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Bank dependency on foreign funding and global liquidity shocks: The importance of US monetary policy for a developing country

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ABSTRACT

We examine international spillover effects of US monetary policy on bank lending in Cambodia, using unique data about loan disbursements and the funding structures of Cambodian banks from 2013Q1 to 2019Q2. The banking sector in a developing country is likely dependent on foreign funding, while the dependency could be the source of vulnerability to international monetary and economic conditions. We empirically document that US monetary policy is likely to be transmitted to Cambodian bank lending through foreign funding. We also document that Cambodian banks change their risk-taking behavior in response to the spillover effects of US monetary policy. Furthermore, these results are robust for US monetary policy, but weak and not robust for the monetary policies of the Cambodian bank's major shareholders' home countries, suggesting that US monetary policy should be primarily taken into account in supervising banks that are reliant on foreign funding, in addition to domestic economic conditions.

1. Introduction

A banking sector in developing countries is likely to be highly dependent on funding sources from abroad as a consequence of lack of stable domestic funding sources or lax regulations on the entry of foreign banks (Korinek, 2018). Recent worldwide economic integration has also caused increasing entries of foreign-owned banks and increasing capital inflows into local banks.

Although those capital inflows have supported growth in the banking sector, heavy dependence on foreign funding sources could raise the risk of instability in the financial sector. Specifically, in the case of liquidity shocks in international financial markets, the cost of foreign funding will increase, and banks may not be able to completely offset their negative impact by raising capital from domestic funding sources due to imperfections in domestic capital markets. Thus, banks with high dependency on parent banks and internal capital markets may be more likely to be affected by changes in global conditions, and this could change their domestic lending behavior. Prior studies have empirically documented that foreign banks are affected by sudden stops or reversals in capital and

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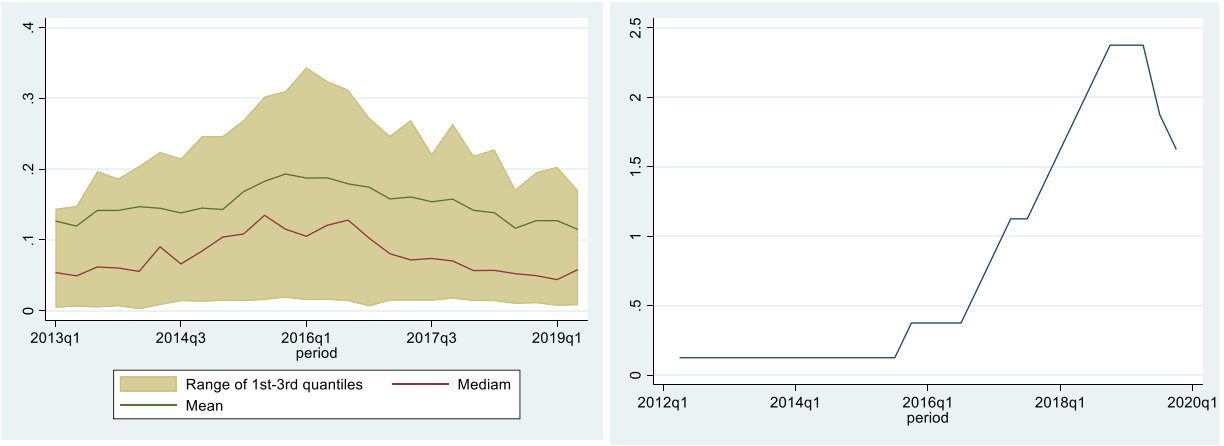


Fig. 1. Ratio of Non-Resident Liabilities to Total Liabilities (Left) and US Monetary Policy Rate (Right).

wholesale funding flows, and they eventually reduce domestic lending (Jeon et al., 2013; Jeon and Wu, 2014).[2] Other studies have also documented the fact that changes in global liquidity can affect the cost of funding from international capital markets or the internal capital markets of global banks (Cao & Dinger, 2018; Cetorelli & Goldberg, 2012).

While most prior studies have addressed the relationship between dependency on foreign funding and financial instability by focusing on the ownership structure of banks (e.g., Jeon and Wu, 2014; Hamid, 2020), there is a scarcity of studies focusing on the level of dependency to foreign funding sources. Even within foreign-owned banks there are variations in their dependence on foreign funding sources, and it is also the case that some locally owned banks also rely significantly on foreign funding sources. Thus, it could also be conjectured that foreign monetary policy and financial shocks are also transmitted through locally owned banks that are dependent on foreign funding sources.

This paper empirically examines whether banks with foreign funding exposure are vulnerable to international monetary policy spillover by employing the unique data of commercial banks in Cambodia,[3] which is a small open economy and one of the most dollarized economies in the world, and where capital movement is free inside the country.[4] Most importantly, the recent progress in ASEAN economic integration also has pushed increasing capital inflows into the financial sectors of the region (Didier et al., 2017; Hamid, 2020). As a consequence, Cambodian commercial banks are highly dependent on foreign funding, and there has been a large number of foreign-owned banks entering the economy in the past decades. As Buch et al. (2018) empirically document, a country with free capital movement and a fixed exchange rate policy will likely transmit the foreign countries' monetary policy. Thus, the Cambodian banking sector is also potentially vulnerable to foreign liquidity shocks, particularly the spillover of foreign monetary policy through the bank lending channel.

Furthermore, this paper exploits the fact that US monetary policy rate has increased from 2015Q4. This situation can be seen as a natural experiment of the impact of shocks in global liquidity.[5] During the period of tightening of US monetary policy, Cambodian banks experienced a decline in foreign funding flows, after the US federal fund rate started increasing (Fig. 1). This sudden decline suggests that Cambodian banks faced an increase in the cost of funding from abroad in the wake of the tightening of US monetary policy. There is a possibility that the decline in foreign funding flow might also affect domestic lending due to limited substitutability of

[2] Guo and Stepanyan (2011) show that aggregated credit growth in countries in which the banking sector is dependent on foreign funding is more likely to be affected by fluctuations in foreign funding flows. In addition, the impact of external shocks is more severe in those developing countries where capital markets are underdeveloped and domestic funds are not always stable. Afrin (2017) also found a close association between exchange rate shocks and bank lending in Bangladesh. These studies concluded that a lack of external shocks is an important determinant of a stable loan supply in developing countries.

[3] We define foreign funding exposure mainly through two variables. One is non-resident liabilities defined as the sum of wholesale funding from abroad, any deposits from foreign banks, and non-resident deposits. Another is foreign liabilities from banks abroad, defined as the sum of wholesale funding from abroad and deposits from foreign banks (non-resident liabilities minus non-resident deposits). Resident deposits can be held by Cambodian citizens or foreigners who have lived in the country for more than 182 days in a row. Otherwise, foreigners can only open non-resident deposit accounts. Our interest in foreign funding flows are non-resident liabilities, and the foreign liabilities taken from balance sheets of foreign banks. While it is not possible to separate equity finance between foreign and domestic sources, equity finance from abroad requires permission from a central bank. Thus, it cannot flexibly meet the demand for collecting funding as wholesale borrowing from a parent bank and other related parties.

[4] Corsetti et al., (2018) also document the effect of US monetary policy on other countries' economic conditions. Their findings suggest that if the exchange rate regime is fixed and the limit on capital mobility is small, the spillover effects of US monetary policy are stronger.

[5] Our interest is in foreign funding flows as non-resident liabilities and foreign liabilities taken from the balance sheets of foreign banks (See Footnote 3). While it is not possible to separate equity finance between foreign and domestic sources, equity finance from abroad requires permission from a central bank. Thus, it cannot as flexibly meet the demand for collecting funding as wholesale borrowing from a parent bank and other related parties can.

domestic funding sources.[6] This spillover of US monetary policy effect might be intense, particularly for banks that are highly dependent on foreign funding.

To examine the causal impact of a rise in US monetary policy rate on Cambodian bank domestic lending, this study applies a difference-in-differences approach with the continuous treatment variable of the US monetary policy rate.[7] We use banks with foreign funding exposure as a treatment group and banks without foreign funding as a control group. In addition, we further extend our analysis to the triple-difference approach by exploiting the difference in the level of foreign funding exposure. Our panel dataset is constructed mainly from administrative records of quarterly new loan disbursements, quarterly balance sheets of individual banks, and International Financial Statistics from 2013Q1 to 2019Q2. The balance sheet data include the amounts of wholesale borrowing and non-resident deposits from abroad for each individual bank, allowing us to calculate the foreign funding exposure. In addition, the detailed loan disbursement records allow us to investigate the effects of periodic changes in the demand and supply factors of certain types of loans. Exploiting the rich information about individual bank's loan disbursement and foreign funding, we examine whether Cambodian bank domestic lending has reacted to a rise in the US monetary policy rate, and whether the foreign funding exposure is a key to such behavior.

In addition, we investigate the distributional effects of US monetary policy spillover across different types of loan characteristics. Several empirical studies have documented the risk-taking channel of domestic and foreign monetary policy, finding that lower policy rates make the allocation of banks shift toward more risky borrowers (Jiménez et al., 2014, for Spain; Ioannidou et al., 2015, for Bolivia). Since our study investigate the situation of a rise in the foreign monetary policy rate on lending, we expect that banks affected by such policy changes would shift their portfolios toward less risky loans. Our data on new loan disbursement is disaggregated by currencies, maturities, security, and sectors, allowing us to examine whether banks do reallocate their loan portfolios to less risky loans. Apart from US monetary policy, we also examine the effects of other foreign countries' monetary policies. Specifically, we examine the effect of changes in monetary policy rates in the home countries of the Cambodian commercial banks' major shareholders.

The results of our study show that changes in a US monetary policy rate have a negative spillover effect on a bank's domestic lending in Cambodia for banks with exposure to foreign funding, and the effect becomes larger as the exposure increases. Spillover in US monetary policy also affects the composition of loan portfolios from Cambodian commercial banks. In particular, an increase in the US monetary policy rate strongly and negatively affects short-term loans, business loans, and local currency loans. This might suggest that in the wake of global liquidity shocks Cambodian banks will shift loan allocations away from higher risk sectors and clients. We also find that the impact of US monetary policy changes was less pronounced in the quarterly average interest rates on new loans from Cambodian commercial banks. Furthermore, the monetary policies in bank shareholders home countries are not strongly associated with Cambodian bank domestic lending compared to US monetary policy, although the estimated distributional effects between USD and local currency associated with the spillover of US monetary policy were statistically significant.

Our study complements the literature on international spillover of monetary policy through global banks (Peek & Rosengren, 1997; De Haas & VanLelyveld, 2006, 2010; Cetorelli & Goldberg, 2012; Jeon et al., 2013; Jeon & Wu, 2014; Ongena et al., 2015; Bruno & Shin, 2015; Temesvary et al., 2018; Buch et al., 2018). Ongena et al. (2015) investigated the impact of the transmission of foreign financial shocks on bank domestic lending through internal capital markets and found that wholesale funding and foreign ownership is a key factor in the transmission of the shocks in a home country to a host country. Temesvary et al. (2018) investigated the effect of US monetary policy on cross-border lending and affiliate lending of US banks and found that the monetary policy of both destination countries and the US are associated with cross-border lending of global banks. De Haas & Van Lelyveld (2006, 2010) investigated the multinational banks in central and eastern Europe and found that credit growth in subsidiaries are associated with their parent banks' conditions, the home country's economic growth, and lending rates. In a recent study, the spillover effect of US monetary policy into Asian countries has been examined by using the data from banks in 12 Asian countries (Lee & Bowdler, 2022).

Even though there is a vast literature on the international spillover of financial shocks and monetary policy on domestic lending and cross-border lending, there are still limitations in the empirical studies relating to how such effects are spilled over onto domestic lending in developing countries (Buch et al., 2018). Bhatttarai et al. (2021) examined the reaction of interest rates in India in response to rises in US interest rates, using a SVAR estimation. They found that expansionary US monetary policy was transmitted to interest rates in India, reflecting the fact that financial markets are closely integrated between those countries. Our study complements this literature by investigating the impacts on domestic bank lending in a developing country, Cambodia. As of 2019Q2, 35 out of 44 commercial banks in Cambodia had more than half their shares owned by foreigners; the nationalities of those shareholders varying widely across developed countries and neighboring Asian countries. In line with Ongena et al. (2015), this study shows that US monetary policy influences domestic lending within developing countries. Furthermore, several empirical studies have documented the risk-taking channels of domestic and foreign monetary policy, finding that lower policy rates shift the allocation of banks toward more risky borrowers (Jiménez et al., 2014, for Spain; Ioannidou et al., 2015, for Bolivia). Similarly, by employing detailed data by loan characteristics, our study finds that an increase in US monetary policy rates leads to a shift of loan provisions into lower

[6] Even though Cambodia is highly dollarized, the interest rates on domestic USD deposits did not change during the period when the US federal fund rate increased. Thus, the changes in US monetary policy affected Cambodian banks through non-resident sources.

[7] Prior empirical studies have often applied a difference-in-differences approach with a continuous treatment variable. For example, Bleakley (2010) estimated the impact of malaria-eradication campaign at region-level. The author used the pre-intervention malaria prevalence across regions as a continuous treatment variable in the difference-in-differences approach since areas with higher pre-intervention malaria prevalence would benefit more from the eradication program. Duflo (2001) estimated the return to education in the case of the Indonesian school construction program. She used the number of school facilities constructed as the continuous treatment variable to estimate the impact.

risk-profile loans, such as secured loans, consumer loans, long maturity loans, and US Dollar-denominated loans.[8]

Our study also contributes to the literature of financial stability by documenting new evidence for the risks of dependency on parent banks and other foreign funding sources. During the global financial crisis period, the increases in the cost of funding from abroad affected bank domestic lending. Jeon and Wu (2014) empirically documented that foreign subsidiaries with a shortage of their own internal funds are more likely to be affected by the financial shocks on their parent banks' internal funds. In contrast to Jeon and Wu, we use two measures to study the channel of international monetary policy spillover via dependence on foreign funding sources not limited to parent banks: the ratio of the entire non-resident liabilities to total liabilities and the ratio of foreign liabilities from banks abroad to total liabilities, respectively. In addition, our study includes local-owned banks as well as foreign subsidiaries. We find similar results showing that if banks collect funds from foreign funding sources (non-resident deposits or wholesale funding from abroad), an increase in the US monetary policy rate leads to a decrease in domestic bank lending. In addition, we find that locally-owned banks with a high dependency on foreign funding are more impacted by increases in the US monetary policy rate than their foreign-owned peers. It means that the locally-owned banks have a limited ability to substitute the funding sources, and are likely to be more vulnerable to foreign financial shocks. Noth and Busch (2016, 2017) and Kneer and Raabe (2019) also found that changes in foreign funding significantly affects bank domestic lending in Brazil and the UK, respectively. Our study provides the additional insight that foreign funding exposure could be the source of vulnerability within the banking sector.

Our study also provides additional insights on the international monetary policy spillover in partially dollarized economies.[9] Due to recent world-wide economic integration, an increasing number of developing countries have experienced large capital inflows and partial dollarization. In the context of developing countries, several recent studies documented evidence of the effectiveness of domestic monetary policy to manage bank lending (Aleem, 2010, for India; Mahathanaseth and Tauer, 2019, for Thailand; Abuka et al., 2019, for Rwanda; Naiborhu, 2020, for Indonesia). However, Ongena et al., (2017) found that the impact of domestic monetary policy on domestic bank lending is limited in Hungary, where bank lending in Swiss Francs and Euros is prevalent. In addition, they found that lending in Swiss Francs (Euro) is negatively associated with interest rates in Switzerland (Euro area), suggesting that foreign monetary policy affects domestic bank lending through the currency composition of banks. Mora (2013) also found that domestic bank lending in Mexico is often affected by US monetary policy, and there is a heterogeneity effect depending on the ratio of FX deposits across banks. The author suggests that US monetary policy might be channeled through the FX deposits. Compared to the existing literature of partial dollarization and monetary policy spillover, our study finds that USD denominated deposits and the degree of dollarization per se are not necessarily the channel of the monetary spillover and, as we will show in this paper, interest rates on USD did not change significantly after US monetary policy brought about a raise in rates. Thus, the effects of US monetary policy on domestic lending are likely to be channeled through foreign funding exposure in the case of Cambodia. This result indicates that even in a dollarized economy, governments could mitigate the spillover effect of foreign monetary policy by facilitating banks to shift to domestic funding sources for their funds. Furthermore, in contrast to the findings of Ongena et al. (2017), we found that increasing the foreign monetary policy rate reduces local currency lending. Our findings reflect the differences in the role of foreign currency in the Cambodian economy. In Hungary, local currency is still dominant in the lending market, and the foreign currency, especially the Swiss Franc, is considered a risky currency.[10] Meanwhile, since the US Dollar has a larger share in the lending and deposit market in Cambodia than does the local currency, lending in the local currency introduces an exchange rate risk in a bank's balance sheets. Our study thus provides new evidence about the role of foreign currency in the international monetary policy spillover under a partially dollarized economy.

The rest of this paper is structured as follows. Section 2 describes the Cambodian banking sector and the recent situation of foreign funding. Section 3 presents our data and empirical strategy, and Section 4 presents the results of empirical analyses. Section 5 closely analyzes the impact of changes in US monetary policy on lending rates of Commercial Banks and Section 6 provides a robustness check of our data on the impact of US monetary policy on Cambodian bank lending. Section 7 concludes the paper.

2. Overview of the Cambodian banking sector and the monetary policy stance of the National Bank of Cambodia

2.1. The institutional background of Cambodian banks

After the prolonged civil war ended in 1999, Cambodia experienced high economic growth, with an average of 8.3% of GDP growth over the last 15 years (Oudom, 2016). This recent high growth rate has attracted large amounts of capital inflows. Cambodia is a highly open economy, and the Cambodian government has adopted a liberal stance toward foreign investment and trade, leading to huge capital inflows (Hill & Menon, 2014). Most capital inflows are in the form of official development assistance (ODA), foreign direct

[8] In Cambodia, the interest rates on USD loans are lower than those on local loans. Thus, the USD loans are provided to lower risk profile borrowers generally. For consumer loans, although the interest rates are not necessarily lower than corporate loans, the size of loans are much smaller and usually include a collateral requirement. Thus, the risk-profile is lower for consumer loans. Regarding the provision of USD and local currency loans by Cambodian banks, Aiba and Sok (2017), Aiba et al., 2018), and Okuda and Aiba (2018) analyze survey data on the currency denominations of bank loans to households and enterprises.

[9] In the context of developing countries, a growing number of studies have investigated the transmission of monetary policy. For example, Mahathanaseth and Tauer (2019) examine the existence of bank lending channels in domestic monetary policy in Thailand. However, few studies have investigated the monetary policy transmission in dollarized economies.

[10] Using survey data, Beer et al., (2010) found that risk-seeking households are more likely to borrow in a foreign currency in Hungary.

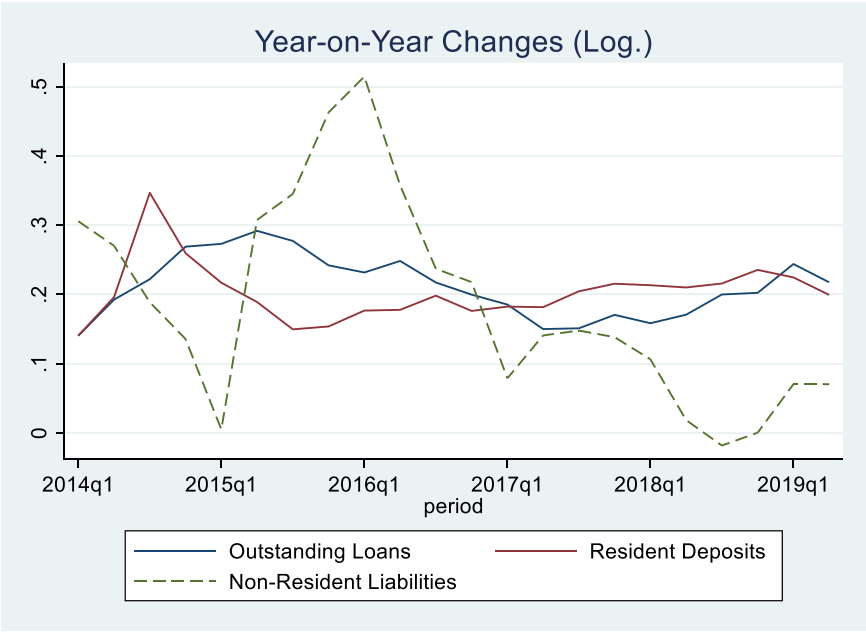


Fig. 2. Growth of Loans and Funding of the Cambodian Banks. Note: Data is from the National Bank of Cambodia, and authors' calculations. Log. growth rate of each variable is calculated as year-on-year changes.

investment (FDI), and other investments (Oudom, 2016).[11] As argued by previous studies, flows of capital into banks are most unstable and subject to sudden stop (Becker & Noone, 2009; de Brouwer, 1999). Thus, a high dependency on foreign funding as a result of borrowing or deposits is likely to make the entire economy vulnerable to external shocks. In the case of Cambodia, Oudom (2016) documented that recent capital flows are volatile and the main driver is inflows into the banking sector.

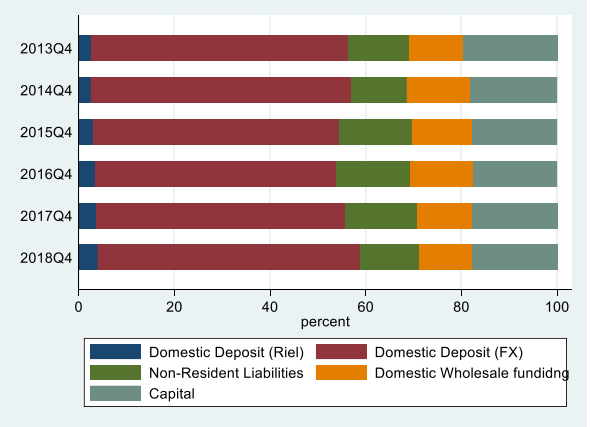
The banking sector plays a pivotal role in fund mobilization in Cambodia, since there is no other formal financial market functioning in the country: there is no bond market, and although a stock exchange market was opened in 2011, only five companies were listed as of 2017. The Cambodian banking sector is composed of three types of financial institutions: commercial banks, specialized banks, and microfinance institutions. Commercial banks are allowed to provide all financial services, while the regulations governing them are most strict in terms of capital and reserve requirements. Specialized banks can be engaged in only one type of financial service, such as settlement network or loan provision to the agricultural sector. Microfinance institutions are aimed to provide financial services for the poor, with restrictions on the amount of each loan grant. Prudential regulations are less stringent for specialized banks and microfinance institutions than commercial banks. As of 2017, commercial banks dominate almost 85% of total assets in the Cambodian banking sector, while microfinance institutions cover the remaining 15% (Aiba & Lam, 2019). Specialized banks have less than 1% of total assets in the entire banking sector. An important characteristic of the Cambodian banking sector is that there are no state-owned commercial banks, although there is one state-owned specialized bank.[12] Thus, the credit supply is completely delegated to private entities.

In the Cambodian banking sector, foreign-owned banks are also allowed to operate, as there are no restrictions on foreign ownership of a subsidiary, a branch, or a representative office. Subsidiaries and branches are permitted to engage in full banking activities. For subsidiaries, a foreign owner could have 100% of its shares, and could acquire the shares of an existing local bank. There is no difference in prudential regulation between locally-ownend banks and foreign-owned banks.[13]

2.2. *Inflow of foreign funding into the Cambodian banking sector*

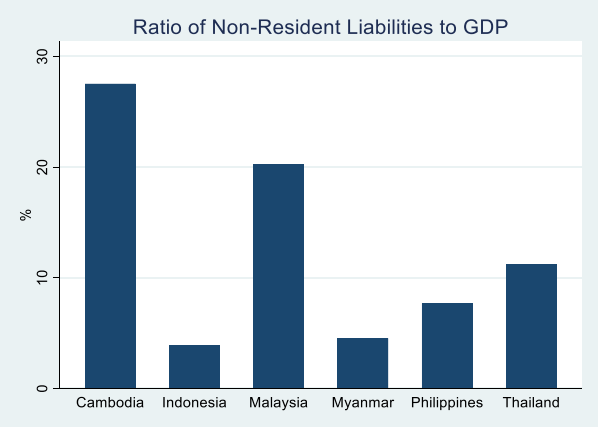
Flows of foreign funding are more volatile than those from domestic sources. Fig. 2 shows year-on-year changes in aggregated outstanding loans, resident deposits, and non-resident funds. Non-resident liabilities include non-resident deposits and wholesale borrowing from abroad. The data are constructed from individual bank balance sheet data that includes the breakdown of deposits, borrowing, and equity by resident and non-resident sources. This administrative data was obtained from the National Bank of Cambodia. The data are reported on a quarterly basis and cover the period from 2013Q1 to 2019Q2. In the case of Cambodia, the year-

[11] Other investment is mainly composed of inflows into banks and other financial institutions.
[12] In August 2019, a state-owned bank, Agricultural and Rural Development Bank was transformed from a specialized bank to a commercial bank. In addition, the government newly founded a state-owned bank, SME Bank, in February 2020.
[13] In our analysis, the representative office is not included since this type of foreign bank is not engaged in banking services to local entities.



Panel A: Composition of liabilities by funding sources

Note: Data is from the National Bank of Cambodia, and authors' calculations. Non-resident liabilities are the sum of wholesale funding from abroad and non-resident deposits.



Panel B: Cross-country comparison of non-resident liabilities to GDP

Note: Data is from International Financial Statistics. For the calculation, we used non-resident liabilities as of 2017Q4 and annual GDP as of 2017.

Fig. 3. Non-Resident Liabilities in the Cambodian Banking Sector.

on-year changes in outstanding loans and resident deposits have been stable from 2014Q1 to 2019Q2, except for the spike in changes in resident deposits in 2014Q3, which reflected large deposit withdrawals in 2013Q3 due to increased political uncertainty after the national election in April 2013.[14] Meanwhile, non-resident liabilities fluctuated more during the same period. In particular, non-resident liabilities were lower after 2016Q1, when the US federal fund rate started increasing. Those fluctuations in funding flows mean foreign funding sources might be unstable compared to domestic funding sources and could be a source of vulnerability in the banking sector.

Fig. 3 shows the composition of liabilities by funding sources in Panel A. Shares of non-resident liabilities fluctuated 10%– 15% over the period, while about 60% of funds in the Cambodian banking sector are domestic residents' deposits. Non-resident liabilities (the sum of wholesale funding from abroad and non-resident deposits) in the banking sector have been large and comparable to domestic wholesale funding over the period, meaning that foreign funding is one important funding source for the Cambodian banking sector. Non-resident liabilities in the Cambodian banking sector are large compared to other countries. Panel B in Fig. 3 provides a comparison of the ratio of non-resident liabilities to GDP across neighboring countries. It shows that the ratio of non-resident liabilities to GDP in Cambodia is higher than in neighboring ASEAN countries.

The figure also shows that a substantial share of deposits in the banking sector are denominated in foreign currency. However, gross official reserves only cover 57% of foreign currency deposits, which severely limits the capacity of the central bank as the lender of last resort (International Monetary Fund, 2018). In addition to this limitation, the country lacks deposit insurance, and both of these might lead to a high liquidity buffer in banks.

2.3. Domestic monetary policy in Cambodia

Due to the high degree of dollarization, the NBC's ability to intervene in the market is limited (International Monetary Fund, 2017). The NBC has not set a specific target inflation rate but has managed to stabilize the exchange rate between USD and KHR at around 4000 KHR/USD. However there is no integrated interbank market in the Cambodian banking sector, thus the NBC has not attempted to control interest rates on short-term funds in the interbank market. Instead, the reserve requirement ratio is an important instrument of monetary and prudential policy for the NBC. The bank has implemented several attempts to control credit growth by changing the reserve requirement rates on deposits. In 2000, the reserve requirement was initially set at the same levels (8% for any currency). In June 2008, NBC differentiated reserve requirements for the local currency and foreign currencies by keeping requirements on KHR at the same level while raising it on foreign currencies (8% for KHR and 16% for foreign currencies). The differentiation in reserve requirements between local and foreign currencies was aimed at increasing the funding cost of foreign currencies, and to further promote the financial intermediation in KHR. Although the reserve requirement was raised during the global financial crisis period, the policy mainly aimed at slowing down the credit growth of foreign currencies and reflected the intention of the expansion of the use of

[14] Ten percent of total deposits were withdrawn in August 2013, although most of that money returned to the banking sector within a few months. Even though the ruling party won the majority of seats, the number of seats and votes for the opposition party came close to those of the ruling party. After the election, there were rumors of voting fraud during the election, and the opposition party boycotted the national assembly for one year. That political uncertainty led to the negative growth of domestic deposits in the third quarter of 2013.

Table 1
Home Countries of Major Shareholders of the Cambodian Banks.

	2013	2014	2015	2016	2017	2018	2019
Australia	1	1	1	1	1	1	0
Cambodia	6	6	6	6	7	7	9
Canada	1	1	1	1	1	1	1
China	2	2	2	2	2	2	2
France	0	0	0	0	1	1	1
India	1	1	1	1	1	1	1
Japan	2	2	2	2	3	3	4
Korea	4	4	4	4	4	4	5
Laos	0	0	0	0	0	1	1
Malaysia	6	6	6	6	6	6	6
Singapore	1	1	1	1	1	1	1
Taiwan	5	5	5	5	5	5	5
Thailand	2	2	3	4	4	4	4
Vietnam	4	4	4	4	4	4	4
Total	35	35	36	37	40	41	44

Note: Data were collected from annual reports of financial institutions or their websites. We defined major shareholders as the largest shareholders of a bank.

KHR use and the stringency of the use of USD during the crisis, given the absence of the NBC's role as the lender of last resort in foreign currencies.

In January 2009, to deal with the decline in credit growth due to the global financial crisis, the reserve requirement for foreign currencies was cut from 16% to 12% while the requirement for the local currency remained the same (8%). Still, there is a differentiation between KHR and foreign currencies. In September 2012, the reserve requirement ratio in foreign currencies (including external borrowing) was raised again from 12% to 12.5%. The primary objective for this increase was to signal a higher credit growth, in particular of credit allocations in USD. After that, the reserve ratio remained unchanged changed until 2020. In March 2020, the NBC decreased the reserve requirement ratio in USD from 12.5% to 7% in response to the global coronavirus pandemic.

In 2013, the NBC introduced negotiable certificates of deposit for both KHR and USD. This facility helps banks' liquidity management and market based monetary policy operations (International Monetary Fund, 2016). In 2016 NBC also introduced Liquidity Providing Collateralized Operations (LCPOs) (International Monetary Fund, 2017). The LCPO is an auction system for financial institutions to obtain long-term KHR funds. Financial institutions provide USD deposits as collateral to NBC, and then borrow KHR from the NBC. The amounts of KHR and minimum interest rates for the auction are set in advance by NBC. Most of the banks that participate in this auction are the large banks, and the maturity of the KHR funds is generally one year. Thus, these monetary policy tools are not designed to control short-term interest rates in the financial market.

3. Data and empirical strategy

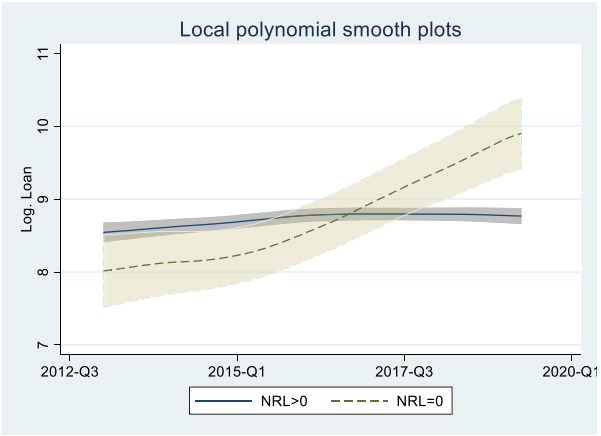
3.1. Data

To examine the effect of the international spillover of monetary policy on bank domestic lending, we use detailed information on their lending behavior and the capital inflows into individual banks. The dataset used in the analysis is composed mainly from three data sources. The first one is the data of loan disbursements, which is quarterly aggregated data capturing the amounts of newly disbursed loans at the bank-level. In the data, we can observe buckets of loan disbursements in detail by loan segments such as currency, maturity, sector, and the collateral requirements for each bank. There are total of 16 loan segments, based on currency (USD or local currency), sector (business or consumer loans), maturity (long-term or short-term), and security (secured or unsecured), and the amounts of loan disbursements are aggregated by each of these segments.[15] Specifically, the data are structured as panel data where the unit of observation is the bank (40 banks)-loan segments (16 segments)-quarter (27 period) pair. The template of collection of the data is presented in Appendix Fig. 1. The data tell us the amount of loan disbursements at the aggregated level of each loan characteristic. For example, the amount of disbursements of unsecured, long-term, USD denominated loans for a business sector by bank i are available for each quarter.

The second data source is bank balance sheets from the period from 2013Q1 to 2019Q2.[16] The data allow investigation of non-resident liabilities and its components, and other bank characteristics, such as capital ratios, liquidity ratios, and total assets. The third data source is International Financial Statistics, from which we constructed the indicators of the monetary policy rate of US federal funds and other foreign countries. The detailed definitions of variables used in this estimation are available in Appendix Table 1.

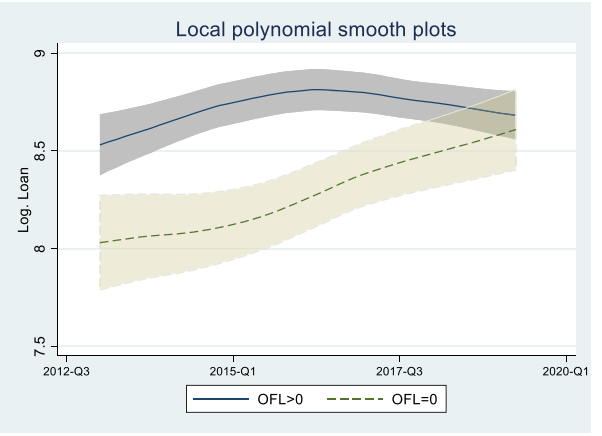
[15] We classified short-term loans as loans of no more than 1 year maturity, and long-term loans as loans of more than 1 year maturity.

[16] The data of aggregated loan disbursements and balance sheets are provided by the National Bank of Cambodia under the project *Empirical Study on Promotion of Home Currency in Cambodia*, a joint research project of the NBC and the JICA Ogata Sadako Research Institute.



Panel A: Banks with and without non-resident liabilities

Note: The figure shows the fitted line by polynomial regression for amounts of loan disbursement of banks with non-resident liabilities (NRL>0) and banks without non-resident liabilities (NRL=0).



Panel B: Banks with and without foreign wholesale borrowing

Note: The figure shows the fitted line by polynomial regression for amounts of loan disbursement of banks with other foreign liabilities (OFL>0) and banks without other foreign liabilities (OFL=0).

Fig. 4. Trends of Loan Disbursements.

According to our data, after the US monetary policy rate increased the trend in lending among Cambodian banks depended on whether they were reliant on foreign funding. In Fig. 4, we compare the trend of loan disbursements between banks with and without foreign funding exposure. By using polynomial regression, we illustrate the trends of loan disbursement for banks with non-resident liabilities (NRL>0) and banks without non-resident liabilities (NRL=0) in Panel A, and banks with other foreign liabilities (OFL>0) and banks without other foreign liabilities (OFL=0) in Panel B. Other foreign liabilities are calculated as non-resident liabilities minus non-resident deposits and may represent funding from other banks or companies including wholesale borrowing and deposits from foreign banks. Both figures show that the trends in amounts of loan disbursements were similar before the increase in US monetary policy in 2015Q4. However, the amounts of loan disbursements increased among banks without foreign funding exposure, while there was neither an increasing trend in Panel A nor a decreasing trend in Panel B for banks with foreign funding exposure. This suggests that US monetary policy does affect domestic bank lending in Cambodia, channeled through the dependency on foreign funding. In the next subsection, we propose a methodology to statistically examine this hypothesis.

3.2. *Empirical model and identification*

Built on Jimenez et al. (2012), Buch et al. (2018), and Temesvary et al. (2018), the empirical model is constructed with lagged variables. We then identify the spillover of US monetary policy on banks' domestic lending by examining the heterogeneity in the effect across different levels of exposures to foreign monetary policy. Specifically, we estimate the following equation: .[17]

$$ln\left(loan_{i,s,c,m,b,t}\right) = \alpha + \Sigma_{k=0}^{3}\beta_k I_i \cdot US\_Policy_{t-k} + \rho_k BankControl_{i,t-k-1} + \Sigma_{k=0}^{3}\varphi_k FDI\_Inflow_{j,t-k} + f_{i,s,c,m,b} + \psi_{s,t} + \psi_{c,t} + \psi_{m,t} + \psi_{b,t} + u_{i,s,c,m,b,t} \quad (1)$$

Where: $ln(loan_{it})$ represents the logarithm of the amount of newly disbursed loans for bank i in quarter t. The subscripts represent the following dimensions: s ∈(Unsecured loan, Secured loan), c ∈ (USD loan or local currency loan), m ∈ (Long-term loan, Short-term loan), b ∈ (Business loan, Consumer loan), and subscript j represents the country origin of the bank's major shareholders. We define long-term loans as those with more than one year of maturity and define all other loans as short-term loans.

As mentioned earlier, the interaction terms of the US monetary policy rate and a dummy variable for whether a bank has exposure of foreign funding are used to identify the effect of US monetary policy through the channel of foreign funding. Jeon and Wu (2014) employ the interaction terms of foreign bank dummy and monetary policy rates to capture the difference in the effect of monetary policy between foreign and domestic banks. This estimation is a difference-in-difference (DID) framework with the continuous variable as a treatment variable as adopted by Bleakley (2010). Following their identification strategy, we estimate the difference in the sensitivity of US monetary policy rates to loan disbursements between banks with foreign funding exposure and banks without it. I_i is a

[17] Panel-data study of bank lending sometimes adopts the dynamic GMM model for estimation purposes. However, earlier papers analyzing the effect of monetary policy using the quasi-natural experiment design often adopted a model without a lagged dependent variable (Ioannidou et al., 2015; Jiménez et al., 2012, 2014; Temesvary et al., 2018). Our study adopts the model without a lagged dependent variable. Thus, we estimate the model with fixed-effect OLS estimation.

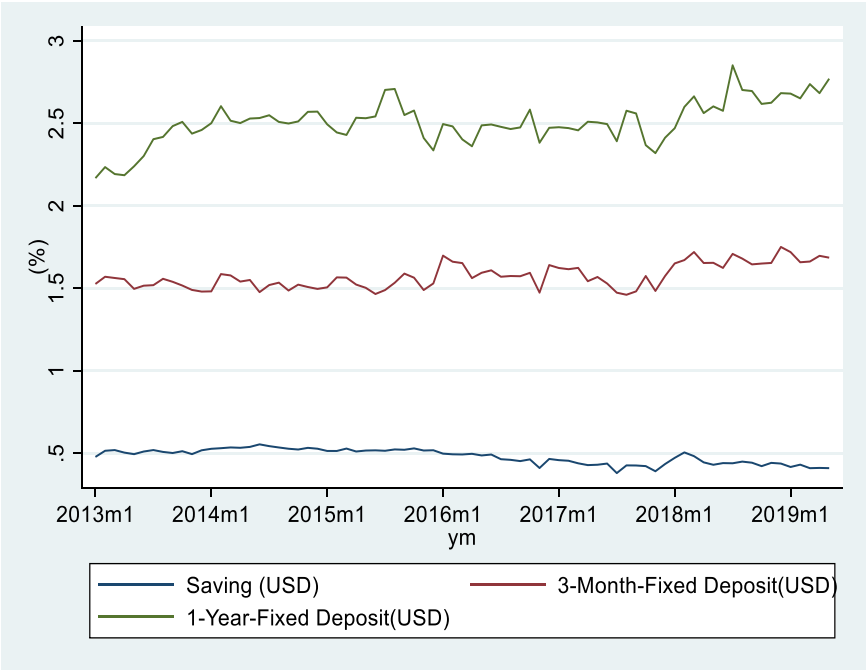


Fig. 5. Average Interest Rates on USD Deposits of Cambodian Commercial Banks. Note: Data is from National Bank of Cambodia, and authors' calculations. This figure shows the average interest rates on USD deposits of Cambodian commercial banks from 2013m1 to 2019m6.

treatment dummy to represent whether a bank has foreign funding exposure. The interaction term of the treatment dummy and US monetary policy rate, $I_i \cdot US\ Policy_{t-k}$, is supposed to capture the effect of US monetary policy through a bank's foreign exposure. As shown in Fig. 4, there is a parallel trend in average loan disbursement between banks with foreign funding and those without foreign funding before the US monetary policy rate started rising. Thus, the estimated coefficients of $I_i \cdot US\ Policy_{t-k}$ capture the causal impact of US monetary policy rate on banks with foreign funding.

Following prior studies (Kneer & Raabe, 2019; Temesvary et al., 2018), we also include lagged bank characteristics as $Bank\ Controls_{it-t}$. These include capital ratio, liquidity ratios, and total assets, and white noise, $u_{i,t}$. In addition, we control the bank-loan-characteristic-fixed effect $f_{i,s,c,m,b}$. Furthermore, by taking advantage of our data, we control for the factors specific to each loan characteristic. The data we use also allow us to look at the breakdown of amounts of newly issued loans by currency, maturity, security, and sector on a quarterly basis. To control for time-specific factors, time-variant loan-type-fixed effects are included for each loan type ($\psi_{s,t}, \psi_{c,t}, \psi_{m,t}, \psi_{b,t}$) to absorb temporal changes in demand or supply of certain types of loans in each period, such as temporal increases in the demand for local currency due to tax payments or changes in other regulations.[18]

We also control for FDI inflows from each bank's major shareholder country into Cambodia ($FDI\ Flow_{j,t}$), as these are likely to affect the banks' lending behavior (Peek & Rosengren, 2000; Baskaya et al., 2017). FDIs could also affect the local demand for credit as FDI could be financed by the related banks. This potential mechanism for credit growth might affect our results as reverse causality. We include the FDI flows to remove biases caused by this channel of transmission of other foreign countries' economic conditions. The data on FDI inflows are provided by the Council of Development in Cambodia and covers the amount of newly implemented FDIs by country for every quarter from 2013Q1 to 2019Q2.

Furthermore, to examine the channels in detail, we also examine whether the effect varies across levels of exposure. Following the triple-difference (DDD) framework (Jeon & Wu, 2014; Muralidharan & Prakash, 2017; Bose et al., 2020), we employ the triple difference extending the model to the following specification:

$$\begin{aligned} ln\left(loan_{i,s,c,m,b,t}\right) = \alpha + \Sigma_{k=0}^{3}\gamma_{1k} I_i \cdot US\quad Policy_{t-k} + \Sigma_{k=0}^{3}\quad \gamma_{2k}\quad I_i \cdot Z_{i,t-k-1} \cdot US\quad Policy_{t-k} \\ + \Sigma_{k=0}^{3}\quad \gamma_{3k} Z_{i,t-k-1} \cdot US\quad Policy_{t-k} + \Sigma_{k=0}^{3}\quad \gamma_{4k} I_i \cdot Z_{i,t-k-1} + \Sigma_{k=0}^{3}\quad \gamma_{5k} Z_{i,t-k-1} \\ +\quad \psi_k BankControl_{i,t-k-1} + \Sigma_{k=0}^{3}\varphi_k FDI\quad Inflow_{j,t-k} + f_{i,s,c,m,b} + \psi_{s,t} + \psi_{c,t} + \psi_{m,t} + \psi_{b,t} + u_{i,s,c,m,b,t} \end{aligned} \tag{2}$$

$Z_{i,t-k-1}$ represents the measure of foreign funding exposure. Our model is saturated with regard to three-way interaction terms. In addition, the interaction terms of treatment dummy and exposure $Z_{i,t-k-1}$ is equivalent to $I_i \cdot Z_{i,t-k-1}$ by definition, since $Z_{i,t-k-1} = 0$ when

[18] The National Bank of Cambodia announced a new regulation that came into effect as of December 2019 that requires banks to keep 10% of outstanding loans in the local currency.

I_i·takes zero, due to the assumption that the banks were not affected if they do not have exposure. Likewise, $Z_{i,t-k-1} \cdot US\ Policy_{t-k}$ is equivalent to, $I_i \cdot Z_{i,t-k-1} \cdot US\ Policy_{t-k}$. Thus, the Eq. 2 can be rewritten as follows:

$$ln\left(loan_{i,s,c,m,b,t}\right) = \alpha + \Sigma_{k=0}^{3}\beta_{1k} I_i \cdot US\quad Policy_{t-k} + \Sigma_{k=0}^{3}\quad \beta_{2k}\quad I_i \cdot Z_{i,t-k-1} \cdot US\quad Policy_{t-k}$$

$$+ \Sigma_{k=0}^{3}\quad \beta_{3k} Z_{i,t-k-1} + \quad \psi_k BankControl_{i,t-k-1} + \Sigma_{k=0}^{3}\varphi_k FDI\quad Inflow_{j,t-k} + f_{i,s,c,m,b} + \psi_{s,t} + \psi_{c,t} + \psi_{m,t} + \psi_{b,t} + u_{i,s,c,m,b,t} \tag{3}$$

In Eq. (3), the triple-interaction of treatment dummy, foreign funding exposure, and US monetary policy $I_i \cdot Z_{i,t-k-1} \cdot US\ Policy_{t-k}$ intended to capture the heterogeneity in the effect of US monetary policy rates across levels of foreign funding exposure. In this empirical model, a four-quarter cumulative effect of US monetary policy spillover is estimated as $\Sigma_{k=0}^{3}\frac{\partial^2 ln\left(loan_{i,s,c,m,b,j,t}\right)}{\partial US\ Policy_{t-k}\partial I_i} = \Sigma_{k=0}^{3}\beta_1 + \Sigma_{k=0}^{3}\beta_{2k} Z_{i,t-k-1}$.[19]

We employ two measures to determine foreign funding exposure. First, we employ the ratio of non-resident liabilities to total liabilities as the measure of foreign funding exposure.[20] Second, instead of the ratio of non-resident liabilities we also employ the ratio of other foreign liabilities to total liabilities. Other foreign liabilities are calculated as non-resident liabilities minus non-resident deposits and may represent funding from other banks or companies including wholesale borrowing and deposits from foreign banks. T he reliance on wholesale borrowing could be more likely to transmit shocks from abroad, since banks are to a large extent reliant on wholesale borrowing when they access the international capital market.

There might be other channels of spillover of foreign monetary policy into dollarized economies, such as domestic foreign currency deposits, as Mora (2013) demonstrate in their examination of US monetary policy spillover through foreign currency deposits in Mexico. However, the interest rates on domestic USD deposits have remained stable even after the US federal fund rate started increasing in 2015Q4. Fig. 5 shows the average interest rates of banks by maturities. This figure shows that interest rates on domestic USD deposits did not change significantly after the US federal fund rate increased. Presumably, this is due to the high degree of dollarization in Cambodia. Banks can collect USD deposits from residents, and the interest rate on deposits are mostly determined by domestic factors.[21] Fig. 1 and Fig. 5 may indicate that changes in US monetary policy have affected only the cost of funding from abroad for Cambodian banks. Thus, the effect could be larger if banks are more dependent on foreign funding, since Cambodian commercial banks could collect USD deposits from domestic customers at a stable funding cost. Thus, the interactions of the treatment dummy, US federal fund rate, and foreign funding exposure ($I_i \cdot Z_{i,t-k-1} \cdot US\ Policy_{t-k}$) would capture the heterogeneity in the effect of US monetary policy change on the cost of non-resident liabilities into Cambodian banks. If the channel of non-resident liabilities plays a role in transmitting US monetary policy to banks' domestic lending, we expect $\Sigma_{k=1}^{l}\beta_{1k} < 0$, and $\Sigma_{k=1}^{l}\beta_{2k} < 0$, respectively.

We further examine whether the spillover effect of foreign monetary policy on bank lending is induced by bank risk-taking behavior. As De Jounghe et al. (2020b) discussed, in the case of the increasing cost of funding, banks are urged to maintain profits by reducing the risk-profile in their loan-portfolios. Thus, a rise in the cost of funding will reduce lending to high-risk borrowers and firms. To examine which types of loans are likely to be affected by the international monetary policy spillover, we extend the empirical model to the following equation:

$$ln\left(loan_{i,s,c,m,b,j,t}\right)$$

$$= \alpha + \Sigma_{k=0}^{3}\beta_1 I_i \cdot US\quad Policy_{t-k} + \Sigma_{k=0}^{3}\beta_{2k}\quad I_i \cdot Z_{i,t-k-1} \cdot US\quad Policy_{t-k}$$

$$+ \Sigma_{k=0}^{3} I_i \cdot US\quad Policy_{t-k} \cdot \left(\gamma_{1k} SecuredDummy_s + \gamma_{2k} LongTermDummy_m + \gamma_{3k} USD\quad Dummy_c + \gamma_{4k} BusinessDummy_b\right)$$

$$+ \Sigma_{k=0}^{3} I_i \cdot Z_{i,t-k-1} \cdot US\quad Policy_{t-k} \cdot \left(\delta_{1k} SecuredDummy_s + \delta_{2k} LongTermDummy_m + \delta\quad _{3k} USD\quad Dummy_c + \delta\quad _{4k} BusinessDummy_b\right)$$

$$+ \Sigma_{k=0}^{3}\quad \beta_{3k} Z_{i,t-k-1} + \quad \Sigma_{k=0}^{3}\rho_k Bank\quad Controls_{i,t-k-1} + \Sigma_{k=0}^{3}\varphi_k FDI\quad Inflow_{j,t-k} + f_{i,s,c,m,b}\quad + \psi_{s,t} + \psi_{c,t} + \psi_{m,t} + \psi_{b,t} + u_{i,s,c,m,b,t} \tag{4}$$

where $SecuredDummy_s$, $LongTermDummy_m$, $USD\ Dummy_c$, and $BusinessDummy_b$ are dummies that stand for whether loans are secured or unsecured, have more than one year maturity or not, are in USD or the local currency, and are for the business or consumer sector.

Jiménez et al. (2014) document how domestic monetary policy can also affect the structure of loan portfolios in terms of risk profiles. Their study found that lowly capitalized banks increased loans without collateral and loans to higher default risk firms after the interest rate decreased. In the context of Cambodia, secured loans are generally less risky for lenders and the funding side of commercial banks is highly dollarized. Thus, lending in the local currency could induce exchange rate risks in the balance sheet of

[19] Some could argue that including only a term of $I_i \cdot Z_{i,t-k-1} \cdot US\ Policy_{t-k}$ is enough if the heterogeneity is linear. However, it is more natural to assume that there could be a difference in estimating impacts between banks with and estimating impact within foreign funding exposure and within banks with foreign funding exposure. Thus, including both of $I_i \cdot US\ Policy_{t-k}$ and $I_i \cdot Z_{i,t-k-1} \cdot US\ Policy_{t-k}$ is more robust and preferred.

[20] Non-resident liabilities include wholesale funding from abroad, deposits from foreign banks, and non-resident deposits.

[21] One of the other possible channels is FX deposits in banks, as previous studies suggest. However, residents mostly keep FX deposits, and as we show in Fig. 4, the interest rate on FX deposits did not change in response to US monetary policy. Thus, it is not likely that FX deposits channel the US monetary policy in Cambodia. Indeed, we also estimated the model with interaction terms of FX deposits × US monetary policy, but the results are not consistent with the transmission hypothesis.

Table 2
Summary Statistics of Variables Used in the Estimation.

		Mean	Standard Errors	Observations
Loan-Disbursement Variables				
Amounts of Loan Disbursement (By Loan Characteristics)				
	Business	36,715	128,345	2827
	Consumer	140,507	662,656	2218
	Short-term	68,789	288,087	2147
	Long Term	95,335	506,456	3492
	Local Currency	35,127	186,500	836
	USD	93,948	466,042	4803
	Unsecured	26,712	353,112	1006
	Secured	96,203	473,219	4039
	All Loans	82,346	452,645	5045
Banks' Balancesheet variables				
Ratio of Non-resident Liablities		0.15	0.18	954
Ratio of Foerign Wholesale Borrowing		0.10	0.17	951
Ratio of Non-Resident Deposits		0.05	0.07	951
Capital Ratio		0.32	0.24	954
Liquidity Ratio		0.34	0.15	915
Log. Total Asset		13.95	1.25	954
Total Assets		2454,523	3835,078.00	954
Ratio of FX Deposit to Liabilities		0.44	0.25	953
Macroeconomc Variables				
Standardized Monetary Policy Rate in Country *j* (%)		-0.16	0.86	300
Capital Inflow into Cambodia from Country *j*		36.39	48.03	324
US Monetary Policy (%)		0.80	0.83	26

Note: Unit is millions of KHR. Loan amounts mean the amounts of newly issued loans by quarters. Long-term loans are loans with more than one year of maturity, while short-term loans have less than one year of maturity. Growth in the amounts of loan disbursements in Table 2 is a quarter-to-quarter change in the log. of loan volume.

banks (Aiba & Sok, 2017; Okuda & Aiba, 2018). In addition, in Cambodia, local currency loans are usually demanded by households or enterprises in rural areas (Aiba et al., 2018). Thus, lending in local currency is generally provided to lower risk profile borrowers.

Furthermore, there could also be differences between the sectors.[22] For consumer loans, the size of loans are far smaller and banks mostly require collateral, although the interest rates are not necessarily lower than corporate loans. Thus, consumer loans could be lower risk than business loans for Cambodian banks. In addition, foreign funding is generally long-term and large, thus facilitating banks loans to the business sector. We examine which loan characters are highly affected by the US and other foreign monetary policies using Eq. (4).

Regarding maturity composition, there are few earlier studies that investigated the impact of monetary policy spillover on maturity composition, and the results are mixed in the literature on monetary policy spillover. In terms of risks and costs in lending, shorter-term loans could require higher costs of rollover (Demirgüç-Kunt et al., 2020). And in the context of the developing countries, good borrowers to whom banks can extend long-term loans are limited. Thus, the borrowers of short-term loans could be risky relative to borrowers of long-term loans. Jiménez et al. (2014) do not find robust results in the distributional effects on different loans with maturity. Temesvary et al. (2018) also focused on the relationship between the maturity of loans and international monetary policy spillover and posited the hypothesis that it is easier for banks to adjust short term-loans than long-term loans in response to monetary policy. Their study finds that shorter-term loans in cross-border lending are more likely to decrease in response to an increase in the US monetary policy rate, while there was no statistically significant impact on long-term loans.

The empirical model developed in this study does not completely rule out influence of other domestic financial market conditions. However, the banking sector plays a dominant role in determining domestic financial conditions, since other domestic financial markets, such as a stock market and bond market, are underdeveloped in Cambodia. In addition, we also controlled for the confounding effect of FDIs and time effects in the model. Thus, bias from the influence of other financial markets is assumed to be small.

3.3. Examination of the spillover effect of monetary policy from other foreign countries

We further examine whether other countries' monetary policies affect Cambodian banks. As with US monetary policy, we include and examine the effect of the monetary policy of each bank's major shareholders' home country *j* at time t($OF\ Policy_{jt}$). This variable

[22] The share of consumer loans in total loans has seen historic increases in recent decades, and an increasing number of studies have looked into credit allocation in terms of consumer loans. Samarina and Bezemer (2016) studied the credit allocation between consumer loans and business loans. They found that the increases in capital flows into both banks and non-financial firms are correlated with an increase in the share of consumer loans. Bezemer et al. (2017) documented evidence that shows changes in the shares of consumer loans are positively correlated to the presence of foreign banks and higher trade. There is also a study on the consequence of increasing shares of consumer loans: Bezemer and Zhang (2019) reported that an increase in the share of household mortgage loans was associated with lower economic growth after the financial crisis.

Table 3
Estimation of the Impact of US Monetay Policy on Newly Disbursed Loans.

	Z: Ratio Non-Resident Liabilities to Total Liabilities				Z: Ratio of Foreign Wholesale Borrowing to Total Liabilities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Σ I (i) x US Policy (t)	-0.452 * **	-0.385 *	-3.278 * **	-3.466 * **	-0.480 * *	-0.362 *	-3.110 * **	-2.379 * **
	(0.187)	(0.198)	(0.485)	(0.608)	(0.210)	(0.199)	(0.495)	(0.768)
Σ I (i) x Z (i, t-1) x US Policy (t)		-0.498		-1.527		-1.310 * *		-4.823 *
		(0.588)		(2.658)		(0.659)		(2.615)
Σ I (i) x Z (i, t-1)	-0.583	-0.268	-0.584	-0.372	-0.848 *	-0.104	-0.850 *	-0.127
	(0.594)	(0.666)	(0.586)	(0.639)	(0.480)	(0.553)	(0.468)	(0.550)
Σ I (i) x US Policy (t) x Collateral Dummy			0.422	0.196			0.473	0.355
			(0.294)	(0.328)			(0.349)	(0.330)
Σ I (i) x US Policy (t) x USD Dummy			2.375 * **	2.661 * **			2.109 * **	1.572 * *
			(0.467)	(0.578)			(0.575)	(0.795)
Σ I (i) x US Policy (t) x Long-term Dummy			0.802 * **	0.902 * **			0.883 * **	0.863 * **
			(0.209)	(0.232)			(0.202)	(0.250)
Σ I (i) x US Policy (t) x Business Dummy			-0.413 *	-0.242			-0.434 *	-0.350
			(0.236)	(0.212)			(0.253)	(0.274)
Σ I (i) x Z (i, t-1) x US Policy (t) x Collateral Dummy				1.819				2.337
				(1.646)				(1.658)
Σ I (i) x Z (i, t-1) x US Policy (t) x USD Dummy				1.282				1.946
				(1.913)				(1.944)
Σ I (i) x Z (i, t-1) x US Policy (t) x Long-term Dummy				-1.579 *				-0.173
				(0.925)				(0.945)
Σ I (i) x Z (i, t-1) x US Policy (t) x Business Dummy				-1.250 *				-0.264
				(0.709)				(0.727)
Other Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Currency Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Sector Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Maturity Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time- Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Sector-Currency-Maturity-Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-6.905	-7.136	-7.266	-6.961	-6.285	-5.958	-6.765	-6.507
	(3.781)	(3.680)	(4.041)	(3.714)	(3.617)	(3.440)	(3.893)	(3.642)
Number of Obseravations	4176	4176	4176	4176	4119	4119	4119	4119
Adjusted R-squared	0.792	0.792	4176	0.794	0.794	0.796	0.795	0.798
Note: Two-way cluster robust standard errros at quarter leve and at firm level.								
Σ Liquidity Ratio (i, t-1)	-0.695	-0.788	-0.750	-0.817	-0.581	-0.726	-0.634	-0.834
	(0.894)	(0.817)	(0.916)	(0.903)	(0.874)	(0.747)	(0.894)	(0.848)
Σ Capital Ratio (i, t-1)	-0.264	-0.193	-0.045	-0.090	-0.607	-0.516	-0.364	-0.110
	(0.764)	(0.731)	(0.838)	(0.713)	(0.712)	(0.676)	(0.786)	(0.806)
Σ Log. Total Asset (j, t-1)	0.564 * **	0.578 * **	0.607 * **	0.592 * **	0.528 * **	0.505	0.577 * **	0.554 * **
	(0.221)	(0.214)	(0.237)	(0.219)	(0.216)	(0.206)	(0.232)	(0.221)
Σ FDI Inflow (j, t)	-0.005	-0.004	-0.005	-0.003	-0.004	-0.002	-0.004	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)

Note: * ** , * *, and * represent statistical significance at 1%, 5%, and 10%, respectively. The fixed-effect OLS estimation is used for each column. To capture the effects over one year, each model included 3 lags of each independent variable and its contemporaneous measure at k = 0. The values in each column show the cumulative values of estimated coefficients of all lagged variables $(\Sigma_{k=0}^{3}\beta_{1k})$, and two-way clustered robust standard errors at the bank- and quarter- level are presented in parentheses. For the other control variables, we included liquidity ratio, capital ratio, log of total assets, and FDI inflow. However, we only report the variables of our interest in this table. The sample period spanned from 2013Q1 to 2019Q2. Z(i, *t*-1) represents the measure of foreign funding exposure. In columns 1–4, the ratio of non-resident liabilities to total liabilities are adopted as Z(i, *t*-1). In columns 5–8, the ratio of other liabilities to total liabilities are adopted as Z(i, *t*-1). I(t) represents the treatment dummy which takes the value one if Z (i, *t*-1) is not zero. US policy (t) represents the US federal fund rate, and OF Policy (t, j) represents the rate in the home countries of the major shareholders of each bank.

is not likely to be affected by Cambodia's economic situation, as the country has one of the World's smallest open economies, while changes in foreign countries' monetary conditions do affect capital inflows to Cambodian banks. In the case that the majority of the shareholders of a given bank are Cambodian, we set the other countries' monetary policy rate ($OF\ Policy_{jt}$) to zero. In addition, since the monetary policy rate varies across countries, $OF\ Policy_{jt}$ is standardized by subtracting mean and dividing by the standard errors of the monetary policy rates for each country. Avdjiev et al. (2018) demonstrates that cross-border lending is affected by the monetary policy of each of the lenders, borrowers and currency-issuing countries. Therefore, it is likely that the monetary policy conditions in the parent banks' locations is also an important factor in understanding the transmission mechanism through non-resident liabilities.

Table 1 gives the breakdown of the ownership of commercial banks in Cambodia. Ownership information was collected from the audited annual report of commercial banks or their websites. The home country of the bank is defined as the country in which a

shareholder with the largest number of shares is located. According to the table, the number of banks has been increasing over time, and most of shareholders of the recent entrants are foreigners. Thailand, Malaysia, Vietnam, Korea, and Japan are the major home country of these entrants.

3.4. Descriptive statistics

Table 2 shows the summary statistics of variables used in the analysis. In the first row of Table 2, we present the mean values and standard errors of amounts of loan disbursements by currency (USD or local currency), sector (business or consumer loans), maturity (long-term or short-term), and security (secured or unsecured). This table also shows another interesting feature of the Cambodian banking sector,[23] the liquidity ratio, defined as liquid assets over total assets, is high. Other studies have found that the liquidity ratio is 0.22 on average in Brazilian banks (Noth and Busch, 2017), and the liquid-asset-to-deposit ratio is 0.36 in Ugandan banks (Abuka et al., 2020). Cambodia's high liquidity ratio could be a consequence of the high extent of the country's financial dollarization and political instability. Delechat et al. (2012) show that liquidity buffers are generally higher for banks in highly dollarized economies because of the absence of a lender of last resort. In addition, the Cambodian banking sector is vulnerable to external shocks, such as political turbulence. In the past, there were large-scale deposit withdrawals in the Cambodian banking sector as occurred just after the national election in 2013. This situation possibly makes the Cambodian banks raise high liquidity buffers to offset the potential risk of future deposit withdrawals.

4. Empirical results

4.1. Spillover effect of US monetary policy

Table 3 presents the results of the estimation using a regression with fixed-effect OLS estimation. To capture the effects over one year, our estimation model included 3 lags of each independent variable and its contemporaneous measure at k = 0. The values in each column represent the cumulative values of the estimated coefficients of all lagged and contemporaneous measures, and standard errors. For the calculation of standard errors, two-way clustered robust standard errors at the bank- and quarter- level are used, following Cameron and Miller (2015). We present the results of the ratio of non-resident liabilities to total liabilities in columns 1–4, and the results of the ratio of other foreign liabilities to total liabilities in columns 5–8.

In columns 1 and 5, we estimated the model with an interaction term of the treatment dummy and US monetary policy rate ($I_i \cdot US\ Policy_{t-k}$) to examine the difference in bank's reaction to an increase in US monetary policy rate between banks with and without exposure. We find that the coefficient of the interaction term was negative at the 1% statistical significance level in column 1 and at 5% in column 4; this interaction term is also significant in the other specifications in the table. Both of the measures of exposure to foreign monetary policy showed that banks with exposure decreased their domestic lending compared to banks without exposure following the increase in US monetary policy, suggesting that banks that are dependent on foreign funding are affected by US monetary policy changes.

The estimated coefficient indicates the large economic impact of US monetary policy on banks with highe dependency on foreign funding. Based on the estimation results in column 1 (column 5), a 1% increase in the US monetary policy rate leads to a 0.452 point (0.480 points) decrease in log scale for domestic lending of banks with exposure on average compared to banks without exposure.[24] Our estimated impact of US monetary policy rates on Cambodian banks was even high when compared to studies of other developing and developed countries. Abuka et al. (2019) reported that a 644 basis point (6.44%) decrease in the interbank rate, which is a one-standard-deviation decrease, is associated with a 7.4 – 17.2% decrease in the rejection rate of loan applications, and 10.2 – 20.3 decreases in log scale of newly disbursed loans.[25] In the advanced economy, Temesvary et al. (2018) reported that a 100 basis point increase in US monetary policy rates leads to a 0.03 – 0.04 point decrease in log scale in the amount of cross-border lending of global banks. The results of our analysis suggest that Cambodian banks are highly dependent on foreign funding and vulnerable to shocks in those sources.

In columns 2 and 6, we estimated Eq. (3) with the triple-interaction term of the treatment dummy, US monetary policy rate, and exposure ($I_i \cdot Z_{i,t-k-1} \cdot USPolicy_{t-k}$). We find that the interaction term of the treatment dummy and US monetary policy rate ($I_i \cdot US\ Policy_{t-k}$) is statistically significant, while the triple interaction term ($I_i \cdot Z_{i,t-k-1} \cdot USPolicy_{t-k}$) is not statistically significant (column 2), although the sign of the coefficient is in line with our prediction. However, as shown in column 5, the triple-interaction term is negative at 5% statistical significance, also in line with our prediction.

Overall, the estimated coefficients are similar between the ratio of other foreign liabilities and the ratio of non-resident liabilities. In addition, the triple-interaction term of the treatment dummy, US monetary policy rate, and exposure ($I_i \cdot Z_{i,t-k-1} \cdot USPolicy_{t-k}$) is statistically significant in the case of the ratio of other foreign liabilities. This suggests that international monetary policy spillover is

[23] For the definition and correlation matrix of the variables, please see Appendix Tables 1 and 2. We also present the loan and bank characteristics between banks with foreign exposure and without foreign exposure in Appendix Table 3.

[24] For the average loan disbursement, which is 82,346 USD, a 0.45-point decrease in log scale means a 30,294 USD decrease in the total amount (36.8%).

[25] The data used in our estimation are aggregated at the bank-loan type level. Thus, our estimated impact includes both intensive and extensive margins.

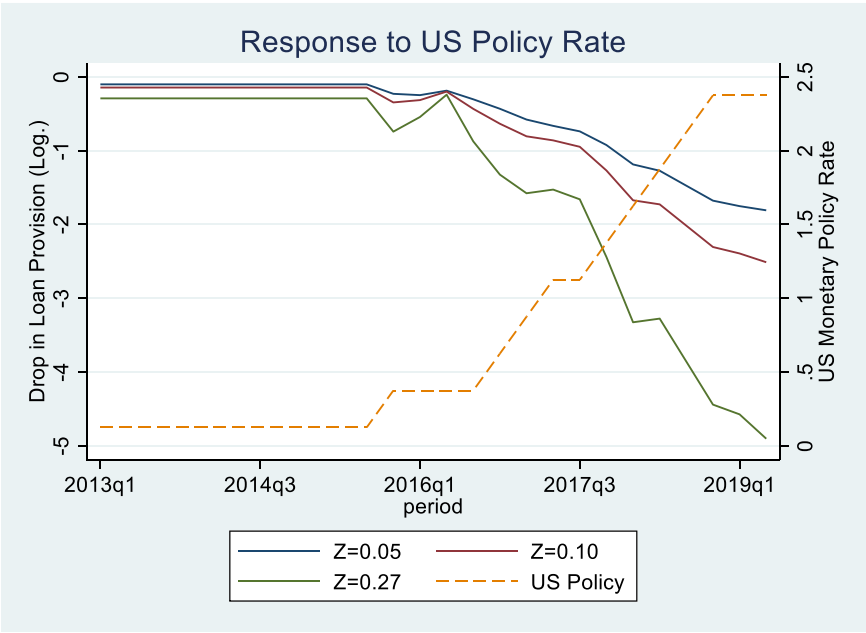


Fig. 6. Estimated Economic Impacts of US Monetary Policy Note: This figure illustrates the estimated impact of an increase in the US monetary policy rate, based on the estimated model shown in column 6 of Table 3. Estimated economic impact is calculated as $(\Sigma_{k=0}^{3}\beta_1+\Sigma_{k=0}^{3}\beta_{2k}Z)\cdot USPolicy_{t-k}$. Each of the plotted lines shows the estimated impact for banks of which the ratio of other foreign liabilities to total liabilities (Z) is 0.05, 0.10, and 0.27.

channeled via wholesale funding from abroad.

Based on the estimation in column 5, the banks with a one-standard-deviation higher ratio of other foreign liabilities (0.17) would experience a 22% larger decline in lending to one loan segment than other banks with exposure, and a 0.58% decline compared to banks without exposure. We also illustrated the estimated effects of US monetary policy rate changes on changes in the loan disbursement of Cambodian banks in Fig. 6, based on the result of column 6 (Table 3). The estimated effects are calculated for banks with an average exposure (Z = 0.10), the banks with one-standard-deviation higher exposure (Z = 0.27), and the banks with small exposure (Z = 0.05), using the following formula:

$$\Sigma_{k=0}^{3}\frac{\partial^2 ln\left(loan_{i,s,c,m,b,j,t}\right)}{\partial US\quad Policy_{t-k}\quad \partial I_i}\cdot USPolicy_{t-k}=\left(\Sigma_{k=0}^{3}\beta_1+\Sigma_{k=0}^{3}\beta_{2k}Z\right)\cdot USPolicy_{t-k}$$

Fig. 6 shows that changes in the US monetary policy rate decreased loan disbursements after 2015Q4, with a severe negative effect on banks with higher exposure. When the US monetary policy rate rose to 2.25% in 2018Q4, the estimated impact amounted to a 2-log reduction for the average banks (Z = 0.10), and a greater than 5-log reduction for the bank with one-standard-deviation higher exposure (Z = 0.27). Our results suggest that tightening of US monetary policy severely affects the domestic lending of those Cambodian banks with high dependency on foreign funding. The results are consistent to prior studies of international monetary policy spillover in other emerging markets (Ongena et al., 2015).

In columns 3–4 and 7–8, we present the results of the estimation of Eq. (4), which include the triple-interactions of the treatment dummy, US monetary policy rates, loan characteristic dummies, the quadruple-interactions of the treatment dummy, the measure of exposure to foreign monetary policy, US monetary policy rates, and loan characteristic dummies.[26] Furthermore, in Fig. 7, we illustrate the estimated impact of an increase in the US monetary policy rate across loan characteristics, based on the estimated model shown in column 8 of Table 3. Each of the plotted lines shows the estimated impact for banks of which the ratio of other foreign liabilities (Z) is 0.10. The secured, short-term, USD business loans are treated as the baseline in each panel. The data illustrate that distributional effects across loan characteristics are large enough on average to change loan composition significantly for banks with exposure to foreign funding.

$$\Sigma_{k=0}^{3}\beta_1 US\quad Policy_{t-k}+\Sigma_{k=0}^{3}\beta_{2k}\quad Z_{i,t-k-1}\cdot US\quad Policy_{t-k}$$

$$+\Sigma_{k=0}^{3} US\quad Policy_{t-k}\cdot(\gamma_{1k}SecuredDummy_s+\gamma_{2k}LongTermDummy_m+\gamma_{3k}USD\quad Dummy_c+\gamma_{4k}BusinessDummy_b)$$

[26] We also checked the robustness in the different specifications of Eq. (4) in a stepwise manner. These results are presented in Appendix Table 4.

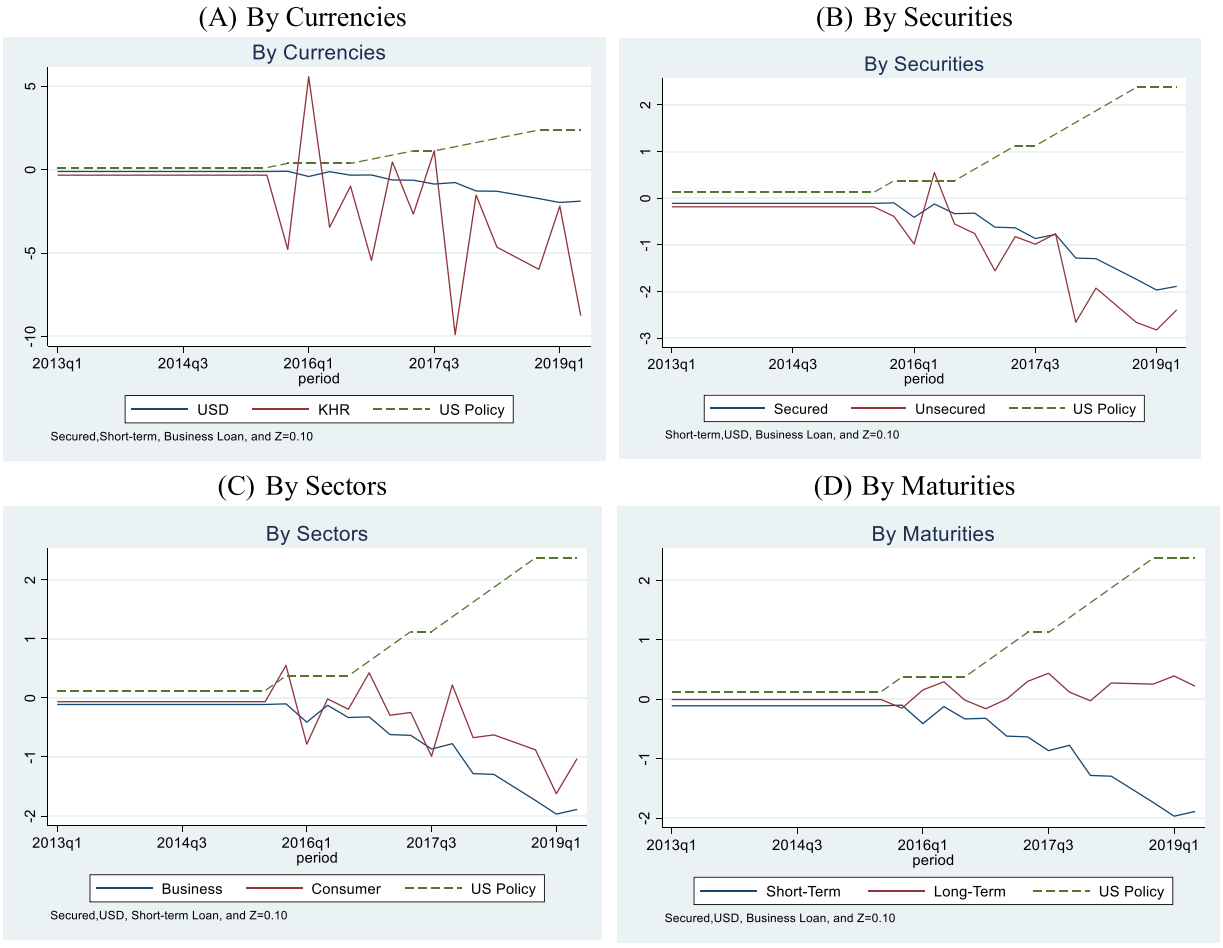


Fig. 7. Estimated Economic Impact of US Monetary Policy (By Loan Characteristics). Note**:** The figure illustrates the estimated impact of an increase in the US monetary policy rate, based on the estimated model values in column 8 of Table 3. The estimated economic impact is calculated from the following equation.

$$+\Sigma_{k=0}^{3} Z_{i,t-k-1} \cdot US \quad Policy_{t-k} \cdot (\delta_{1k} SecuredDummy_s + \delta_{2k} LongTermDummy_m + \delta \quad _{3k} USD \quad Dummy_c + \delta \quad _{4k} BusinessDummy_b)$$

Each of the plotted lines shows the estimated impact on banks where the ratio of other foreign liabilities (Z) is 0.10. Secured, short-term, USD-denominated, business loans are treated as the baseline in each panel.

We find that there are distributional effects from US monetary policy across different characteristics of loans. First, the coefficients of the triple-interaction term of the treatment dummy, US monetary policy rate, and USD currency dummy ($I_i \cdot USPolicy_{t-k} \cdot USDDummy_c$) were positive and statistically significant in all the specifications in Table 3. Panel A of Fig. 7 illustrates that the cumulative effect of increases in monetary policy rate amounted to about a 2-log reduction in USD loans in 2019Q2, while decreases in KHR business loans amounted to about an 8-point decrease in log scale. These findings suggest that lending in the local currency is more sensitive to changes in the cost of funding from abroad than is lending in USD. This result might reflect the fact that the Cambodian banks are highly dependent on USD funds. Since more than 90% of deposits and borrowings of Cambodian commercial banks are in USD, lending in the local currency could induce exchange rate risks. In addition, the risk profiles of clients are different between loan currencies as rural clients in Cambodia prefer to borrow in the local currency (Aiba & Okuda 2018; Aiba et al., 2018). The results also suggest that increases in funding costs facilitate asset allocations of banks toward less risky assets, in line with Jiménez et al. (2014) and De Jonghe et al. (2020a). These results are different from Ongena et al. (2017), who found that foreign monetary policy negatively affected bank lending in the foreign currency in the case of Hungary. However, lending in the local currency still dominated the lending market in Hungary, and foreign currency, especially the Swiss Franc, was considered as a risky currency (Beer et al., 2010). These differences in the risks of foreign currency lending may lead to differences in the impact of the rising cost of funding.

Furthermore, the dummy for secured loans is also estimated as positive, although it is statistically insignificant. Panel B of Fig. 7 illustrates that the cumulative effects of US monetary policy rate amounted to about a 2.5-log reduction in insecure loans in 2019Q, while the decrease was around a 2-log reduction in secured loans.

We also find that US monetary policy rate is associated with the loan allocations of the banks across sectors. The interactions with

the business loan dummy are estimated as negative and statistically significant in columns 3 and 7, meaning that increases in funding costs from abroad negatively affected the provision of domestic business loans. Panel C of Fig. 7 illustrates that the effect of US monetary policy amounted to about a 1-log reduction in consumer loans in 2019Q2, while it was about a 2-log reduction in business loans. In the context of the Cambodian economy, it is easy for banks to extend consumer loans with a collateral requirement, such as a land title, as a relatively large number of households own land for housing or farming due to their history during the Pol Pot regime. In the meantime, banks require financial statements and business plans for the provision of business loans. Thus, in the case of Cambodia the results can be interpreted as banks reallocating loans from risky borrowers to safer ones.

Regarding maturity, the triple-interactions of the treatment dummy, US policy, and long-term loans ($I_i \cdot US\ Policy_{t-k}$) are estimated as positive at the 1% statistical significance level in columns 3–4 and 7–8. This suggests that there is a difference in the effect of US monetary policy between long-term loans and short-term loans. Panel D of Fig. 7 further illustrates that long-term loans are not negatively affected by US policy, while the short-term loans strongly react to the US monetary policy rate, ending in a 2-point decrease in log scale. This result means that the rising cost of foreign funding increases the disbursement of long-term loans relative to short-term loans. The results are consistent with the findings by Tremesvary et al. (2018), suggesting that adjusting the amount of short-term loans is more tractable for banks when they are coping with changes in monetary conditions than making adjustments of amount of long-term loans. Or there is other possible interpretation. The results might reflect that short-term loans are more costly in the context of Cambodia. As explained by Zetzsche and Dewi (2018), short-term loans entail large costs in loan disbursements, since short-term loans are generally rolled over, and the risks of refinancing and administrative costs including screening costs can occur frequently.

Furthermore, since the short-term loans are generally small, the number of loan disbursements is larger compared to the number of disbursements of long-term loans within a loan portfolio of the same gross size. In addition, the risk profile could be also different, and borrowers with long maturity loans are likely to be better borrowers. Thus, banks are urged to reduce the costs in lending by shifting to more long-term loans and reducing the administrative and monitoring costs. However, a large portion of loans in Cambodia are short-term, and borrowers in rural areas are more likely to take out short-term loans because of their high-risk profile.[27]

Moreover, the coefficient of the interactions of the treatment dummy and US monetary policy ($I_i \cdot USPolicy_{t-k}$) is estimated to be higher overall in the model including distributional effects (columns 3–4, and 7–8), and the triple-interaction term of the treatment dummy, US monetary policy rate, and exposure ($I_i \cdot Z_{i,t-k-1} \cdot USPolicy_{t-k}$) is also higher, as seen in column 8. In the estimated model of column 7, the estimated coefficient of the interaction of the treatment dummy and US monetary policy rate ($I_i \cdot US\ Policy_{t-k}$) is − 3.110. This means that banks with exposure experienced a − 3.110 decrease on average in the log scale of newly disbursed loans in response to a 1% increase of US monetary policy, compared to banks without exposure. Furthermore, in column 8, the triple-interaction term of the treatment dummy, US monetary policy rate, and exposure ($I_i \cdot Z_{i,t-k-1} \cdot USPolicy_{t-k}$) was estimated to be − 4.123, meaning that the impact of US monetary policy increases as the exposure of foreign funding increases, and one-standard-deviation higher exposure (0.17) additionally deceases loan provision on average by 0.701 points in the log scale.

4.2. Spillover effect of monetary policy from the home countries of the bank's major shareholders

We further investigate the relationship between domestic bank lending and foreign countries' monetary policy. De Haas and Van Lelyveld (2006, 2010) show that economic and monetary shocks within the home countries of multinational banks can affect the performance of local subsidiaries. Particularly, their studies found that contractionary monetary policy in a home country boosts the credit growth of subsidiaries. In a similar vein, Ongena et al. (2017) investigate the impact of foreign monetary policy on bank lending in Hungary, where Swiss Franc or Euro currency lending is prevalent. Their study also finds that the interest rates in Switzerland or Euro areas are associated with lending by lowly capitalized banks in Hungary. Thus, aside from US monetary policy, other foreign countries' monetary policies will be transmitted to Cambodia as a result of its banks' reliance on foreign funding. Here, we examine the hypothesis that the foreign monetary policy in the home country of a bank's major shareholders affects that bank's lending in Cambodia. We also examine whether a home country's monetary policy has a comparable impact to the US monetary policy for a developing country. To do so, we added the interaction terms of treatment dummy and other foreign country monetary policy ($I_i \cdot OF\ Policy_{j,t-k}$) in the same manner as we included the US monetary policy rate in Eq. (4).

The estimation results are presented in Table 4. We ran a regression with fixed-effect OLS estimation. To capture the effects over one year, the estimation model included 3 lags of each independent variable and its contemporaneous measure at k = 0. The values in each column show the cumulative values of the estimated coefficients of all lagged and contemporaneous measures and standard errors. For the calculation of standard errors the study employed two-way clustered robust standard errors at the bank- and quarter-level, following Cameron and Miller (2015). The results of the ratio of non-resident liabilities to total liabilities are presented in columns 1–4, and the results of the ratio of other foreign liabilities to total liabilities in columns 5–8.

The estimated results in columns 1 and 5 reveal that the coefficient of the triple-interactions of the treatment dummy, exposure, and monetary policy of the home countries of majority shareholders ($I_i \cdot Z_{i,t-k-1} \cdot OF\ Policy_{j,t-k}$) is not statistically significant, indicating that the ratio of non-resident liabilities is not working to channel the monetary policy effects in other foreign countries. In the meantime, the effect of US monetary policy is still estimated as negative (statistically significant) in both columns 1 and 4.

In columns 2 and 6, we included the triple- and quadruple-interaction of the treatment dummy, exposure, monetary policy, and

[27] According to credit registry data from the Credit Bureau of Cambodia, the average maturity of all the newly disbursed loans from banks in 2016–2019 was 33 months for individual lending, which includes business purposes, personal loans, mortgage loans, and credit card loans (Aiba et al., 2020).

Table 4
Estimation with Other Foreign Monetary Policy Rates.

	Z: Ratio Non-Resident Liabilities to Total Liabilities				Z: Ratio of Foreign Wholesale Borrowing to Total Liabilities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Σ I (i) x US Policy (t)	-0.549	-3.626 * **	-5.131 * **		-0.597	-2.882 * **	-4.066 * **	
	(0.384)	(0.845)	(1.557)		(0.382)	(0.812)	(1.428)	
Σ I (i) x Z (i, t-1) x US Policy (t)	-0.703	-2.554	-3.519		-1.653 * *	-8.208 * **	-7.467 * **	
	(0.685)	(4.021)	(3.669)		(0.737)	(2.309)	(2.326)	
Σ I (i) x OF Policy (t)	-0.028	-0.235	0.170	-0.544	0.046	0.023	-0.143	-0.843
	(0.264)	(0.610)	(0.816)	(0.734)	(0.258)	(0.237)	(0.677)	(0.659)
Σ I (i) x Z (i, t-1) x OF Policy (t)	-0.193	-0.479	-2.270	-4.187	-0.037	-0.104	-2.633	-4.417 *
	(0.688)	(3.791)	(3.599)	(3.135)	(0.449)	(2.384)	(2.751)	(2.676)
Σ I (i) x Z (i, t-1)	-0.490	-0.629	-1.209	-1.762	-0.053	-0.062	-1.599 * *	-2.300 * **
	(0.617)	(0.579)	(0.771)	(0.728)	(0.445)	(0.521)	(0.725)	(0.844)
Σ I (i) x US Policy (t) x Collateral Dummy		0.404	-0.839			0.617 * *	-0.500	
		(0.270)	(1.161)			(0.284)	(1.171)	
Σ I (i) x US Policy (t) x USD Dummy		2.507 * **	3.551 * **			1.694 *	2.346 *	
		(0.893)	(1.420)			(0.930)	(1.402)	
Σ I (i) x US Policy (t) x Long-term Dummy		0.750 * **	0.874 * **			0.695 * *	0.868 * **	
		(0.301)	(0.289)			(0.323)	(0.321)	
Σ I (i) x US Policy (t) x Business Dummy		-0.182	0.140			-0.219	0.082	
		(0.281)	(0.298)			(0.343)	(0.319)	
Σ I (i) x Z (i, t-1) x US Policy (t) x Collateral Dummy		1.685	2.125			2.920 * *	2.670 *	
		(1.563)	(1.825)			(1.447)	(1.623)	
Σ I (i) x Z (i, t-1) x US Policy (t) x USD Dummy		2.676	1.965			4.982 * **	4.844 * *	
		(3.559)	(3.151)			(2.049)	(2.248)	
Σ I (i) x Z (i, t-1) x US Policy (t) x Long-term Dummy		-1.896 * *	-1.675			-0.581	-0.824	
		(0.982)	(1.035)			(1.148)	(1.190)	
Σ I (i) x Z (i, t-1) x US Policy (t) x Business Dummy		-1.509	-1.714 *			-0.466	-0.781	
		(0.978)	(1.016)			(0.939)	(0.960)	
Σ I (i) x OF Policy (t) x Collateral Dummy		-0.338	-0.385	-0.358		-0.484	-0.424	-0.459
		(0.380)	(0.398)	(0.358)		(0.327)	(0.344)	(0.336)
Σ I (i) x OF Policy (t) x USD Dummy		0.546	0.349	-0.034		0.381 * *	0.402 *	0.587 * **
		(0.602)	(0.529)	(0.392)		(0.182)	(0.213)	(0.218)
Σ I (i) x OF Policy (t) x Long-term Dummy		-0.109	-0.070	0.113		0.059	0.122	0.119
		(0.266)	(0.299)	(0.236)		(0.224)	(0.249)	(0.243)
Σ I (i) x OF Policy (t) x Business Dummy		-0.031	-0.122	0.033		-0.147	-0.198	-0.197
		(0.291)	(0.303)	(0.228)		(0.226)	(0.234)	(0.232)
Σ I (i) x Z (i, t-1) x OF Policy (t) x Collateral Dummy		0.625	0.553	0.782		-0.027	0.112	0.152
		(1.683)	(1.636)	(1.393)		(1.390)	(1.342)	(1.393)
Σ I (i) x Z (i, t-1) x OF Policy (t) x USD Dummy		-0.784	1.023	2.551		0.075	1.550	0.921
		(2.915)	(2.702)	(2.552)		(1.830)	(2.015)	(2.100)
Σ I (i) x Z (i, t-1) x OF Policy (t) x Long-term Dummy		1.434 *	1.427	0.948		0.716	0.730	0.761
		(0.801)	(0.886)	(0.855)		(0.788)	(0.849)	(0.844)
Σ I (i) x Z (i, t-1) x OF Policy (t) x Business Dummy		-0.732	-0.461	-0.699		-0.616	-0.457	-0.489
		(0.881)	(0.946)	(0.885)		(0.763)	(0.825)	(0.821)
Time-Currency Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Sector Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Maturity Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time- Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-Period Fixed Effect	No	No	Yes	Yes	No	No	No	Yes
Bank-Sector-Currency-Maturity-Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-4.996	-7.084	-13.795	-9.541	-3.655	-6.255	-10.156	-9.514
	(4.111)	(4.980)	(8.653)	(6.647)	(3.751)	(4.534)	(8.257)	(6.296)
Number of Obseravations	3959	3959	3959	3959	3902	3902	3902	3902
R-squared	0.792	0.797	0.803	0.799	0.796	0.802	0.807	0.803
	Z: Ratio Non-Resident Liabilities to Total Liabilities				Z: Ratio of Foreign Wholesale Borrowing to Total Liabilities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Σ I (i) x US Policy (t)	-0.549	-3.626 * **	-5.131 * **		-0.597	-2.882 * **	-4.066 * **	
	(0.384)	(0.845)	(1.557)		(0.382)	(0.812)	(1.428)	
Σ I (i) x Z (i, t-1) x US Policy (t)	-0.703	-2.554	-3.519		-1.653 * *	-8.208 * **	-7.467 * **	
	(0.685)	(4.021)	(3.669)		(0.737)	(2.309)	(2.326)	
Σ I (i) x OF Policy (t)	(−0.028)	(−0.235)	(0.170)	-0.544	0.046	0.023	-0.143	-0.843
	(0.264)	(0.610)	(0.816)	(0.734)	(0.258)	(0.237)	(0.677)	(0.659)
Σ I (i) x Z (i, t-1) x OF Policy (t)	-0.193	-0.479	-2.270	-4.187	-0.037	-0.104	-2.633	-4.417 *
	(0.688)	(3.791)	(3.599)	(3.135)	(0.449)	(2.384)	(2.751)	(2.676)
Σ Z (i, t-1)	-0.490	-0.629	-1.209	-1.762	-0.053	-0.062	-1.599 * *	-2.300 * **
	(0.617)	(0.579)	(0.771)	(0.728)	(0.445)	(0.521)	(0.725)	(0.844)

(*continued on next page*)

Table 4 (*continued*)

	Z: Ratio Non-Resident Liabilities to Total Liabilities				Z: Ratio of Foreign Wholesale Borrowing to Total Liabilities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Σ Liquidity Ratio (i, t-1)	-0.336	-0.371	-0.972	-1.399	-0.306	-0.640	-0.547	-1.025
	(0.933)	(0.960)	(1.177)	(1.105)	(0.840)	(0.897)	(1.140)	(1.126)
Σ Capital Ratio (i, t-1)	-0.451	-0.283	0.663	-0.119	-0.656	-0.319	-0.482	-0.823
	(0.696)	(0.842)	(1.699)	(1.304)	(0.662)	(0.817)	(1.719)	(1.367)
Σ Log. Total Asset (j, t-1)	0.441 *	0.590 * *	1.017 * *	0.606	0.359	0.546 * *	0.790	0.619 *
	(0.237)	(0.288)	(0.520)	(0.387)	(0.225)	(0.267)	(0.496)	(0.361)
Σ OF Policy (j, t)	-0.003	-0.002			0.001	0.000		
	(0.003)	(0.004)			(0.004)	(0.004)		
Σ FDI Inflow (j, t)	-0.019	0.049			-0.086	0.035		
	(0.210)	(0.063)			(0.230)	(0.070)		
Σ I (i) x US Policy (t) x Collateral Dummy		0.404	-0.839			0.617 * *	-0.500	-1.046
		(0.270)	(1.161)			(0.284)	(1.171)	(0.938)
Σ I (i) x US Policy (t) x USD Dummy		2.507 * **	3.551 * **			1.694 *	2.346 *	2.825 * *
		(0.893)	(1.420)			(0.930)	(1.402)	(1.238)
Σ I (i) x US Policy (t) x Long-term Dummy		0.750 * **	0.874 * **			0.695 * *	0.868 * **	0.843 * **
		(0.301)	(0.289)			(0.323)	(0.321)	(0.334)
Σ I (i) x US Policy (t) x Business Dummy		-0.182	0.140			-0.219	0.082	-0.033
		(0.281)	(0.298)			(0.343)	(0.319)	(0.379)
Σ I (i) x Z (i, t-1) x US Policy (t) x Collateral Dummy		1.685	2.125			2.920 * *	2.670 *	2.790 *
		(1.563)	(1.825)			(1.447)	(1.623)	(1.626)
Σ I (i) x Z (i, t-1) x US Policy (t) x USD Dummy		2.676	1.965			4.982 * **	4.844 * *	4.871 * *
		(3.559)	(3.151)			(2.049)	(2.248)	(2.201)
Σ I (i) x Z (i, t-1) x US Policy (t) x Long-term Dummy		-1.896 * *	-1.675			-0.581	-0.824	-0.816
		(0.982)	(1.035)			(1.148)	(1.190)	(1.192)
Σ I (i) x Z (i, t-1) x US Policy (t) x Business Dummy		-1.509	-1.714 *			-0.466	-0.781	-0.814
		(0.978)	(1.016)			(0.939)	(0.960)	(0.957)
Σ I (i) x OF Policy (t) x Collateral Dummy		-0.338	-0.385	-0.358		-0.484	-0.424	-0.459
		(0.380)	(0.398)	(0.358)		(0.327)	(0.344)	(0.336)
Σ I (i) x OF Policy (t) x USD Dummy		0.546	0.349	-0.034		0.381 * *	0.402 *	0.587 * **
		(0.602)	(0.529)	(0.392)		(0.182)	(0.213)	(0.218)
Σ I (i) x OF Policy (t) x Long-term Dummy		-0.109	-0.070	0.113		0.059	0.122	0.119
		(0.266)	(0.299)	(0.236)		(0.224)	(0.249)	(0.243)
Σ I (i) x OF Policy (t) x Business Dummy		-0.031	-0.122	0.033		-0.147	-0.198	-0.197
		(0.291)	(0.303)	(0.228)		(0.226)	(0.234)	(0.232)
Σ I (i) x Z (i, t-1) x OF Policy (t) x Collateral Dummy		0.625	0.553	0.782		-0.027	0.112	0.152
		(1.683)	(1.636)	(1.393)		(1.390)	(1.342)	(1.393)
Σ I (i) x Z (i, t-1) x OF Policy (t) x USD Dummy		-0.784	1.023	2.551		0.075	1.550	0.921
		(2.915)	(2.702)	(2.552)		(1.830)	(2.015)	(2.100)
Σ I (i) x Z (i, t-1) x OF Policy (t) x Long-term Dummy		1.434 *	1.427	0.948		0.716	0.730	0.761
		(0.801)	(0.886)	(0.855)		(0.788)	(0.849)	(0.844)
Σ I (i) x Z (i, t-1) x OF Policy (t) x Business Dummy		-0.732	-0.461	-0.699		-0.616	-0.457	-0.489
		(0.881)	(0.946)	(0.885)		(0.763)	(0.825)	(0.821)
	Z: Ratio Non-Resident Liabilities to Total Liabilities				Z: Ratio of Foreign Wholesale Borrowing to Total Liabilities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Other Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Currency Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Sector Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Maturity Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time- Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-Period Fixed Effect	No	No	Yes	Yes	No	No	No	Yes
Bank-Sector-Currency-Maturity-Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-4.996	-7.084	-13.795	-9.541	-3.655	-6.255	-10.156	-9.514
	(4.111)	(4.980)	(8.653)	(6.647)	(3.751)	(4.534)	(8.257)	(6.296)
Number of Obseravations	3959	3959	3959	3959	3902	3902	3902	3902
Number of Banks	40	40	40	40	40	40	40	40
Adjusted R-squared	0.792	0.797	0.803	0.799	0.796	0.802	0.807	0.803

Note: * ** ,* *, and * represent statistical significance at 1%, 5%, and 10%, respectively. The fixed-effect OLS estimation is used for each column. To capture the effects over one year, each model included 3 lags of each independent variable and its contemporaneous measure at k = 0. The values in each column show the cumulative values of estimated coefficients of all lagged variables ($\Sigma_{k=0}^{3}\beta_{1k}$), and two-way clustered robust standard errors at the bank- and quarter-level are presented in parentheses. For the other control variables, we included liquidity ratio, capital ratio, log of total assets, and FDI inflow. However, we only reported the variables of our interest in this table. The sample period spanned from 2013Q1 to 2019Q2. Z(i, *t*-1) represent the measure of foreign funding exposure. In columns 1–3, the ratio of non-resident liabilities to total liabilities are adopted as Z(i, *t*-1). In columns 4–6, the ratio of other liabilities to total liabilities are adopted as Z(i, *t*-1). I(t) represents the treatment dummy which takes one if Z(i, *t*-1) is

not zero. US policy (t) represents the US federal fund rate, and OF Policy (t, j) represents the monetary policy rate in the home countries of the major shareholders of each bank.

Table 5
Summary Statistics of Interest Rates on Newly Disbursed Loans.

	Mean	Standard Errors	Observations
Interest rates on newly disbursed loans			
Business	10.67	5.38	2842
Consumer	10.16	5.50	2222
Short-term	10.34	6.09	2131
Long Term	10.02	4.72	3518
Local Currency	16.50	7.97	845
USD	9.03	3.64	4804
Unsecured	10.98	6.69	1001
Secured	10.31	5.08	4063
All Loans	10.44	5.44	5064

Note: This table presents the summary statistics of interest rates on newly disbursed loans by loan types. Interest rates are averaged each quarter.

loan characteristic dummies, to capture the distributional effect of foreign monetary policy across different types of loans. In columns 3 and 6, we included country-period fixed effects to take into account the time-variant effect relating to the shareholders' home country for the robustness check of the results. Even though we include the capital inflows from shareholders' countries, there could still be variable biases, such as changes in trade volumes and other macroeconomic variables within those countries. As a result, we find that statistical significance becomes smaller overall in coefficients relating to US monetary policy and monetary policy in shareholders' home countries in the model with the ratio of non-resident liabilities as the proxy of exposure. However, the model with the ratio of other foreign liabilities as the proxy of exposure shows a robust result even when we include the county-period fixed effect (column 7).

The significance of other foreign monetary policy is weak in most relevant variables. In columns 4 and 8, we only included the interactions of treatment dummies and other foreign monetary policy. However, in column 8 we find that the interaction of treatment dummies, exposure, and other foreign monetary policy ($I_i \cdot Z_{i,t-k-1} \cdot OF\ Policy_{j,t-k}$) is negative at 10% statistical significance, and the significance disappears once US monetary policy variables are included in other specifications. In column 2, the quadruple-interaction with a long-term loan dummy ($I_i \cdot Z_{i,t-k-1} \cdot OF\ Policy_{t-k} \cdot Long\ Term\ Dummy_c$) is positive but statistically significant at the 10% level. Columns 6, 7, and 8 show that the triple-interaction with the USD loan dummy ($I_i \cdot OF\ Policy_{t-k} \cdot USDDummy_c$) is positive at 5%, 10%, and 1% statistical significance, respectively. However, the point estimation of this coefficient was weaker than the one for US monetary policy.

Therefore, there is no strong evidence on the effect of monetary policy of majority shareholders' home countries across different specifications in Table 4. These results are different from De Haas and Lelyveld (2006, 2010) who found that the monetary shocks within the home countries of multinational banks affects the performance of local subsidiaries. However, their study did not consider the impact of US monetary policy rate as it could also be associated with the home countries' monetary conditions. Thus, the omitted variable could lead to this difference in the results of statistical analysis. Apart from the variables in consideration, the present study also includes domestic banks in the sample, and its focus is on foreign funding exposure as the channel of spillover. Thus, the difference in the result might be that the impact of monetary policy is different depending on the channel of the monetary policy spillover.

5. Impact on the lending rates of commercial banks

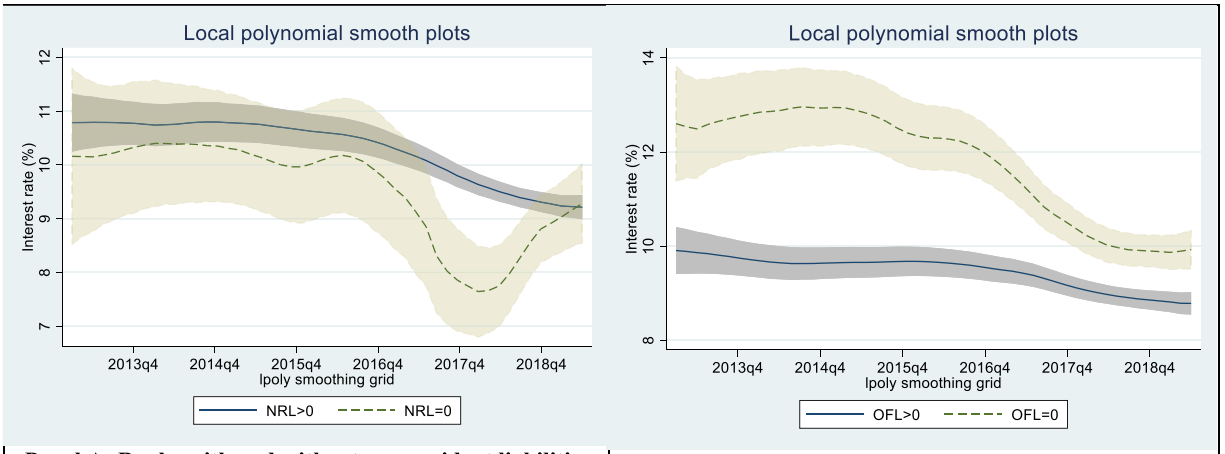
In the previous section, our empirical analysis provided evidence that Cambodian banks with foreign exposure slowed their overall lending activity after the US monetary policy rate increased and rebalanced their portfolio towards lower risk loans. However, a bank can also pass on the increase in funding costs to its customers, while keeping its net interest margin constant. In the literature of monetary policy and bank lending, Abuka et al. (2019) find that tightening of domestic monetary policy affected bank lending. Their study used loan registry data from Uganda and found that increases in interbank market rates lead to increases in lending rate of commercial banks.

For investigating the impact of US monetary policy on the interest rates on new loans, we further estimate the following Eqs. (5 and 6), respectively:

$$\begin{aligned} ln(Interest\quad Rate_{i,s,c,m,b,t}) = {} & \alpha + \Sigma_{k=0}^{3}\beta_k I_i \cdot US\quad Policy_{t-k} + \rho_k BankControl_{i,t-k-1} + \Sigma_{k=0}^{3}\varphi_k FDI\quad Inflow_{j,t-k} \\ & + f_{i,s,c,m,b} + \psi_{s,t} + \psi_{c,t} + \psi_{m,t} + \psi_{b,t} + u_{i,s,c,m,b,t} \end{aligned} \tag{5}$$

$$\begin{aligned} ln(Interest\quad Rate_{i,s,c,m,b,t}) = {} & \alpha + \Sigma_{k=0}^{3}\beta_{1k}\quad I_i \cdot US\quad Policy_{t-k} + \Sigma_{k=0}^{3}\beta_{2k}\quad I_i \cdot Z_{i,t-k-1} \cdot US\quad Policy_{t-k} + \Sigma_{k=0}^{3}\beta_{3k}\quad I_i \cdot Z_{i,t-k-1} \\ & + \rho_k BankControl_{i,t-k-1} + \Sigma_{k=0}^{3}\varphi_k FDI\quad Inflow_{j,t-k} + f_{i,s,c,m,b} + \psi_{s,t} + \psi_{c,t} + \psi_{m,t} + \psi_{b,t} + u_{i,s,c,m,b,t} \end{aligned} \tag{6}$$

In Eqs. (5 and 6), we simply replace the dependent variable of Eqs. (1 and 3) for interest rates on each loan category. Thus, the definition of each variable and parameters are the same as in Eqs. (1 and 3). For the data on interest rates, we use the average interest



Panel A: Banks with and without non-resident liabilities

Note: The figure shows the fitted line by polynomial regression for interest rates of banks with non-resident liabilities (NRL>0) and banks without non-resident liabilities (NRL=0).

Panel B: Banks with and without foreign wholesale borrowing

Note: The figure shows the fitted line by polynomial regression for interest rates of banks with foreign wholesale borrowing (OFL>0) and banks without foreign wholesale borrowing (OFL=0).

Fig. 8. Parallel trends in lending rate between banks with and without foreign exposure.

rates on newly disbursed loans for each quarter. Table 5 presents the summary statistics of data of average interest rates on newly disbursed loans by loan categories.

To check the parallel trend between banks with and without foreign exposure, we estimate the trend interest rates using polynomial regression as in Fig. 8. In both definitions of foreign exposure, there are similar trends before the US monetary policy rate increased between banks with and without foreign exposure. In the meantime, banks without foreign exposure reduced interest rates on average after the US monetary policy rate increased, while the interest rates of banks with foreign exposure remained stable. This implies that banks with foreign exposure had difficulty in reducing the interest rates on loans, possibly due to increases in funding costs.

Table 6 presents the estimation results using Eq. (5). The column (1)-(2) show that the interaction term of the treatment dummy and the US monetary policy rate was positive and statistically significant at 1%. The results suggest that increases in the US monetary policy rate have led to increases in interest rates on domestic bank lending through the banks with foreign exposure. In the estimation using the amount of newly disbursed loans as a dependent variable (Table 3), the coefficients of those loans were negative. Thus, these results suggest that banks with foreign exposure decreased lending by charging a higher interest rate.

However, the estimated coefficients are smaller than the estimation results with the amount of newly disbursed loans (Table 3). In addition, the results are not robust as in the other specifications. There was no statistical significance for example in the estimation with the ratio of foreign wholesale borrowing as foreign exposure (Column 5–6). In Columns 4 and 8, the triple-interaction term of the treatment dummy, foreign exposure, and US monetary policy were estimated as negative, which is inconsistent with our prediction.

Generally, increases in funding costs push up the lending rate as found in Abuka et al. (2019). However, our results suggest that the increases in funding costs do not push up the lending rate for Cambodian banks, implying that they might have not significantly passed the loss onto their borrowers by raising rates. One of the possible interpretations is that the price elasticity of demands for loans is high in the case of Cambodia, so that increasing the lending rate could lead to a significant reduction in the demand for loans. Or since the impact of US monetary policy was smaller for banks without foreign exposure, those banks do not have an incentive to raise interest rates. Thus, banks with foreign exposure cannot easily raise their interest rates due to the competition they face.

6. Robustness check of the impact of US monetary policy on cambodian bank lending

6.1. Other possible channels of US monetary policy spillover

Robustness is examined with regard to other possible channels of spillover of foreign monetary policy. Prior studies have examined the effect of monetary policy spillover using the interactions of the monetary policy rate with the capital ratio and liquidity ratio (Peek & Rosengren, 2000; Baskaya et al., 2017; Temesvary et al., 2018). Following these studies, we include the interaction terms between the monetary policy stance rate in the US and other foreign countries and $BankControls_{i,t-1}$ as follows. Banks with liquidity constraints are likely to be affected by increases in the cost of funding. Thus, the interaction between the liquidity ratio and US monetary policy rate is estimated to be positive. Likewise, since less capitalized banks are likely to be affected by the increase in the cost of funding, the interaction between the capital ratio and the US monetary policy rate is also estimated to be positive. If there is heterogeneity in the effects of foreign monetary policy across different levels of liquidity ratios and capitalization, interaction terms between these variables

Table 6
Estimation of Impact of US Monetay Policy on Interest Rates of Newly Disbursed Loans.

Log. Interenst rate	Z: Ratio Non-Resident Liabilities to Total Liabilities				Z: Ratio of Foreign Wholesale Borrowing to Total Liabilities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Σ I (i) x US Policy (t)	0.212 * **	0.205 * **	-0.461	-0.373	0.022	-0.005	0.087	0.212 *
	(0.085)	(0.086)	(0.435)	(0.440)	(0.043)	(0.036)	(0.136)	(0.117)
Σ I (i) x Z (i, t-1) x US Policy (t)		0.065		-0.656 * *		0.197		-0.726 * **
		(0.125)		(0.301)		(0.137)		(0.258)
Σ I (i) x Z (i, t-1)	-0.085	-0.128	-0.071	-0.127	-0.080	-0.198	-0.083	-0.218
	(0.119)	(0.190)	(0.119)	(0.185)	(0.122)	(0.207)	(0.118)	(0.211)
Σ I (i) x US Policy (t) x Collateral Dummy			-0.089	-0.126			-0.175	-0.276 * **
			(0.220)	(0.236)			(0.120)	(0.112)
Σ I (i) x US Policy (t) x USD Dummy			0.24	0.206			0.033	-0.013
			(0.482)	(0.501)			(0.042)	(0.042)
Σ I (i) x US Policy (t) x Long-term Dummy			0.003	-0.04			0.034	-0.013
			(0.138)	(0.132)			(0.052)	(0.036)
Σ I (i) x US Policy (t) x Business Dummy			0.434 *	0.416 *			0.050	0.046
			(0.239)	(0.252)			(0.080)	(0.078)
Σ I (i) x Z (i, t-1) x US Policy (t) x Collateral Dummy				0.215				0.572 * **
				(0.324)				(0.206)
Σ I (i) x Z (i, t-1) x US Policy (t) x USD Dummy				0.272				0.164
				(0.170)				(0.154)
Σ I (i) x Z (i, t-1) x US Policy (t) x Long-term Dummy				0.367 * *				0.416 * **
				(0.168)				(0.192)
Σ I (i) x Z (i, t-1) x US Policy (t) x Business Dummy				0.158				-0.009
				(0.231)				(0.151)
Other Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Currency Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Sector Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Maturity Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time- Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Sector-Currency-Maturity-Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	4.961	5.023	5.273	5.298	4.566	4.445	4.523	4.397
	(0.787)	(0.822)	(0.794)	(0.843)	(1.144)	(1.199)	(1.034)	(1.104)
Number of Obseravations	4169	4169	4169	4169	4112	4112	4112	4112
Adjusted R-squared	0.558	0.558	0.56	0.563	0.556	0.557	0.559	0.562

Note: Two-way cluster robust standard errros at quarter leve and at firm level.
Note: * ** ,* *, and * represent statistical significance at 1%, 5%, and 10%, respectively. The fixed-effect OLS estimation is used for each column. To capture the effects over one year, each model included 3 lags of each independent variable and its contemporaneous measure at k = 0. The values in each column show the cumulative values of estimated coefficients of all lagged variables ($\Sigma_{k=0}^{3}\beta_{1k}$), and two-way clustered robust standard errors at the bank- and quarter-level are presented in parentheses. For the other control variables, we included liquidity ratio, capital ratio, log of total assets, and FDI inflow. However, we only reported the variables of our interest in this table. The sample period spanned from 2013Q1 to 2019Q2. Z(i, *t*-1) represents the measure of foreign funding exposure. In columns 1–3, the ratio of non-resident liabilities to total liabilities are adopted as Z(i, *t*-1). In columns 4–6, the ratio of other liabilities to total liabilities are adopted as Z(i, *t*-1). I(t) represents the treatment dummy which takes one if Z(i, *t*-1) is not zero. US policy (t) represents the US federal fund rate, and OF Policy (t, j) represents the monetary policy rate in the home countries of the major shareholders of each bank.

and monetary policy are estimated as positive when statistically significant.

In Table 5, we estimate the other specifications. A regression with a fixed-effect OLS estimation is run. To capture the effects over one year, each model included 3 lags of each independent variable and its contemporaneous measure at k = 0. The two-way clustered robust standard errors both at the bank- and quarter-level are applied in the estimation. The cumulative effects of all lagged variables are presented in the table. In columns 1 and 5, we estimate the model including US monetary policy spillover with potential channels of liquidity ratio and capitalization. In columns 2 and 6, we estimate the model including both US and other foreign monetary policy spillover through the potential channels of liquidity ratio and capitalization. The results relevant to the exposure to foreign funding and US monetary policy ($I_i \cdot US\ Policy_{t-k}$ and $I_i \cdot Z_{i,t-k-1} \cdot US\ Policy_{t-k}$) did not change from Table 3 and Table 4, thus the robust result is that US monetary policy is transmitted through the foreign funding channel.

In the meantime, the coefficients of liquidity ratio and capitalization measures are estimated in opposite signs than we predicted in columns 1 and 2 and were not statistically significant as shown in columns 4 and 5. The results suggest that bank capitalization and a liquidity buffer do not necessarily mitigate the impact of changes in the cost of foreign funding on bank domestic lending.

In columns 3 and 7, we examined the models without Cambodian-owned banks. In columns 4 and 8, we estimated the models with the Cambodian ownership dummy to examine the difference in the effect of US monetary policy between Cambodian-owned banks (6 banks) and foreign-owned banks. Firstly, when we exclude the Cambodian banks (columns 3 and 7), statistical significance disappears

Table 7
Robustness Checks with Other Specifications.

	Z: Ratio Non-Resident Liabilities to Total Liabilities				Z: Ratio of Foreign Wholesale Borrowing to Total Liabilities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Σ I (i) x US Policy (t)	-0.819 * *	-0.451	0.036	-0.613 * *	-0.547 *	-0.529	0.085	-0.567 * *
	(0.387)	(0.408)	(0.507)	(0.260)	(0.311)	(0.444)	(0.431)	(0.263)
Σ I (i) x Z (i, t-1) x US Policy (t)	-0.811	-1.040 * *	0.199	0.110	-1.428 * *	-1.584 * **	-0.566	-0.703
	(0.548)	(0.513)	(0.542)	(0.527)	(0.683)	(0.651)	(0.616)	(0.599)
Σ I (i) x OF Policy (t)		-0.338	-0.379	0.057		-0.175	-0.400	0.038
		(0.208)	(0.449)	(0.181)		(0.217)	(0.380)	(0.143)
Σ I (i) x Z (i, t-1) x OF Policy (t)		-0.019	-0.329	-0.459		0.085	-0.175	-0.288
		(0.637)	(0.733)	(0.679)		(0.493)	(0.522)	(0.478)
Σ I (i) x Z (i, t-1)	-6.183	-0.441	-0.461	-0.601	-0.184	-0.123	-0.082	-0.199
	(5.689)	(0.511)	(0.747)	(0.647)	(0.536)	(0.458)	(0.601)	(0.514)
Σ Liquidity Ratio (i, t-1) x US Policy (t)	-0.910 * **	-1.286 * **			-0.243	-0.432		-8.748 * **
	(0.321)	(0.291)			(0.355)	(0.424)		(0.960)
Σ Capital Ratio (i, t-1) x US Policy (t)	-0.298	-0.819			-0.074	-0.767		0.483 * **
	(0.302)	(0.524)			(0.269)	(0.630)		(0.192)
Σ Liquidity Ratio (i, t-1) x OF Policy (t)		0.395				-0.078		
		(0.538)				(0.608)		
Σ Liquidity Ratio (i, t-1) x OF Policy (t)		0.532				0.596		
		(0.390)				(0.499)		
Σ I (i) x US Policy (t) x Cambodia Dummy				0.704 * **				0.483 * **
				(0.243)				(0.192)
Σ Z (i, t-1) x US Policy (t) x Cambodia Dummy				-8.632 * **				-8.748 * **
				(1.849)				(0.960)
Other Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Currency Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Sector Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Maturity Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time- Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Sector-Currency-Maturity-Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-6.386	-6.737	0.158	-3.779	-4.349	-3.969	1.244	-1.144
	(5.089)	(5.458)	(3.644)	(3.990)	(4.710)	(5.182)	(3.481)	(3.764)
Number of Obseravations	3959	3959	2878	3959	3902	3902	2821	3902
Number of Banks	40	40	40	40	40	40	32	40
Adjusted R-squared	0.793	0.794	0.750	0.796	0.797	0.797	0.754	0.801

Note: * ** ,* *, and * represent statistical significance at 1%, 5%, and 10%, respectively. The fixed-effect OLS estimation is used for each column. To capture the effects over one year, each model included 3 lags of each independent variables and its contemporaneous measure at k = 0. The values in each column show the cumulative values of estimated coefficients of all lagged variables ($\Sigma_{k=0}^{3}\beta_{1k}$), and two-way clustered robust standard errors at the bank- and quarter-level are presented in parentheses. For the other control variables, we included liquidity ratio, capital ratio, log of total assets, and FDI inflow. However, we only reported the variables of our interest in this table. The sample period spanned from 2013Q1 to 2019Q2. Z(i, *t*-1) represent the measure of foreign funding exposure. In columns 1–4, the ratio of non-resident liabilities to total liabilities are adopted as Z(i, *t*-1). In columns 5–8, the ratio of other liabilities to total liabilities are adopted as Z(i, *t*-1). I(t) represents the treatment dummy which takes one if Z(i, *t*-1) is not zero. US policy (t) represents the US federal fund rate, and OF Policy (t, j) represents the monetary policy rate in the home countries of the major shareholders of each bank.

in the variable relevant to US monetary policy spillover. This suggests that Cambodian-owned banks might have driven the results in previous estimations, or that the reduction in the sample size contributed to the insignificance in the results. In fact, since some Cambodian-owned banks also have a large extent of exposure to foreign funding, and Cambodian-owned banks existed throughout the period of our analysis, the exclusion of these banks did lead to a large reduction in sample size.

Secondly, when we include the interaction terms of the Cambodian ownership dummy with variables relevant to US monetary policy spillover (columns 4 and 8), we find that the statistical significance in the interaction terms of the treatment dummy and US monetary policy $I_i \cdot US\ Policy_{t-k}$ remains, meaning that the spillover effect of monetary policy is still found in non-Cambodian-owned banks. In the meantime, the quadruple-interaction with the Cambodian-ownership dummy ($I_i \cdot Z_{i,t-k-1} \cdot US\ Policy_{t-k} \cdot CambodianDummy$) is estimated as negative (1% statistical significance) in both columns 4 and 8. This suggests that the Cambodian owned banks have a larger negative impact from the increase in US monetary policy compared to the foreign-owned banks with the same level of exposure to foreign funding. Furthermore, the magnitude of the coefficient is − 8.563 in column 4 and − 10.482 in column 8, suggesting that the Cambodian-owned banks with a higher dependency on foreign funding decreased their provision of loans by approximately − 8.563% (−10.482%) more than foreign-owned banks with the same level of dependency on foreign funding when the US monetary policy rate changed by 1%. The analysis reveals that banks with Cambodian ownership and a higher dependence on foreign funding are particularly prone to a decline in lending when the cost of foreign funding increases. These results imply that local banks have a disadvantage in access to the capital market, which is particularly serious when US monetary policy tightens.

Table 8
Robustness Check with Other Variables of Channel of International Monetary Policy Spillover.

	Z: Ratio of Non-Resident Deposit to Liabilities		Z: Ratio of FX Deposit to Liabilities	
	(1)	(2)	(3)	(4)
Σ I (i) x US Policy (t)	-0.257	-0.117		
	(0.263)	(0.516)		
Σ I (i) x Z (i, t-1) x US Policy (t)	0.814	11.268 * *	-0.045	0.642
	(1.392)	(5.176)	(0.303)	(1.131)
Σ I (i) x Z (i, t-1)	0.254	0.304	-0.150	-0.015
	(1.124)	(1.146)	(0.648)	(0.599)
Σ Liquidity Ratio (i, t-1)	-0.717	-0.739	-0.788	-0.803
Σ I (i) x US MP (t) x Collateral Dummy		0.667		
		(0.413)		
Σ I (i) x US MP (t) x USD Dummy		-1.041 * *		
		(0.417)		
Σ I (i) x US MP (t) x Long-term Dummy		0.627 * *		
		(0.244)		
Σ I (i) x US MP (t) x Business Dummy		0.047		
		(0.247)		
Σ I (i) x Z (i, t-1) x US Policy (t) x Collateral Dummy		0.293		-0.556
		(3.060)		(0.963)
Σ I (i) x Z (i, t-1) x US Policy (t) x USD Dummy		-8.930 * *		-0.301
		(4.135)		(0.754)
Σ I (i) x Z (i, t-1) x US Policy (t) x Long-term Dummy		-3.64388		-0.233
		(1.928)		(0.660)
Σ I (i) x Z (i, t-1) x US Policy (t) x Business Dummy		1.276		0.536
		(2.505)		(0.686)
Other Control Variables	Yes	Yes	Yes	Yes
Time-Currency Fixed Effect	Yes	Yes	Yes	Yes
Time-Sector Fixed Effect	Yes	Yes	Yes	Yes
Time-Maturity Fixed Effect	Yes	Yes	Yes	Yes
Time- Security Fixed Effect	Yes	Yes	Yes	Yes
Bank-Sector-Currency-Maturity-Security Fixed Effect	Yes	Yes	Yes	Yes
Constant	-5.182	-6.138	-3.833	-4.024
	(3.280)	(2.981)	(4.042)	(3.684)
Number of Obseravations	4119	4119	4139	4139
Adjusted R-squared	0.794	0.797	0.793	0.794

Note: * ** ,* *, and * represent statistical significance at 1%, 5%, and 10%, respectively. The fixed-effect OLS estimation is used for each column. To capture the effects over one year, each model included 3 lags of each independent variable and its contemporaneous measure at k = 0. The values in each column show the cumulative values of estimated coefficients of all lagged variables ($\Sigma_{k=0}^{3}\beta_{1k}$), and two-way clustered robust standard errors at the bank- and quarter-level are presented in parentheses. For the other control variables, we included liquidity ratio, capital ratio, log of total assets, and FDI inflow. However, we only reported the variables of our interest in this table. The sample period spanned from 2013Q1 to 2019Q2. Z(i, *t*-1) represents the measure of foreign funding exposure. In columns 1–4, the ratio of non-resident deposits to total liabilities are adopted as Z(i, *t*-1). In columns 5–8, the ratio of FX deposits to total liabilities are adopted as Z(i, *t*-1). I(t) represents the treatment dummy which takes one if Z(i, *t*-1) is not zero. US policy (t) represents the US federal fund rate.

In Tables 6 and 7, we carry out further additional robustness checks. Specifically, we replaced the measures of foreign funding exposure for other potential channels of international monetary spillover. In columns 1–4, we included the ratio of non-resident deposits to total liabilities. In columns 5–8, we included the ratio of FX deposits to total liabilities. Likewise, we run a regression with fixed-effect OLS estimation for each specification, and each model included 3 lags of each independent variable and its contemporaneous measure at k = 0. Two-way clustered robust standard errors at the bank- and quarter-level are applied in the estimation. The cumulative effects of all the lagged variables are presented in the table.

Regarding the ratio of non-resident deposits to total liabilities, the coefficients of interaction with US monetary policy are not significant as shown in columns 5 or 6. Although it is statistically significant, the coefficient is estimated in the opposite directions in columns 7 and 8. Even when we look at the distributional effects of US monetary policy and other foreign monetary policy in loan characteristics, the estimated coefficients are mostly not significant. Again, although significant, the signs of the coefficients are opposite from the results of non-resident liabilities and other foreign liabilities shown in Table 4. These results suggest that international monetary policy spillover is likely to be channeled through wholesale funding from abroad rather than non-resident deposits. However, given that the coefficients relevant to US monetary policy were in a different direction from other foreign liabilities, the results might also imply that non-resident deposits could work to buffer the effect of US monetary policy changes.

Next, we examine the channel of FX deposits. In Cambodia, about 80% of FX deposits are denominated in USD. Mora (2013) documents that FX deposits are a channel of US monetary policy into Mexico by testing the interaction terms of the ratio of USD deposits and US monetary policy. However, as shown in Tables 6 and 7 this study finds that the coefficients of interactions of the ratio of FX deposits to total liabilities and US monetary policy are not statistically significant overall.

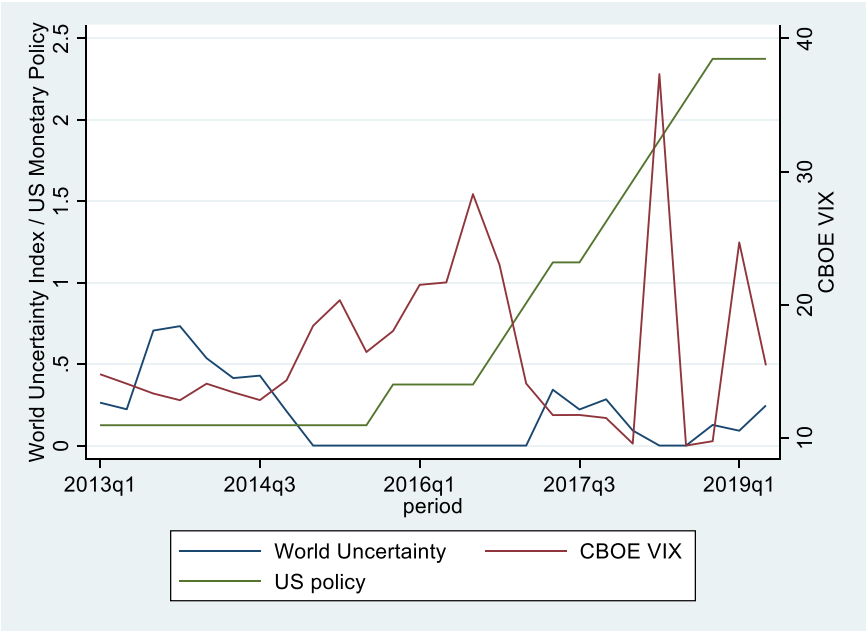


Fig 9. World Uncertainty Index for Cambodia and CBOE VIX.

All in all, our findings suggest that spillover of international monetary policy is likely to be channeled through wholesale funding from abroad rather than non-resident deposits or FX deposits. In other words, the effect of US monetary policy is likely to be transmitted from parent banks or associated banks in foreign countries.

6.2. *The shadow rate of US monetary policy*

We further tested the results with a shadow rate of US monetary policy instead of US monetary policy. The Federal fund rate was zero from 2008Q4 to 2015Q4 and lowering the interest rates to produce a stimulus was not an option during this period. In the meantime, the US Federal Fund Reserve conducted unconventional policy measures, such as large scale asset purchase programs, to influence the economy. Thus, the monetary policy rate itself does not represent the US monetary policy stance during this period. In the zero-lower bound environments, a shadow rate model is developed to quantify the monetary policy stance. The shadow rate of US monetary policy is publicly presented by the Board of Governors of the Federal Reserve System, based on Wu and Xia (2016).[28] We present the results of estimation with the shadow rate in Table 8. The results of the estimation are similar to the previous estimation with the nominal US monetary policy rate. Particularly, the coefficient of the interaction term of the shadow rate and treatment dummy ($I_i \cdot Z_{i,t-k-1} \cdot USPolicy_{t-k}$) was negative (statistically significant) in columns 1 and 5. This suggests that the changes in shadow rates were also associated with lending by banks with foreign funding exposure. This result supports our hypothesis that the US monetary policy is transmitted to bank lending in a developing country.

However, the estimated coefficients are smaller than the previous estimation results, and the statistical significance is also smaller overall. Therefore, the results might suggest that the nominal rate of monetary policy might be important to predict the significance of US monetary policy spillover to Cambodia. The difference between nominal US monetary policy rate and the shadow rate is that the shadow rate takes negative values during the zero-lower bound period. Thus, the difference in the estimation results suggest that bank lending in Cambodia is not strongly correlated to the monetary policy stance during the zero-lower bound period. Our result does not necessarily deny the association of the monetary policy stance during the zero-lower bound period however, it might reflect the possibility that a different form of intervention by the Federal Reserve could have a different channel to impact bank behavior in foreign countries.

6.3. *Controlling for other macroeconomic variables*

Lastly, we tested the robustness of our model with other macroeconomic factors. Specifically, we included the World Uncertainty Index for Cambodia constructed by Ahir et al. (2018). As is common in developing countries, the Cambodian banking sector is sensitive to political instability. For example, the Cambodian banking sector experienced 10% deposit withdrawals during the period of time around the national election in 2013, although most of the withdrawn money came back to the banking sector in a couple of months

[28] We obtained the data of shadow rate from the website, https://www.atlantafed.org/cqer/research/wu-xia-shadow-federal-funds-rate.

(Hor, 2014). Thus, there is the possibility that the political instability might have affected domestic lending and contaminated our estimation results. To check the robustness against this possibility, we further tested a model including the variable of the World Uncertainty Index for Cambodia.

Apart from US monetary policy, there are other international macroeconomic variables which may directly or indirectly influence the lending decisions of banks in Cambodia. We controlled for changes in global confidence using CBOE VIX index as a proxy variable.[29] For instance, the 'Taper Tantrum' episode in the summer of 2013 caused a major turmoil across emerging market economies (Naiborhu, 2020).

Fig. 9 presents the World Uncertainty Index (WUI) for Cambodian, CBOE VIX, and US monetary policy rates, respectively. During the period of this study, those macroeconomic variables moved differently compared with US monetary policy. The correlation between US monetary policy and CBOE VIX was 0.014, and the correlation between CBOE VIX and US monetary policy rate was − 0.26. Thus, the contamination by those global factors may not be strong. However, to test robustness, the regression included interaction terms of the treatment dummy and international and domestic macroeconomic variables such as WUI and VIX. The results are presented in Table 9.

Overall, we confirmed the robustness in our results. Although the statistical significance became smaller, we found that there is negative sign in the coefficient of the interaction terms of the treatment dummy and US monetary policy and the triple-interaction terms of treatment dummy, foreign exposure, and US monetary policy (Columns 2–7). The statistical significance in the results of Columns 1 and 8 are relatively small. One explanation for this small significance is the increase in explanatory variables.(Tables 10 and 11)

7. Conclusions and policy implications

Globalization in the banking sector and an increase in foreign funding flows increases the likelihood of financial contagion and vulnerability to external shocks within the banking sector. In particular, US monetary policy plays a role in increasing or decreasing the cost of foreign funding through international capital markets, which are sometimes dominant funding sources for banks in developing countries.

In our study, we investigated the spillover effect of the US monetary policy and monetary policy of the home countries of the bank's major shareholders into Cambodian commercial banks through the channel of non-resident funds. Specifically, we exploit unique data that allow us to measure the amounts of individual bank's exposure to changes in foreign funding, and to investigate in detail the amounts of newly disbursed loans by loan characteristics on a quarterly basis. This paper provides empirical evidence that US monetary policy is transmitted through non-resident funds into bank domestic lending in Cambodia, and the funding from foreign banks, such as parent banks and associated banks, is a particularly important channel. Furthermore, we found that US monetary policy also affected the allocations of domestic bank loans. Specifically, local currency loans, unsecured loans, short-term loans, and business loans reacted more strongly to the increases in the cost of funding from abroad. This suggests that foreign monetary policy has led Cambodian banks to shift loan allocations to lower risk sectors and clients. We also find that the monetary policies of the home countries of the banks' major shareholders are not strongly associated with Cambodian bank domestic lending compared to US monetary policy, although there was a similar distributional effect from US monetary policy between local currency loans and USD loans.

The Cambodian financial sector is still underdeveloped and is also vulnerable to global economic conditions and political shocks, and the capacity to serve as the lender of last resort is limited due to dollarization, while non-resident liabilities have come to a comprise substantial share of the banking sector over the last decade. As our study suggests, the impact of global financial conditions, especially the US monetary policy, could be a factor of vulnerability for the banking sector. A central bank may consider adjusting the reserve requirement ratio (RRR) in foreign borrowing as a tool to control credit growth against a change in global market conditions. In the current practice, the RRR is usually set to the same rate as domestic foreign deposits but differentiating the RRR for foreign funding to control the funding inflows is also a possible strategy for the central bank. In addition, it may be worth noting that diversifying the ownership of foreign affiliation might be one strategy to stabilize the financial sector. This is not only needed to permit banks to collect funds from abroad, but also to make them commit to the aggressive collection of domestic funds. In the case of Cambodia, bank ownership is biased to neighboring countries, some of which are still developing countries, with financial systems and economies vulnerable to shocks. In addition, most commercial banks are strongly dependent on funding from abroad. Further diversification of bank ownership and a commitment from foreign banks to collect domestic funds is necessary.

From the policy-making point of view in a partially dollarized economy, a better understanding of the international monetary policy spillover is important to properly control the supply of local and foreign currencies through banks. In the literature of partial dollarization, Ongena et al. (2017) find that foreign currency lending is less likely to be affected by domestic monetary policy in a partially dollarized economy, and that foreign monetary policy has an impact on foreign currency lending. In the case of Cambodia, more than 90% of bank lending is in USD as of 2019. Thus, the domestic monetary policy is less likely to affect the bank supply. However, our study revealed that the effect of foreign monetary policy is likely to be channeled through exposure to foreign funding, rather than USD deposit per se. This indicates that banks in Cambodia could mitigate the effect of foreign monetary policy by collecting domestic funds, and governments could be required to support that funding through deposits for those banks.

[29] The global factors can have a contemporaneous or lagged impact on the banking sector in a developing economy. Our model also considered this global factor by taking three lags of each explanatory variable in the model.

Table 9
Robustness Check with Other Variable of Channel of International Monetary Policy Spillover.

	Z: Ratio of Non-Resident Deposit to Liabilities				Z: Ratio of FX Deposit to Liabilities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Σ I (i) x US Policy (t)	-0.257	-0.117	-0.321	-0.216				
	(0.263)	(0.516)	(0.340)	(0.667)				
Σ I (i) x Z (i, t-1) x US Policy (t)	0.814	11.268 * *	0.408	16.440 * **	-0.045	0.642	0.004	0.780
	(1.392)	(5.176)	(1.780)	(4.485)	(0.303)	(1.131)	(0.435)	(1.205)
Σ I (i) x OF Policy (t)			-0.001	(0.027)				
			(0.151)	(0.745)				
Σ I (i) x Z (i, t-1) x OF Policy (t)			0.566	1.989			-0.002	-0.024
			(1.276)	(5.604)			(0.210)	(0.367)
Σ I (i) x Z (i, t-1)	0.254	0.304	0.759	0.356	-0.150	-0.015	-0.457	-0.189
	(1.124)	(1.146)	(1.624)	(1.914)	(0.648)	(0.599)	(0.686)	(0.643)
Σ Liquidity Ratio (i, t-1)	-0.717	-0.739	-0.691	-0.931	-0.788	-0.803	-0.775	-1.016
Σ OF Policy (j, t)	-0.005	-0.005	-0.004	-0.004	-0.004	-0.004	-0.003	-0.003
	(0.004)	(0.004)	(0.005)	(0.005)	(0.003)	(0.003)	(0.004)	(0.004)
Σ I (i) x US Policy (t) x Collateral Dummy		0.667		0.824 *				
		(0.413)		(0.434)				
Σ I (i) x US Policy (t) x USD Dummy		-1.041 * *		-1.290 * **				
		(0.417)		(0.428)				
Σ I (i) x US Policy (t) x Long-term Dummy		0.627 * *		0.565 * *				
		(0.244)		(0.287)				
Σ I (i) x US Policy (t) x Business Dummy		0.047		0.299				
		(0.247)		(0.329)				
Σ I (i) x Z (i, t-1) x US Policy (t) x Collateral Dummy		0.293		-0.871		-0.556		-0.855
		(3.060)		(1.427)		0.963		(1.023)
Σ I (i) x Z (i, t-1) x US Policy (t) x USD Dummy		-8.930 * *		-12.515 * **		-0.301		-0.392
		(4.135)		(4.148)		0.754		(0.833)
Σ I (i) x Z (i, t-1) x US Policy (t) x Long-term Dummy		-3.643 * *		-3.525		-0.233		-0.170
		(1.928)		(2.110)		0.660		(0.862)
Σ I (i) x Z (i, t-1) x US Policy (t) x Business Dummy		1.276		-0.052		0.536		1.215
		(2.505)		(2.495)		0.686		(0.853)
Σ I (i) x OF Policy (t) x Collateral Dummy				-0.014				
				(0.624)				
Σ I (i) x OF Policy (t) x USD Dummy				0.124				
				(0.347)				
Σ I (i) x OF Policy (t) x Long-term Dummy				-0.030				
				(0.267)				
Σ I (i) x OF Policy (t) x Business Dummy				-0.339				
				(0.251)				
Σ I (i) x Z (i, t-1) x OF Policy (t) x Collateral Dummy				-5.338				-0.822 *
				(5.142)				(0.442)
Σ I (i) x Z (i, t-1) x OF Policy (t) x USD Dummy				1.589				0.819 * *
				(1.873)				(0.373)
Σ I (i) x Z (i, t-1) x OF Policy (t) x Long-term Dummy				1.586				0.206
				(1.709)				(0.434)
Σ I (i) x Z (i, t-1) x OF Policy (t) x Business Dummy				1.714				-0.481
				(2.067)				(0.305)
	Z: Ratio of Non-Resident Deposit to Liabilities				Z: Ratio of FX Deposit to Liabilities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Time-Currency Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Sector Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Maturity Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time- Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Sector-Currency-Maturity-Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-5.182	-6.138	-3.796	-5.914	-3.833	-4.024	-1.376	-4.033
	(3.280)	(2.981)	(4.785)	(4.771)	(4.042)	(3.684)	(4.993)	(4.641)
Number of Obseravations	4119	4119	3902	3902	4139	4139	3922	3922
R-squared	0.794	0.797	0.794	0.798	0.793	0.794	0.793	0.796

Note: * ** ,* *, and * represent statistical significance at 1%, 5%, and 10%, respectively. The fixed-effect OLS estimation is used for each column. To capture the effects over one year, each model included 3 lags of each independent variable and its contemporaneous measure at k = 0. The values in each column show the cumulative values of estimated coefficients of all lagged variables ($\Sigma_{k=0}^{3}\beta_{1k}$), and two-way clustered robust standard errors at the bank- and quarter-level are presented in parentheses. For the other control variables, we included liquidity ratio, capital ratio, log of total assets, and FDI inflow. However, we only reported the variables of our interest in this table. The sample period spanned from 2013Q1 to 2019Q2. Z(i, *t*-1) represents the measure of foreign funding exposure. In columns 1–4, the ratio of non-resident deposits to total liabilities are adopted as Z(i, *t*-1). In columns 5–8, the ratio of FX deposits to total liabilities are adopted as Z(i, *t*-1). I(t) represents the treatment dummy which takes one if Z(i, *t*-1) is not zero. US policy (t) represents the US federal fund rate, and OF Policy (t, j) represents the monetary policy rate in the home countries of the major shareholders of each bank.

Table 10
Robustness Test with US Shadow Rate.

	Z: Ratio Non-Resident Liabilities to Total Liabilities				Z: Ratio of Foreign Wholesale Borrowing to Total Liabilities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Σ I (i) x Shadow Rate (t)	-0.186 * **	-0.177 * *	-0.279	-0.444 *	-0.192 * **	-0.153 *	-0.323	-0.287
	(0.064)	(0.090)	(0.238)	(0.232)	(0.063)	(0.084)	(0.231)	(0.215)
Σ I (i) x Z (i, t-1) x Shadow Rate (t)		0.002		-0.472		-0.135		-1.445
		(0.191)		(1.306)		(0.214)		(1.316)
Σ I (i) x Z (i, t-1)	-0.672	-0.592	-0.671	-0.559	-0.891 *	-0.754 * *	-0.895 *	-0.74 *
	(0.561)	(0.526)	(0.566)	(0.571)	(0.492)	(0.383)	(0.491)	(0.408)
Σ I (i) x Shadow Rate (t) x Collateral Dummy			0.149	0.238			0.195	0.228
			(0.140)	(0.200)			(0.140)	(0.217)
Σ I (i) x Shadow Rate (t) x USD Dummy			0.111	0.029			0.083	-0.089
			(0.271)	(0.262)			(0.274)	(0.295)
Σ I (i) x Shadow Rate (t) x Long-term Dummy			-0.046	0.091			-0.017	0.098
			(0.157)	(0.163)			(0.152)	(0.156)
Σ I (i) x Shadow Rate (t) x Business Dummy			-0.219 *	-0.075			-0.209 *	-0.118
			(0.124)	(0.143)			(0.127)	(0.151)
Σ I (i) x Z (i, t-1) x Shadow Rate (t) x Collateral Dummy				-0.239				-0.097
				(0.608)				(0.763)
Σ I (i) x Z (i, t-1) x Shadow Rate (t) x USD Dummy				1.631				2.183
				(1.257)				(1.370)
Σ I (i) x Z (i, t-1) x Shadow Rate (t) x Long-term Dummy				-0.725				-0.621
				(0.471)				(0.471)
Σ I (i) x Z (i, t-1) x Shadow Rate (t) x Business Dummy				-0.826 * **				-0.583
				(0.341)				(0.390)
Other Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Currency Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Sector Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Maturity Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time- Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Sector-Currency-Maturity-Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-5.49	-5.015	-6.673	-7.211	-4.927	-3.88	-6.205	-5.664
	(3.823)	(4.224)	(3.990)	(4.568)	(3.758)	(4.184)	(3.793)	(4.198)
Number of Obseravations	3959	3959	3959	3959	3902	3902	3902	3902
Number of Banks	40	40	40	40	40	40	40	40
Adjusted R-squared	0.793	0.793	0.793	0.795	0.796	0.796	0.796	0.798

Note: * ** ,* *, and * represent statistical significance at 1%, 5%, and 10%, respectively. The fixed-effect OLS estimation is used for each column. To capture the effects over one year, each model included 3 lags of each independent variable and its contemporaneous measure at k = 0. The values in each column show the cumulative values of estimated coefficients of all lagged variables ($\Sigma_{k=0}^{3}\beta_{1k}$), and two-way clustered robust standard errors at the bank- and quarter-level are presented in parentheses. For the other control variables, we included liquidity ratio, capital ratio, log of total assets, and FDI inflow. However, we only reported the variables of our interest in this table. The sample period spanned from 2013Q1 to 2019Q2. Z(i, *t*-1) represents the measure of foreign funding exposure. In columns 1–4, the ratio of non-resident deposits to total liabilities are adopted as Z(i, *t*-1). In columns 5–8, the ratio of FX deposits to total liabilities are adopted as Z(i, *t*-1). I(t) represents the treatment dummy which takes one if Z(i, *t*-1) is not zero. Shadow rate (t) represents the shadow rate US federal fund rate. The source of the shadow rate is the Board of Governors of the Federal Reserve System, and Wu and Xia (2016). OF Policy (t, j) represents the monetary policy rate in the home countries of the major shareholders of each bank.

Furthermore, our finding that the rising costs of funding from abroad leads to increases in USD lending has policy implications in the promotion of local currency in partially dollarized countries. Since collecting local currency deposits is usually costly in the sense that interest rates on local deposits are higher than USD deposits, the availability of cheaper foreign funds might affect lending in the local currency. In the case of Cambodia, banks can swap local currency with USD through a currency swap operation by the National Bank of Cambodia, which is called the "local currency collateralized provision operation." In this operation, banks can obtain local currency liquidity in exchange for USD liquidity as collateral. Increases in funding costs from abroad might decrease the banks' USD funds for this operation, and could lead to decreases in the supply of local currency via this route.

There are limitations to our analysis. Our study revealed that there were distributional effects from US monetary policy across types of loans, for example, between business loans and consumer loans. However, due to data limitations, it did not identify what types of firms and consumers were particularly affected by the policy. An increase in the cost of funding could have a larger impact on lending to SMEs since the costs of SME lending, such as monitoring costs, are relatively higher than lending to large firms. If this is the case, the distributional impact across firm sizes could affect the structure of an industry and have a long-term effect in the industry. Therefore, an investigation into this heterogeneity in the monetary policy effect among borrowers could have important implications from the perspectives of industrial organization and policymaking. Future study is required to investigate the distributional effects across borrowers in detail by employing granular data at the borrower-level.

Furthermore, since this study used samples from a single country over a period of 25 quarters, there could be limits in the control of

Table 11
Robustness Test with Other International and Domestic Macroeconomic Variables.

	Z: Ratio Non-Resident Liabilities to Total Liabilities				Z: Ratio of Foreign Wholesale Borrowing to Total Liabilities			
	Macro = WUI		Macro= VIX		Macro = WUI		Macro= VIX	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Σ I (i) x US Policy (t)	-0.307	-12.529 * **	-0.519 * *	-6.375 * *	-0.227	-0.436	-0.501 * **	-0.687
	(0.368)	(4.166)	(0.244)	(2.906)	(0.157)	(0.340)	(0.194)	(0.571)
Σ I (i) x Z (i, t-1) x US Policy (t)	-0.513	-1.156	-0.55	-1.714	-1.103 *	-4.679 *	-0.523	-3.415
	(0.616)	(2.714)	(0.537)	(2.190)	(0.669)	(2.698)	(0.641)	(2.657)
Σ I (i) x Macro (t)	-0.351	37.25 *	0.043 *	-0.251 * *	0.429	0.475	0.035 * **	0.021
	(0.815)	(6.298)	(0.024)	(0.098)	(0.476)	(1.480)	(0.015)	(0.049)
Σ I (i) x Z (i, t-1) x Macro (t)	1.427	5.506	-0.026	-0.083	0.275	1.111	-0.083	-0.300
	(1.012)	(6.333)	(0.055)	(0.236)	(1.583)	(4.659)	(0.060)	(0.313)
Σ I (i) x Z (i, t-1)	-0.586	-0.843	0.14	0.012	-0.317	-0.268	0.345	0.007
	(0.766)	(0.733)	(0.875)	(0.824)	(0.748)	(0.778)	(0.940)	(0.928)
Σ Liquidity Ratio (i, t-1)	-0.891	-0.535	-0.755	-0.663	-0.798	-0.86	-1.01	-1.069
Σ I (i) x US Policy (t) x Collateral Dummy		1.185		0.359		0.21	-6.219	0.318
		(0.712)		(0.767)		(0.294)	(3.799)	(0.368)
Σ I (i) x US Policy (t) x USD Dummy		13.056 * **		4.815 * **		-0.093	4119	-0.275
		(2.961)		(1.289)		(0.394)	(0.797)	(0.521)
Σ I (i) x US Policy (t) x Long-term Dummy		0.008		0.59		0.354		0.512
		(0.654)		(0.800)		(0.343)		(0.374)
Σ I (i) x US Policy (t) x Business Dummy		-1.615		0.578		-0.288		-0.465 *
		(1.397)		(2.250)		(0.214)		(0.268)
Σ I (i) x Z (i, t-1) x US Policy (t) x Collateral Dummy		1.82		1.851		2.096		1.868
		(1.625)		(1.614)		(1.567)		(1.938)
Σ I (i) x Z (i, t-1) x US Policy (t) x USD Dummy		0.966		1.274		2.247		2.208
		(1.895)		(1.623)		(1.815)		(2.155)
Σ I (i) x Z (i, t-1) x US Policy (t) x Long-term Dummy		-1.467		-1.477		-0.229		-0.973
		(0.917)		(0.895)		(1.055)		(0.927)
Σ I (i) x Z (i, t-1) x US Policy (t) x Business Dummy		-1.408 * *		-1.186 *		-0.164		0.068
		(0.706)		(0.679)		(0.715)		(0.688)
Σ I (i) x Macro (t) x Collateral Dummy		1.441		-0.071		-1.139		-0.005
		(1.265)		(0.065)		(1.746)		(0.038)
Σ I (i) x Macro (t) x USD Dummy		-37.601 * **		0.42 * **		0.000		0.031
		(5.919)		(0.048)		(1.647)		(0.033)
Σ I (i) x Macro (t) x Long-term Dummy		-1.749 * **		-0.072 * *		0.953		-0.017
		(0.694)		(0.032)		(1.064)		(0.019)
Σ I (i) x Macro (t) x Business Dummy		-0.334		-0.03		0.671		0.014
		(0.968)		(0.058)		(1.027)		(0.021)
Σ I (i) x Z (i, t-1) x Macro (t) x Collateral Dummy		1.888		-0.02		3.909		-0.015
		(2.128)		(0.077)		(3.803)		(0.098)
Σ I (i) x Z (i, t-1) x Macro (t) x USD Dummy		-7.117		0.026		-3.68		0.137
		(0.293)		(0.229)		(5.249)		(0.288)
Σ I (i) x Z (i, t-1) x Macro (t) x Long-term Dummy		-0.604		0.041		-2.268		0.106 *
		(1.930)		(0.034)		(2.354)		(0.056)
Σ I (i) x Z (i, t-1) x Macro (t) x Business Dummy		3.765 * **		0.049		1.872		0.059
		(1.353)		(0.039)		(2.665)		(0.044)
Time-Currency Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Sector Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-Maturity Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time- Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Sector-Currency-Maturity-Security Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-6.657	-2.269	-8.213	-2.269	-7.463	-8.39	-6.219	-6.939
	(4.210)	(3.205)	(3.827)	(3.205)	(4.151)	(4.064)	(3.799)	(4.225)
Number of Obseravations	4176	4176	4176	4176	4119	4119	4119	4119
R-squared	0.791	0.793	0.792	0.793	0.796	0.799	0.797	0.800

macroeconomic variables. Thus, there could be other channels or factors affecting bank lending in Cambodia. US monetary policy rate increases could affect global confidence and the domestic political situation alike, and in turn those global and local factors could affect the liquidity of global banks while simultaneously amplifying the effect of US monetary policy. Our study may therefore not identify the exact channel from US monetary policy to Cambodian bank lending policies. However, using DID and DDD frameworks, we provide supporting evidence that an increase in the US monetary policy rate leads to a decrease in Cambodian bank lending via the foreign funding exposure of each bank.

In addition, the determinants of funding costs and funding flows into Cambodian banks are not sufficiently investigated in our study. Apart from monetary policies, other economic conditions within shareholders' home countries and the US could be factors behind funding costs and the fluctuations of funding flows. Omitting such variable biases could have caused the insignificance in the

correlation between monetary policy and bank lending. Apart from shareholder country of origin, it is also necessary to identify the exact origins of funding. In fact, the sources of foreign funding are not limited to parent banks, and there is an increasing amount of investment in Cambodian banks due to the high interest rates in the Cambodian financial market. However, the investigation of funding flows is outside the scope of our study. Future studies should consider the nature of recent capital inflows into the banking sector of developing countries.

Data Availability

The authors do not have permission to share data.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.asieco.2022.101553.

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