.282	0.180	0.001	4.207
Efficiency score	1.126	0.873	0.097	0.103	0.981
Change in policy rate	1.881	-0.160	0.704	-1.733	0.958
Change in CHIBOR 1w	1.881	0.093	0.937	-1.728	1.835
Change in RRR	1.881	0.545	2.097	-1.750	4.625

Big Five Banks

Variable	# of obs	Mean	Std.dev.	Min	Max
Loan growth	59	0.131	0.069	-0.114	0.399
Total assets (CNY mln)	60	11900000	6135973	1719483	26100000
Capitalization	60	0.065	0.014	0.015	0.082
Liquidity ratio	56	0.193	0.067	0.073	0.309
Efficiency score	60	0.860	0.073	0.395	0.930

Joint-stock commercial banks

Variable	# of obs	Mean	Std.dev.	Min	Max
Loan growth	142	0.210	0.117	0.089	0.888
Total assets (CNY mln)	143	1951783	1711957	15338.2	6416842
Capitalization	143	0.055	0.027	0.005	0.313
Liquidity ratio	123	0.265	0.113	0.055	0.500
Efficiency score	122	0.900	0.031	0.747	0.952

City commercial banks

Variable	# of obs	Mean	Std.dev.	Min	Max
Loan growth	914	0.214	0.170	-0.657	3.244
Total assets (CNY mln)	1.041	144243.6	231836.5	0	2329805
Capitalization	1.039	0.068	0.023	-0.064	0.308
Liquidity ratio	761	0.272	0.194	0.039	4.207
Efficiency score	570	0.867	0.089	0.370	0.980

Rural commercial banks

Variable	# of obs	Mean	Std.dev.	Min	Max
Loan growth	269	0.144	0.087	-0.045	0.619
Total assets (CNY mln)	333	152587	297255.1	207.7	4654776
Capitalization	332	0.076	0.019	0.005	0.149
Liquidity ratio	228	0.243	0.113	0.021	0.589
Efficiency score	161	0.894	0.071	0.494	0.967

Foreign banks

Variable	# of obs	Mean	Std.dev.	Min	Max
Loan growth	359	0.109	0.494	-3.489	3.728
Total assets (CNY mln)	403	58109.18	91067.64	108.5	808942
Capitalization	403	0.178	0.151	0.032	0.947
Liquidity ratio	257	0.385	0.192	0.001	0.938
Efficiency score	205	0.863	0.142	0.103	0.981

Table 2 Efficiency scores

Year	All banks			Big Five			Joint stock commercial banks			City commercial banks			Rural commercial banks			Foreign banks		
	#	Efficiency	Std.dev.	#	Efficiency	Std.dev.	#	Efficiency	Std.dev.	#	Efficiency	Std.dev.	#	Efficiency	Std.dev.	#	Efficiency	Std.dev.
2006	46	0.874	0.093	5	0.895	0.016	11	0.874	0.038	20	0.887	0.058	5	0.853	0.122	4	0.927	0.031
2007	77	0.851	0.150	5	0.898	0.022	11	0.904	0.037	37	0.854	0.110	7	0.880	0.076	16	0.812	0.249
2008	101	0.843	0.128	5	0.871	0.017	11	0.901	0.034	51	0.814	0.133	10	0.822	0.149	24	0.882	0.137
2009	106	0.864	0.108	5	0.906	0.008	11	0.913	0.024	57	0.845	0.110	10	0.915	0.029	23	0.855	0.143
2010	107	0.870	0.096	5	0.913	0.016	11	0.917	0.015	54	0.852	0.108	12	0.919	0.032	25	0.854	0.104
2011	119	0.859	0.114	5	0.767	0.219	11	0.903	0.055	59	0.850	0.105	13	0.906	0.044	31	0.857	0.135
2012	103	0.880	0.078	5	0.856	0.023	12	0.896	0.017	44	0.871	0.083	14	0.910	0.035	28	0.877	0.103
2013	91	0.873	0.101	5	0.856	0.043	10	0.907	0.016	44	0.886	0.049	12	0.810	0.147	19	0.867	0.164
2014	127	0.880	0.088	5	0.830	0.033	11	0.982	0.024	60	0.880	0.069	17	0.910	0.185	32	0.866	0.141
2015	86	0.899	0.033	5	0.844	0.029	8	0.895	0.022	51	0.898	0.034	20	0.911	0.191	1	0.936	.
2016	86	0.897	0.034	5	0.841	0.024	8	0.900	0.024	50	0.895	0.034	21	0.907	0.024	1	0.936	.
2017	77	0.897	0.033	5	0.842	0.018	7	0.904	0.021	43	0.897	0.032	20	0.904	0.024	1	0.923	.

Table 3 Main estimations with reserve requirements

Monetary policy:	Average of reserve requirements (large and small and mid-sized banks)		
VARIABLES	(1) dlogloans	(2) dlogloans	(3) dlogloans
dMP	-0.010***	-0.008*	-0.009**
	(0.003)	(0.004)	(0.004)
L.capitalization	1.666***	0.677**	0.793***
	(0.222)	(0.295)	(0.292)
L.liquidity	0.307***	0.502***	0.358***
	(0.055)	(0.049)	(0.069)
L.size	-0.135***	-0.161***	-0.148***
	(0.021)	(0.029)	(0.029)
dMP_capitalization	-0.172***		-0.266***
	(0.041)		(0.053)
dMP_liquidity	0.070***		0.055***
	(0.017)		(0.021)
dMP_size	-0.001		-0.002
	(0.002)		(0.002)
dGDP	2.017***	0.763	0.744
	(0.424)	(0.581)	(0.581)
L.efficiency		-0.495***	-0.525***
		(0.107)	(0.105)
dMP_efficiency		0.057*	0.064**
		(0.032)	(0.032)
Constant	0.056	0.213***	0.208***
	(0.037)	(0.054)	(0.054)
Observations	1,297	898	898
R-squared	0.245	0.259	0.287
Number of id	212	175	175

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4 Main estimations with CHIBOR interbank rate

Monetary policy:	CHIBOR 7-day interbank rate		
VARIABLES	(1) dlogloans	(2) dlogloans	(3) dlogloans
dMP	-0.023*** (0.006)	-0.020*** (0.007)	-0.025*** (0.007)
L.capitalization	1.445*** (0.212)	0.694** (0.295)	0.102 (0.297)
L.liquidity	0.325*** (0.054)	0.511*** (0.049)	0.350*** (0.066)
L.size	-0.138*** (0.021)	-0.155*** (0.029)	-0.161*** (0.028)
dMP_capitalization	-0.355*** (0.091)		-0.784*** (0.112)
dMP_liquidity	0.134*** (0.036)		0.125*** (0.042)
dMP_size	-0.001 (0.004)		-0.004 (0.004)
dGDP	1.643*** (0.369)	0.673 (0.516)	0.432 (0.500)
L.efficiency		-0.401*** (0.098)	-0.416*** (0.094)
dMP_efficiency		0.009 (0.064)	0.019 (0.065)
Constant	0.082** (0.034)	0.215*** (0.050)	0.231*** (0.049)
Observations	1,297	898	898
R-squared	0.244	0.259	0.310
Number of id	212	175	175

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5 Main estimations with policy rate

Monetary policy:	1-year benchmark policy rate		
VARIABLES	(1) dlogloans	(2) dlogloans	(3) dlogloans
dMP	-0.030*** (0.008)	-0.030*** (0.010)	-0.029*** (0.010)
L.capitalization	1.310*** (0.212)	0.669** (0.296)	0.039 (0.301)
L.liquidity	0.349*** (0.047)	0.516*** (0.049)	0.371*** (0.058)
L.size	-0.133*** (0.021)	-0.152*** (0.029)	-0.154*** (0.029)
dMP_capitalization	-0.504*** (0.111)		-0.976*** (0.143)
dMP_liquidity	0.260*** (0.055)		0.232*** (0.066)
dMP_size	-0.007 (0.005)		-0.013** (0.006)
dGDP	1.869*** (0.379)	0.737 (0.518)	0.630 (0.509)
L.efficiency		-0.400*** (0.099)	-0.431*** (0.096)
dMP_efficiency		0.015 (0.085)	0.096 (0.087)
Constant	0.054 (0.035)	0.201*** (0.051)	0.203*** (0.050)
Observations	1,297	898	898
R-squared	0.252	0.260	0.307
Number of id	212	175	175

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6 Estimations by ownership type with reserve requirements

	Big Five		Joint stock		CCB		RCB		Foreign	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
VARIABLES	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans
dMP	-0.008**	-0.009**	-0.008*	-0.008**	-0.008	-0.002	-0.008**	-0.009**	-0.006	-0.008
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.006)	(0.004)	(0.004)	(0.004)	(0.006)
dMP_type	0.017	0.074	-0.004	-0.018	-0.001	-0.010	0.008	0.000	-0.007	0.004
	(0.016)	(0.158)	(0.012)	(0.042)	(0.007)	(0.009)	(0.011)	(0.019)	(0.009)	(0.011)
L.capitalization	0.667**	0.762***	0.668**	0.783***	0.729**	0.720**	0.669**	0.786***	0.755**	0.670**
	(0.296)	(0.292)	(0.296)	(0.295)	(0.296)	(0.292)	(0.296)	(0.293)	(0.296)	(0.292)
L.liquidity	0.501***	0.336***	0.502***	0.356***	0.501***	0.277***	0.502***	0.352***	0.497***	0.280***
	(0.049)	(0.069)	(0.049)	(0.070)	(0.049)	(0.071)	(0.049)	(0.069)	(0.049)	(0.070)
L.size	-0.164***	-0.152***	-0.161***	-0.150***	-0.158***	-0.138***	-0.162***	-0.146***	-0.154***	-0.130***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
L.efficiency	-0.513***	-0.578***	-0.494***	-0.525***	-0.524***	-0.515***	-0.512***	-0.545***	-0.563***	-0.530***
	(0.109)	(0.108)	(0.107)	(0.106)	(0.107)	(0.107)	(0.108)	(0.107)	(0.109)	(0.107)
dMP_capitalization		-0.313***		-0.268***		-0.257***		-0.272***		-0.074
		(0.056)		(0.053)		(0.063)		(0.053)		(0.154)
dMP_liquidity		0.060***		0.056***		-0.096**		0.059***		0.089***
		(0.021)		(0.021)		(0.042)		(0.021)		(0.022)
dMP_size		-0.007**		-0.002		-0.005**		-0.003		0.001
		(0.003)		(0.002)		(0.003)		(0.002)		(0.002)
dMP_efficiency	0.059*	0.081**	0.055*	0.063*	0.124***	0.094**	0.066**	0.076**	-0.007	-0.004
	(0.032)	(0.033)	(0.032)	(0.032)	(0.043)	(0.042)	(0.033)	(0.034)	(0.039)	(0.039)
dMP_capitalization_type		1.046		-0.112		0.074		0.107		-0.484***
		(0.754)		(0.548)		(0.195)		(0.560)		(0.186)
dMP_liquidity_type		-0.297		-0.025		0.188***		-0.126		-0.174***
		(0.335)		(0.117)		(0.047)		(0.117)		(0.058)
dMP_size_type		-0.004		0.001		0.001		0.006		-0.038***
		(0.035)		(0.010)		(0.006)		(0.013)		(0.009)
dMP_efficiency_type	-0.257	-0.296	0.148	0.208	-0.137**	-0.075	-0.142	-0.127	0.159***	0.120**
	(0.469)	(0.533)	(0.253)	(0.293)	(0.058)	(0.060)	(0.128)	(0.128)	(0.059)	(0.059)
dGDP	0.690	0.629	0.814	0.775	0.833	0.636	0.724	0.728	0.773	0.954*
	(0.586)	(0.588)	(0.589)	(0.599)	(0.581)	(0.576)	(0.582)	(0.585)	(0.581)	(0.571)
Constant	0.222***	0.220***	0.210***	0.206***	0.207***	0.210***	0.218***	0.208***	0.210***	0.178***
	(0.055)	(0.055)	(0.054)	(0.056)	(0.054)	(0.054)	(0.054)	(0.055)	(0.054)	(0.054)
Observations	898	898	898	898	898	898	898	898	898	898
R-squared	0.260	0.295	0.259	0.288	0.264	0.309	0.260	0.290	0.267	0.323
Number of id	175	175	175	175	175	175	175	175	175	175

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7 Estimations by ownership type with CHIBOR interbank rate

	Big Five		Joint stock		CCB		RCB		Foreign banks	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
VARIABLES	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans
dMP	-0.020***	-0.025***	-0.018**	-0.022***	-0.028***	-0.013	-0.021***	-0.025***	-0.015*	-0.017
	(0.007)	(0.007)	(0.008)	(0.007)	(0.010)	(0.011)	(0.008)	(0.008)	(0.008)	(0.011)
dMP_type	0.007	-0.080	-0.024	-0.035	0.014	-0.007	0.016	0.023	-0.023	0.055***
	(0.030)	(0.339)	(0.031)	(0.090)	(0.014)	(0.017)	(0.021)	(0.040)	(0.017)	(0.021)
L.capitalization	0.692**	0.084	0.695**	0.099	0.659**	0.074	0.683**	0.083	0.613**	0.165
	(0.296)	(0.298)	(0.296)	(0.297)	(0.296)	(0.297)	(0.296)	(0.298)	(0.297)	(0.298)
L.liquidity	0.511***	0.346***	0.511***	0.341***	0.504***	0.295***	0.512***	0.344***	0.502***	0.314***
	(0.049)	(0.067)	(0.049)	(0.067)	(0.049)	(0.070)	(0.049)	(0.066)	(0.049)	(0.069)
L.size	-0.154***	-0.162***	-0.155***	-0.160***	-0.159***	-0.153***	-0.153***	-0.157***	-0.160***	-0.151***
	(0.029)	(0.028)	(0.029)	(0.028)	(0.029)	(0.028)	(0.029)	(0.029)	(0.029)	(0.028)
L.efficiency	-0.411***	-0.428***	-0.401***	-0.420***	-0.393***	-0.434***	-0.419***	-0.430***	-0.418***	-0.388***
	(0.099)	(0.096)	(0.098)	(0.095)	(0.098)	(0.095)	(0.099)	(0.096)	(0.098)	(0.094)
dMP_capitalization		-0.809***		-0.787***		-0.787***		-0.803***		-0.159
		(0.118)		(0.114)		(0.137)		(0.114)		(0.336)
dMP_liquidity		0.127***		0.135***		-0.048		0.134***		0.150***
		(0.042)		(0.043)		(0.084)		(0.042)		(0.045)
dMP_size		-0.006		-0.000		-0.007		-0.004		-0.002
		(0.006)		(0.005)		(0.005)		(0.004)		(0.005)
dMP_efficiency	0.012	0.032	0.011	0.019	0.085	-0.040	0.021	0.034	-0.050	-0.029
	(0.064)	(0.067)	(0.065)	(0.065)	(0.102)	(0.103)	(0.067)	(0.069)	(0.075)	(0.076)
dMP_capitalization_type		-0.193		0.298		0.443		1.072		-0.353
		(2.801)		(1.345)		(0.406)		(1.357)		(0.392)
dMP_liquidity_type		-0.379		-0.104		0.216**		-0.208		-0.176
		(0.641)		(0.255)		(0.094)		(0.225)		(0.118)
dMP_size_type		0.016		-0.002		-0.001		0.012		0.054***
		(0.067)		(0.024)		(0.012)		(0.026)		(0.020)
dMP_efficiency_type	-0.412	-0.446	0.384	0.413	-0.108	0.057	-0.188	-0.206	0.218	-0.057
	(0.659)	(0.704)	(0.705)	(0.795)	(0.132)	(0.139)	(0.229)	(0.238)	(0.144)	(0.154)
dGDP	0.674	0.395	0.717	0.479	0.671	0.388	0.679	0.484	0.620	0.666
	(0.516)	(0.505)	(0.519)	(0.507)	(0.516)	(0.499)	(0.516)	(0.502)	(0.516)	(0.497)
Constant	0.215***	0.234***	0.211***	0.226***	0.217***	0.229***	0.214***	0.224***	0.221***	0.207***
	(0.050)	(0.049)	(0.050)	(0.049)	(0.050)	(0.049)	(0.050)	(0.049)	(0.050)	(0.048)
Observations	898	898	898	898	898	898	898	898	898	898
R-squared	0.259	0.312	0.259	0.314	0.261	0.319	0.260	0.313	0.263	0.331
Number of id	175	175	175	175	175	175	175	175	175	175

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8 Estimations by ownership type with policy rate

	Big Five		Joint stock		CCB		RCB		Foreign banks	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
VARIABLES	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans
dMP	-0.030***	-0.029***	-0.028***	-0.026**	-0.036***	-0.011	-0.031***	-0.027**	-0.031***	-0.030*
	(0.010)	(0.010)	(0.011)	(0.011)	(0.014)	(0.015)	(0.011)	(0.011)	(0.011)	(0.017)
dMP_type	-0.006	0.132	-0.023	-0.037	0.007	-0.022	0.010	0.001	-0.009	0.031
	(0.043)	(0.451)	(0.035)	(0.119)	(0.019)	(0.024)	(0.030)	(0.062)	(0.023)	(0.030)
L.capitalization	0.670**	-0.031	0.669**	0.034	0.637**	0.007	0.660**	0.016	0.618**	-0.180
	(0.296)	(0.302)	(0.296)	(0.302)	(0.295)	(0.301)	(0.296)	(0.301)	(0.295)	(0.305)
L.liquidity	0.516***	0.352***	0.516***	0.369***	0.510***	0.342***	0.518***	0.365***	0.508***	0.346***
	(0.049)	(0.059)	(0.049)	(0.060)	(0.049)	(0.063)	(0.049)	(0.059)	(0.049)	(0.061)
L.size	-0.152***	-0.164***	-0.152***	-0.155***	-0.155***	-0.152***	-0.151***	-0.151***	-0.155***	-0.152***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.028)
L.efficiency	-0.400***	-0.442***	-0.400***	-0.432***	-0.400***	-0.438***	-0.416***	-0.446***	-0.432***	-0.478***
	(0.099)	(0.096)	(0.099)	(0.096)	(0.098)	(0.096)	(0.099)	(0.096)	(0.098)	(0.096)
dMP_capitalization		-1.069***		-0.978***		-1.050***		-1.013***		-0.238
		(0.151)		(0.145)		(0.173)		(0.144)		(0.469)
dMP_liquidity		0.247***		0.235***		0.140		0.248***		0.263***
		(0.066)		(0.069)		(0.129)		(0.067)		(0.072)
dMP_size		-0.021***		-0.010		-0.018**		-0.015**		-0.003
		(0.008)		(0.007)		(0.007)		(0.006)		(0.006)
dMP_efficiency	0.016	0.126	0.020	0.098	0.239*	0.232*	0.056	0.159*	-0.162*	-0.143
	(0.086)	(0.089)	(0.087)	(0.088)	(0.133)	(0.136)	(0.091)	(0.094)	(0.098)	(0.101)
dMP_capitalization_type		2.636		0.261		0.653		1.210		-1.452***
		(3.133)		(1.620)		(0.578)		(2.002)		(0.544)
dMP_liquidity_type		-1.368		0.119		0.131		-0.360		0.242
		(0.923)		(0.396)		(0.153)		(0.394)		(0.191)
dMP_size_type		-0.013		0.007		0.003		0.037		-0.063**
		(0.092)		(0.032)		(0.018)		(0.040)		(0.029)
dMP_efficiency_type	-0.005	0.465	0.195	-0.167	-0.368**	-0.282	-0.332	-0.423	0.726***	0.908***
	(1.839)	(1.851)	(0.832)	(1.055)	(0.172)	(0.185)	(0.250)	(0.261)	(0.196)	(0.228)
dGDP	0.743	0.450	0.778	0.668	0.790	0.682	0.741	0.669	0.790	0.754
	(0.521)	(0.520)	(0.525)	(0.519)	(0.518)	(0.510)	(0.519)	(0.510)	(0.519)	(0.508)
Constant	0.201***	0.222***	0.198***	0.200***	0.199***	0.197***	0.200***	0.198***	0.199***	0.190***
	(0.051)	(0.052)	(0.052)	(0.051)	(0.051)	(0.050)	(0.051)	(0.050)	(0.051)	(0.050)
Observations	898	898	898	898	898	898	898	898	898	898
R-squared	0.260	0.313	0.261	0.309	0.265	0.316	0.262	0.312	0.274	0.333
Number of id	175	175	175	175	175	175	175	175	175	175

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9 Estimations by loan-to-deposit ratio

Monetary policy:	Reserve requirements		CHIBOR 7-day interbank rate		Policy rate	
	(1)	(2)	(1)	(2)	(1)	(2)
	Above median	Below median	Above median	Below median	Above median	Below median
VARIABLES	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans	dlogloans
dMP	0.004	-0.022***	-0.009	-0.032***	-0.012	-0.067***
	(0.004)	(0.005)	(0.007)	(0.010)	(0.010)	(0.015)
L.capitalization	-0.125	1.346***	-0.669**	0.297	-0.946***	0.605
	(0.312)	(0.431)	(0.315)	(0.411)	(0.319)	(0.414)
L.liquidity	0.240***	0.220**	0.169**	0.191**	0.185***	0.224**
	(0.083)	(0.088)	(0.077)	(0.089)	(0.064)	(0.091)
L.size	-0.531***	0.023	-0.534***	-0.016	-0.532***	0.002
	(0.041)	(0.033)	(0.039)	(0.033)	(0.039)	(0.034)
dMP_capitalization	-0.130**	-0.439***	-0.639***	-0.761***	-0.913***	-1.175***
	(0.057)	(0.072)	(0.115)	(0.146)	(0.140)	(0.235)
dMP_liquidity	0.033	0.027	0.121**	-0.052	0.216***	0.029
	(0.024)	(0.037)	(0.048)	(0.071)	(0.073)	(0.121)
dMP_size	-0.005**	-0.001	-0.011**	0.002	-0.023***	0.002
	(0.002)	(0.003)	(0.004)	(0.006)	(0.006)	(0.007)
dGDP	-0.191	1.934**	-0.121	0.924	0.122	1.373*
	(0.587)	(0.845)	(0.502)	(0.761)	(0.499)	(0.787)
L.efficiency	0.055	-0.862***	0.102	-1.015***	0.062	-1.076***
	(0.126)	(0.126)	(0.102)	(0.122)	(0.100)	(0.126)
dMP_efficiency	0.027	-0.058	0.130*	-0.217**	0.231***	-0.382***
	(0.033)	(0.044)	(0.066)	(0.084)	(0.088)	(0.115)
Constant	0.623***	0.015	0.612***	0.096	0.582***	0.046
	(0.065)	(0.072)	(0.058)	(0.067)	(0.059)	(0.071)
Observations	457	441	457	441	457	441
R-squared	0.610	0.350	0.640	0.347	0.654	0.335
Number of id	118	126	118	126	118	126

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 10 Influence of shadow banking expansion

Monetary policy:	Reserve requirements			CHIBOR 7-day interbank rate			Policy rate		
VARIABLES	(1) dlogloans	(2) dlogloans	(3) dlogloans	(1) dlogloans	(2) dlogloans	(3) dlogloans	(1) dlogloans	(2) dlogloans	(3) dlogloans
dMP	-0.010***	-0.012***	-0.011**	-0.023***	-0.022***	-0.023***	-0.029***	-0.030***	-0.030***
	(0.003)	(0.004)	(0.004)	(0.006)	(0.008)	(0.008)	(0.008)	(0.010)	(0.010)
Shadow Banking Dummy (dShD)	-0.043**	-0.073***	-0.076***	-0.021	-0.042**	-0.014	-0.003	-0.044*	-0.019
	(0.022)	(0.026)	(0.029)	(0.017)	(0.020)	(0.022)	(0.021)	(0.025)	(0.026)
dMP_dShB	-0.041*	-0.033	-0.053*	-0.012	-0.016	0.011	0.062	-0.087	0.085
	(0.021)	(0.025)	(0.029)	(0.023)	(0.023)	(0.031)	(0.052)	(0.065)	(0.073)
L.capitalization	1.758***	0.226	0.456	1.462***	0.338	-0.172	1.387***	0.328	-0.342
	(0.231)	(0.303)	(0.311)	(0.215)	(0.301)	(0.299)	(0.214)	(0.303)	(0.304)
capitalization_dShB	-0.049	0.746**	0.002	0.011	0.968***	0.165	0.735**	0.930**	1.740***
	(0.381)	(0.375)	(0.562)	(0.304)	(0.368)	(0.393)	(0.374)	(0.375)	(0.478)
L.liquidity	0.250**	0.589***	0.557***	0.239***	0.591***	0.346***	0.322***	0.587***	0.440***
	(0.098)	(0.055)	(0.128)	(0.087)	(0.055)	(0.109)	(0.067)	(0.055)	(0.083)
liquidity_dShB	0.187	-0.104	-0.174	0.094	-0.202*	-0.186	0.220*	-0.182	0.146
	(0.154)	(0.119)	(0.205)	(0.120)	(0.107)	(0.152)	(0.133)	(0.118)	(0.165)
L.size	-0.126***	-0.144***	-0.150***	-0.126***	-0.130***	-0.157***	-0.130***	-0.132***	-0.160***
	(0.023)	(0.030)	(0.031)	(0.022)	(0.030)	(0.030)	(0.022)	(0.031)	(0.030)
size_dShB	-0.012	-0.009	-0.015	-0.010	-0.008	-0.014	-0.008	-0.010	-0.008
	(0.011)	(0.009)	(0.013)	(0.008)	(0.009)	(0.010)	(0.010)	(0.009)	(0.012)
dMP_capitalization	-0.187***		-0.234***	-0.352***		-0.781***	-0.523***		-0.953***
	(0.045)		(0.059)	(0.101)		(0.122)	(0.115)		(0.145)
dMP_capitalization_dShB	0.165		-0.423	-0.509		-0.491	3.612***		8.722***
	(0.524)		(0.827)	(0.395)		(0.493)	(1.325)		(2.061)
dMP_liquidity	0.084***		0.002	0.195***		0.141**	0.273***		0.149*
	(0.027)		(0.034)	(0.051)		(0.063)	(0.068)		(0.086)
dMP_liquidity_dShB	-0.074		-0.149	-0.224		-0.447**	0.537		0.928*
	(0.151)		(0.203)	(0.154)		(0.203)	(0.358)		(0.474)
dMP_size	-0.004*		-0.005**	-0.005		-0.009*	-0.009*		-0.013**
	(0.002)		(0.002)	(0.004)		(0.005)	(0.005)		(0.006)
dMP_size_dShB	0.009		0.010	0.008		0.013	0.017		0.027
	(0.012)		(0.013)	(0.013)		(0.015)	(0.028)		(0.031)

Monetary policy:	Reserve requirements			CHIBOR 7-day interbank rate			Policy rate		
VARIABLES	(1) dlogloans	(2) dlogloans	(3) dlogloans	(1) dlogloans	(2) dlogloans	(3) dlogloans	(1) dlogloans	(2) dlogloans	(3) dlogloans
dGDP	1.677***	-0.353	-0.505	1.168***	-0.580	-0.625	1.681***	-0.341	-0.322
	(0.480)	(0.636)	(0.675)	(0.440)	(0.609)	(0.595)	(0.471)	(0.630)	(0.635)
L.efficiency		-0.324**	-0.364***		-0.276**	-0.279***		-0.281**	-0.285***
		(0.127)	(0.131)		(0.108)	(0.104)		(0.109)	(0.105)
efficiency_dShB		-0.910***	-1.004***		-0.707***	-0.899***		-0.376	-0.246
		(0.266)	(0.277)		(0.204)	(0.203)		(0.228)	(0.221)
dMP_efficiency		0.018	0.032		-0.017	0.038		-0.004	0.057
		(0.034)	(0.036)		(0.066)	(0.068)		(0.085)	(0.086)
dMP_efficiency_dShB		-0.968**	-1.171***		-0.643**	-1.151***		1.217	2.087*
		(0.393)	(0.412)		(0.292)	(0.307)		(1.140)	(1.109)
Constant	0.092**	0.325***	0.343***	0.129***	0.330***	0.335***	0.073	0.299***	0.298***
	(0.046)	(0.062)	(0.067)	(0.043)	(0.061)	(0.060)	(0.047)	(0.063)	(0.065)
Observations	1,297	898	898	1,297	898	898	1,297	898	898
R-squared	0.255	0.302	0.322	0.258	0.299	0.356	0.266	0.293	0.359
Number of id	212	175	175	212	175	175	212	175	175

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 11 Alternative efficiency approach with reserve requirements

Monetary policy:	Average of reserve requirements (large and small and mid-sized banks)		
VARIABLES	(1) dlogloans	(2) dlogloans	(3) dlogloans
dMP	-0.010***	-0.009**	-0.010**
	(0.003)	(0.004)	(0.004)
L.capitalization	1.666***	0.704**	0.805***
	(0.222)	(0.301)	(0.296)
L.liquidity	0.307***	0.507***	0.367***
	(0.055)	(0.050)	(0.072)
L.size	-0.135***	-0.176***	-0.164***
	(0.021)	(0.029)	(0.029)
dMP_capitalization	-0.172***		-0.346***
	(0.041)		(0.061)
dMP_liquidity	0.070***		0.048**
	(0.017)		(0.022)
dMP_size	-0.001		0.000
	(0.002)		(0.002)
dGDP	2.017***	1.001	0.606
	(0.424)	(0.642)	(0.644)
L.efficiency2		-0.022	-0.039
		(0.110)	(0.111)
dMP_efficiency2		-0.006	0.103***
		(0.027)	(0.036)
Constant	0.056	0.205***	0.227***
	(0.037)	(0.058)	(0.059)
Observations	1,297	885	885
R-squared	0.245	0.237	0.272
Number of id	212	165	165

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12 Alternative efficiency approach with CHIBOR interbank rate

Monetary policy:	CHIBOR 7-day interbank rate		
VARIABLES	(1) dlogloans	(2) dlogloans	(3) dlogloans
dMP	-0.023*** (0.006)	-0.029*** (0.008)	-0.028*** (0.008)
L.capitalization	1.445*** (0.212)	0.687** (0.298)	0.126 (0.302)
L.liquidity	0.325*** (0.054)	0.519*** (0.050)	0.375*** (0.069)
L.size	-0.138*** (0.021)	-0.176*** (0.029)	-0.177*** (0.029)
dMP_capitalization	-0.355*** (0.091)		-0.804*** (0.122)
dMP_liquidity	0.134*** (0.036)		0.107** (0.043)
dMP_size	-0.001 (0.004)		-0.003 (0.004)
dGDP	1.643*** (0.369)	0.938* (0.556)	0.637 (0.543)
L.efficiency2		0.025 (0.110)	0.060 (0.110)
dMP_efficiency2		-0.141** (0.055)	0.035 (0.066)
Constant	0.082** (0.034)	0.211*** (0.053)	0.224*** (0.052)
Observations	1,297	885	885
R-squared	0.244	0.248	0.293
Number of id	212	165	165

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 13 Alternative efficiency approach with policy rate

Monetary policy:	1-year benchmark policy rate		
VARIABLES	(1) dlogloans	(2) dlogloans	(3) dlogloans
dMP	-0.030***	-0.055***	-0.037***
	(0.008)	(0.014)	(0.014)
L.capitalization	1.310***	0.638**	0.042
	(0.212)	(0.299)	(0.307)
L.liquidity	0.349***	0.535***	0.408***
	(0.047)	(0.051)	(0.062)
L.size	-0.133***	-0.171***	-0.170***
	(0.021)	(0.029)	(0.029)
dMP_capitalization	-0.504***		-0.990***
	(0.111)		(0.160)
dMP_liquidity	0.260***		0.184***
	(0.055)		(0.069)
dMP_size	-0.007		-0.008
	(0.005)		(0.006)
dGDP	1.869***	1.366**	0.832
	(0.379)	(0.593)	(0.598)
L.efficiency2		0.106	0.134
		(0.119)	(0.122)
dMP_efficiency2		-0.177**	0.092
		(0.087)	(0.108)
Constant	0.054	0.162***	0.194***
	(0.035)	(0.057)	(0.057)
Observations	1,297	885	885
R-squared	0.252	0.248	0.288
Number of id	212	165	165

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

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