



# Economic policy uncertainty, bank deposits, and liability structure

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## ABSTRACT

This study used data from 2009 to 2017 to investigate the impact of economic policy uncertainty (EPU) on the liability side of Chinese commercial banks. The results show that the increase in EPU leads commercial bank customers to shift from term to demand deposits, which shortens deposit maturity and triggers commercial banks' liquidity-hoarding behavior. Our research provides insights into the motives and strategies behind commercial banks' liquidity hoarding and offers implications for risk management, monetary policy, and systemic financial risk prevention.

## 1. Introduction

In an economic policy uncertainty (EPU) environment, companies become conservative in their decisions due to increased information asymmetry and friction in financial markets. As a precaution, companies reduce investment in fixed assets (Kang et al., 2014; Kim and Kung, 2017; Caixe, 2022), research and development (Xu, 2020), and mergers and acquisitions (Nguyen and Phan, 2017; Bonaime et al., 2018); however, they also increase cash hoarding (Demir and Ersan, 2017; Phan et al., 2019; Zeng et al., 2020; D'Mello and Toscano, 2020; Duong et al., 2020). Conversely, commercial banks can use short-term liabilities to fund enterprises' long-term loans (Diamond and Dybvig, 1983), and such excessive maturity mismatch quickly causes bank runs (Gorton and Metrick, 2012; Luo et al., 2019). Therefore, commercial banks may be more sensitive to EPU. This study explored the driving mechanism behind EPU's impact on the liability side of commercial banks' liquidity hoarding and the specific strategies used. This research expands the literature on EPU and commercial banks' liquidity hoarding, serving as a reference for banks' risk management and implementing government monetary policies.

Several researchers adopted the EPU index developed by Baker et al. (2016) to study the impact of uncertainty on commercial banks. According to the literature, EPU increases the possibility of bank loan defaults (Chi and Li, 2017; Caglayan and Xu, 2019) and adversely affects banks' stability (Nguyen, 2021). Therefore, to avoid uncertainty, commercial banks try to reduce the amount of loan issuance (Gissler et al., 2016; Chi and Li, 2017; Valencia, 2017; Hu and Gong, 2019; Nguyen et al., 2020). Reduction efforts include increasing cross-border lending (Biswas and Zhai, 2021), tightening lending standards (Bordo et al., 2016), limiting the approval of new loan applications (Alessandri and Bottero, 2020), increasing loan loss reserves (Ng et al., 2020; Danisman et al., 2021), and increasing credit spreads (Gong et al., 2022). Some literature also suggests that political linkages (Cheng et al., 2021) and stricter banking regulations (Nguyen, 2021) can help mitigate the adverse impact of EPU on commercial banks' asset allocation.

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Research concerning the impact of EPU on commercial banks primarily focuses on the asset side, represented by loans (Bordo et al., 2016; Chi and Li, 2017; Valencia, 2017; Hu and Gong, 2019; Nguyen et al., 2020); however, the impact of EPU on the liability structure of commercial banks been largely overlooked. More than 90% of commercial banks' funds come from liabilities; therefore, changes in their liability structure can significantly impact their asset allocation and risk-taking, which may also significantly influence systemic financial risks (Song and Thakor, 2007; López-Espinosa et al., 2012). To the best of our knowledge, no research has examined the nature of EPU's impact on the liability structure of commercial banks. The only exception is Berger et al. (2022b), who considered the liability side of commercial banks in their study of the impact of EPU on bank liquidity hoarding. They developed a measurement method for bank liquidity hoarding, based on Berger and Bouwman (2009), to investigate the impact of EPU on bank liquidity hoarding concerning assets, liabilities, and off-balance sheet items. The measure of liquidity hoarding is the weighted average of the proportion of various liabilities, considering the liquidity of different liabilities; however, this method cannot reveal the specific methods of liquidity hoarding adopted by banks. Our study aims to systematically examine the specific methods of adjusting the liability structure of commercial banks when facing EPU and whether there are differences between the adjustment behavior of commercial banks of different sizes, using unique Chinese data.

We collected data from the Chinese banking industry to study the impact of EPU on commercial banks' liability structures, which may provide insight into how commercial banks adjust their liability structure in response to uncertainty and the need for risk avoidance. We selected data from Chinese commercial banks for several reasons. First, China has the world's largest banking industry in terms of assets.<sup>1</sup> The *China Financial Stability Report 2020*, released by the People's Bank of China, reported that by the end of 2019, China's financial institutions' assets reached 290 trillion Chinese yuan. This amount exceeds the total assets of the EU banking industry and is two times greater than the US banking industry's assets, as announced by Guangwei Pan, Secretary of the Party Committee of the China Banking Association.<sup>2</sup>

Second, China's banking industry is in an unparalleled position regarding its financial system. The banking industry accounts for over 80% of the total assets of China's financial industry; additionally, more than 80% of corporate financing also comes from commercial banks. More importantly, deposits are the most significant source of funds for Chinese commercial banks, with over 70% of funds from deposits; thus, the deposit maturity structure change can significantly impact China's commercial banks and the broader financial industry. Nonetheless, the few studies on the effects of EPU on the liabilities of commercial banks do not focus on EPU's potential impact on the deposit maturity structure of commercial banks (Berger et al., 2022b).

Third, EPU is particularly pronounced in China and can significantly impact commercial banks. For example, in the 120 months from 2011 to 2020—when China's EPU index surpassed the global EPU index—the EPU index of Baker et al. (2016) accounted for 84.1%. In particular, China's EPU index increased to approximately two to three times the global EPU index over the past five years.

Fourth, China's monetization process is supported by a financial system that differs significantly from developed countries. Unlike developed countries' robust financial markets and downward trend of monetization indicators (Goldsmith, 1969), China's capital market is underdeveloped, with “direct financing” comprising a relatively low market percentage. Additionally, the Chinese government provided massive “implicit guarantees” to the banking system (Mckinnon, 1993), enhancing the system's capacity to attract deposits and address liquidity dilemmas. Therefore, this research examines the impact of EPU on the number of commercial bank deposits and the deposit maturity structure in China, which may help determine how EPU affects the liquidity risks of banks and their corresponding risk-hedging strategies in an economy that is overly dependent on the banking system. This study may also serve as a policy reference for underdeveloped countries with financial systems similar to China's.

This study defined EPU as a measure of “Knightian uncertainty,” following the definition of Chi and Li (2017) and Gong et al. (2022). Per Knight (1921), this type of uncertainty refers to the inability to predict the likelihood of an event occurring, in contrast to risk, defined as a known probability distribution of a known event.<sup>3</sup> Commercial banks, as economic decision-makers, react strongly to this type of uncertainty, which cannot be easily predicted or hedged by economic actors. The EPU index developed by Baker et al. (2016) measures this type of uncertainty concerning economic policy decisions and their effects. This index is consistent with Knight's definition and is considered exogenous and difficult to hedge (Attig et al., 2021; Duong et al., 2020; El Ghouli et al., 2021).

EPU is distinct from other forms of uncertainty in several ways. First, it differs from event-driven uncertainty because it has better time-varying and continuous characteristics (Attig et al., 2021; El Ghouli et al., 2021; El Ghouli et al., 2022). Individual measurements of events that cause uncertainty may miss the impact of other shocks. In addition, EPU is more detrimental than protectionism, trade conflicts, and other uncertainties (Chi and Li, 2017; Nguyen, 2021). Second, EPU differs from macroeconomic uncertainty, focusing on economic fundamentals (El Ghouli et al., 2022); however, EPU generally refers to the uncertainty surrounding government actions that affect the economic environment (Attig et al., 2021). This distinction is crucial for research in China, where the government frequently intervenes and supervises the economy, resulting in a stronger EPU. Third, EPU differs from firm-level uncertainty, characterized by strong idiosyncrasies and endogeneity (El Ghouli et al., 2021; El Ghouli et al., 2022). For example, EPU is easily affected by the company's negative news but not easily affected by the characteristics of microeconomic entities. Moreover, Chinese companies lack

<sup>1</sup> According to a report in the *Financial Times* on March 5, 2017, China's banking system overtook the Eurozone to become the largest in the world regarding assets. China's total banking sector assets reached 33 trillion US dollars (USD) at the end of 2016, compared to 31 trillion USD in the Eurozone, 16 trillion USD in the United States, and 7 trillion USD in Japan (For details, please visit <https://www.ft.com/content/14f929de-ffc5-11e6-96f8-3700c5664d30>).

<sup>2</sup> For detail, please visit <https://www.china-cba.net/Index/show/catid/32/id/18303.html>.

<sup>3</sup> We refer to the Merriam-Webster dictionary to distinguish risk and uncertainty: “Risk is the possibility that something bad or unpleasant (such as an injury or a loss) will happen,” and uncertainty is “Something that is doubtful or unknown, something that is uncertain.”

political lobbying and cannot influence policy-making channels (Wu et al., 2020); thus, EPU can be considered exogenous. Fourth, the EPU index differs from the CBOE Volatility (VIX) index, which reflects the views of stock investors. In contrast, the EPU index measures more macro and broad uncertainties (El Ghouli et al., 2021; El Ghouli et al., 2022). Since this study's research objectives cover many micro-entities, such as commercial banks and enterprises, it is more reasonable to use the EPU index. Especially for China, the indirect financing system represented by commercial banks is more developed than the direct financing system represented by the stock market. Therefore, using the VIX index to cover uncertainties affecting all economic decision-makers is challenging.

This study aimed to uncover the underlying reasons, logical processes, and specific strategies involved in commercial banks' adjustments to their liability structure in an uncertain environment. Our significant findings can be summarized as follows.

First, EPU does not significantly impact the deposit scale of commercial banks; however, it significantly increases the proportion of demand deposits and decreases the proportion of time deposits, thus shortening the deposit maturity structure. Second, to cope with the impact of shortening the deposit maturity structure, commercial banks increase the source of funds in various ways to hoard liquidity. Specifically, commercial banks increase financing by increasing borrowings from the central bank and issuing bonds. Regarding interbank liabilities, commercial banks also actively obtain financing via borrowed funds and assets sold for repurchase and by reducing interbank deposits to reduce the supply of funds. Third, our findings indicate significant heterogeneity in how commercial banks react to EPU. Specifically, we find that joint-venture commercial banks are more affected by the rise of EPU regarding their deposit term structure than large commercial banks. In contrast, we find that the impact of EPU on liquidity hoarding is relatively insignificant for large commercial banks compared to joint-venture commercial banks.

This study may have endogeneity problems. Liquidity hoarding on the liability side of banks at the micro level is unlikely to affect the EPU level at the macro level. There may be no bidirectional causality problem between EPU and liquidity-hoarding behavior on banks' liability side; however, banks' debt restructuring may be affected by economic uncertainties; omitted variables may cause endogeneity problems. To alleviate the estimation bias caused by omitted variables, we controlled for variables reflecting macro-economic conditions in the benchmark regression.

Moreover, we adopted the following methods to alleviate the endogeneity problem. We used the American EPU index as an instrumental variable for China's EPU. The relationship between China's EPU and the liquidity-hoarding behavior of commercial banks remains unchanged. We also conducted a placebo test and controlled for other sources of uncertainty to ensure the results were not incidental or caused by economic uncertainty. Furthermore, we excluded large state-owned commercial banks and introduced a first-order lag term with a dynamic panel model to address potential autocorrelation issues. The main conclusions remained unchanged.

This study's contributions to the literature are four fold. First, it expands on the existing literature on the relationship between EPU and commercial bank behavior by focusing on the liability side of banks. While previous studies mainly focused on the impact of EPU on the asset side of banks (Bordo et al., 2016; Chi and Li, 2017; Valencia, 2017; Hu and Gong, 2019; Nguyen et al., 2020), this study is one of the few to examine the impact of EPU on the liability side. Our findings suggest that increased EPU results in a shorter deposit maturity structure and a greater need for commercial banks to hoard liquidity. This result expands on the analysis of Berger et al. (2022b) concerning the impact of EPU on bank liquidity hoarding at the debt end. Additionally, this study provides a new micro-level explanation for the existing literature consensus that EPU hinders bank lending behavior by showing that EPU leads to more conservative asset allocation decisions among banks.

Second, compared to Berger et al. (2022b), we considered the impact of deposit term structure and opened the "black box" of banks' liquidity hoarding on the liability side. Our study and Berger et al. (2022b) found that banks hoard liquidity on the liability side when EPU increases; however, the following differences exist between the two. First, we emphasized the impact of EPU on the maturity structure of deposits, which Berger et al. (2022b) do not consider. Second, Berger et al. (2022b) examined the influence of EPU on deposit spread and showed that banks mainly drive liquidity hoarding on the liability side; however, we find that EPU increases demand deposits and reduces time deposits. Hence, the critical driving force of bank liquidity hoarding seems to arise from customers' precautionary cash-holding motivation. Third, Berger et al. (2022b) primarily constructed the overall index of liquidity hoarding based on the items of commercial banks; therefore, on the liability side, only the impact of EPU on the amount of bank deposits is specifically investigated. Commercial banks' specific liquidity-hoarding methods remain uninvestigated. This study opened the "black box" of liquidity hoarding of commercial banks to determine commercial banks' specific liquidity-hoarding methods. More importantly, if we followed Berger et al.'s (2022b) exact method—only considering the influence of EPU on the deposit amount of commercial banks (without examining the structure of liabilities)—we would likely have concluded that banks under EPU would not conduct liquidity hoarding on the liability side. Conversely, by further studying the specific impact of EPU on banks' debt structure, we find that banks actively hoard liquidity, mainly driven by the adjustment of the deposit maturity structure of customers.

Third, this study makes a more general contribution to the EPU literature by examining the interactions of various economic actors, including firms and banks. For example, one stream of literature finds that EPU would make enterprises' behavioral decisions more cautious (Bonaime et al., 2018; Demir and Ersan, 2017); however, the literature does not examine the impact of EPU on the deposit term structure of economic entities, including enterprises. Meanwhile, another literature stream finds that EPU forces banks to reduce loan issuance (Danisman et al., 2020; Alessandri and Bottero, 2020) and liquidity hoarding (Berger et al., 2022b) for uncertainty avoidance; however, such literature ignores whether deposit term structure is a driving factor that forces banks to make prudent decisions. This study determined that the risk avoidance behavior of enterprises by shortening the maturity structure of deposits under EPU can trigger the precautionary liquidity-hoarding behavior of banks, thus establishing a close relationship between these two types of literature. Furthermore, the literature indicates that the information asymmetry caused by EPU causes friction in financial markets (Nagar et al., 2019). In contrast, our study reveals that shortening the term structure of deposits in the EPU context leads to bank liquidity hoarding and is also a new channel for financial market friction. When EPUs rise, this new channel may be an essential driver for firms to seek alternative sources of financing by improving accounting quality (El Ghouli et al., 2021), increasing voluntary

information disclosure (Nagar et al., 2019), and increasing the credibility of managers' signals through insider trading (El Ghouli et al., 2022).

Furthermore, although our study focuses on China, our conclusions can be helpful for other emerging markets. Some literature compared the differences between traditional and Islamic banking (Abedifar et al., 2015; Beck et al., 2013; Berger et al., 2019). Bilgin et al. (2021) further analyzed the differences between traditional and Islamic banks in the impacts of economic uncertainty and bank stability. China's banking system dominates financial markets as the world's largest emerging market; simultaneously, the government has provided an "implicit guarantee" for the banking system and has clarified and limited the scope of commercial banks' operations (for example, the banking and securities industries are not allowed to operate in the same bank at the same time). Given the significant impact on the bank stability of government guarantees (Berger et al., 2020) and banking rights associated with permission to engage in non-traditional activities (Berger et al., 2022a), it is clear that China's banking system and its position are very different from those of developed countries. Therefore, this study's conclusions have policy implications for China and other emerging market countries with banking systems similar to China, such as India.<sup>4</sup>

## 2. Related literature and hypothesis development

### 2.1. The impact of EPU on the deposit maturity structure of commercial banks

There is a consensus that enterprises increase their cash holdings due to preventive motives (Demir and Ersan, 2017; Phan et al., 2019). Regarding commercial banks, the existing research speculates that this can inhibit depositors' saving behavior and thus reduce the size of commercial bank deposits (Berger et al., 2022b). Conversely, we argue that, as companies and individuals hold cash mainly through bank demand deposits rather than by withdrawing cash, their cash hoarding would not significantly reduce commercial bank deposits but would affect the maturity structure of the deposits. Deposits are divided into demand and time deposits by the maturity category; however, as a passive liability, the deposits of commercial banks mainly depend on depositors' preferences. In the context of increased EPU, how will commercial banks' demand and time deposits be affected?

From the perspective of transaction costs, EPU can affect the deposit term structure of commercial banks. A depositor incurs transaction costs when opening, adding, or withdrawing a deposit. Compared to demand deposits, time deposits have higher transaction costs, which include the bank's stricter restrictions on the transaction time (especially the withdrawal time), the bank's requirements regarding a larger minimum deposit amount, and the penalty for the early redemption of long-term deposits (Hess, 1995). To a certain extent, the actual situation can also reflect the transaction cost and adjustment flexibility difference between demand deposits and time deposits. In the banks examined in this study, the average proportion of demand deposits from 2009, 2010, and 2011 was 66.19%, 63.8%, and 60.62%, respectively, representing almost twice the corresponding proportions of time deposits. In this study's entire sample period (i.e., 2009–2017), the proportion of demand deposits was higher than that of time deposits. Therefore, when the increase in EPU raises precautionary cash holdings, depositors are more inclined to choose demand deposits, which are easy to withdraw cash from, and less inclined to choose less flexible time deposits.

Additionally, when EPU increases, depositors' concern regarding banks' risks may also cause them to adjust the term structure of their deposits. As a result, EPU can increase banks' credit risk (Chi and Li, 2017) and instability (Nguyen, 2021). Guillemin (2020) states that depositors tend to withdraw funds from the bank or switch from higher-risk time deposits to short-term demand deposits through maturity transfer when they believe the bank is facing risks. The rise in EPU may trigger customers' concerns about banks' solvency; however, the invisible guarantee provided by the Chinese government to the banking system enhances the ability of China's banking system to cope with liquidity difficulties. Therefore, depositors may not choose to withdraw massive amounts of cash and are more likely to convert time deposits into demand deposits. Based on the above analysis, we propose the following research hypothesis:

**Hypothesis H<sub>1</sub>.** The increase in EPU can affect the deposit maturity structure of commercial banks, leading to a rise in demand deposits and a decrease in time deposits.

### 2.2. The impact of EPU on the liability structure of commercial banks

When EPU increases, depositors tend to increase demand deposits and decrease time deposits due to precautionary motives, potentially creating liquidity risks for banks. According to the theory of financial intermediation, banks can help meet investors' liquidity needs by providing funds for long-term loans with short-term liabilities (Diamond and Dybvig, 1983); however, from the financial stability perspective, excessive maturity mismatch can easily cause liquidity risks for banks (Gorton and Metrick, 2012; Luo et al., 2019). In China, demand deposits and long-term loans account for many funds in commercial banks (Shi and Liu, 2016). Therefore, increasing demand and decreasing time deposits can increase the maturity mismatch and aggravate banks' liquidity risk. To handle the liquidity risk, commercial banks can increase the source of funds through various methods to hoard liquidity, which is the direct motivation underlying commercial banks' adjustment of the debt structure.

According to the working capital financing strategy theory, liquid liabilities should finance a part of liquid assets while considering the trade-off of financing costs and risks. For example, Berger et al. (2022b) found that, with the increase in EPU, commercial banks

<sup>4</sup> China's and India's banking sectors share several characteristics. For instance, both rely heavily on the banking system for funding and have underdeveloped capital markets; moreover, state ownership plays an important role in both countries' banking systems.

would hold more liquid assets and hoard more liquid liabilities, resulting in the liquidity-hoarding effect. Based on the characteristics of the debt structure of Chinese commercial banks, we believe that when EPU increases, commercial banks increase financing and hoard liquidity in several ways; the specific reasons for this are analyzed below.

First, when EPU increases, commercial banks can obtain funds by borrowing from the central bank to cope with liquidity risks. Generally, the central bank only acts as the lender of last resort for commercial banks; hence, borrowing from the central bank is not a common method to obtain liquidity. In contrast to the role of central banks in developed countries, China's central bank has introduced several lending facility instruments (including the Standing Lending Facility and the Medium-term Lending Facility) for commercial banks. This approach is a standard practice of China's central bank and also the most common method through which China's central bank releases base money (Fang et al., 2020; Liu et al., 2023). Therefore, when EPU increases, Chinese commercial banks can significantly increase their borrowings from the central bank to mitigate liquidity risks.

Second, with the increasing uncertainty of economic policies, commercial banks can obtain long-term financing by increasing bond issuance to cope with the uncertainty. The increase in EPU can prompt commercial banks to increase liquid asset holdings (Berger et al., 2022b). Compared with non-financial enterprises, commercial banks pay more attention to risk management and are more likely to adopt conservative liquidity financing strategies. Therefore, a considerable proportion of funds required by liquid assets can be raised through long-term financing. For Chinese commercial banks, bond issuance is essential for raising long-term funds. In several commercial banks, financing through bond issuance comprises over 20% of the total liabilities; however, the increasing uncertainty of economic policies causes commercial banks to become more likely to adopt conservative financing strategies and more inclined to obtain long-term financing by issuing bonds. Based on the above analysis, we propose the following research hypothesis:

**Hypothesis H<sub>2</sub>.** The increase in EPU can cause commercial banks to adjust the overall liability structure for liquidity hoarding, leading to increased borrowing from the central bank and bond issuance.

### 2.3. The impact of EPU on the interbank liability structure of commercial banks

Under the impact of the increase in EPU, increasing financing is the motivation underlying commercial banks' adjustment of the debt structure. In addition to borrowing from the central bank and issuing bonds, we must determine if commercial banks increase interbank debt for financing. In Chinese commercial banks' debt structure, the scale of interbank liabilities is second only to deposits, and some commercial banks' interbank liabilities are nearly equal to deposits. Such interbank liabilities include borrowed funds, financial assets sold for repurchase, and interbank deposits. The impact of EPU is analyzed below.

First, when EPU increases, the proportion of commercial banks' borrowed funds increases significantly. Borrowed funds are those that commercial banks borrow from other financial institutions through interbank lending. In addition to borrowing from the central bank, interbank lending is also an important mechanism through which commercial banks obtain short-term financing. Therefore, when the uncertainty of economic policies increases and liquidity risks rise, commercial banks borrow funds from other financial institutions to supplement short-term financing, increasing the proportion of borrowed funds.

Second, with the increase in EPU, the proportion of commercial banks' financial assets sold for repurchase increases significantly. Financial assets sold for repurchase refer to the liabilities formed by commercial banks, which obtain cash by selling financial assets, such as bonds and commercial bills, and then buy back financial assets at maturity by signing repurchase agreements. For commercial banks, a repo is equivalent to a financing method with financial assets as collateral, performing a short-term financing function similar to borrowed funds. Therefore, to cope with the liquidity risk caused by the increase in EPU, commercial banks can obtain financing by increasing the sale and repurchase of financial assets, leading to an increase in the proportion of assets sold for repurchase.

Third, with the increase in EPU, commercial banks' proportion of interbank deposits significantly decreases. This finding is contrary to the logic of the previous two reasons; however, it is consistent, as it reflects the motivation of commercial banks to hoard liquidity when EPU is increasing. In contrast to borrowed funds and financial assets sold for repurchase, the interbank deposit money is also a type of short-term debt financing; however, commercial banks do not take the initiative to obtain financing. Instead, because of payments and settlements with other commercial banks and the need for business cooperation, the fund is deposited in the commercial bank, similar to regular deposits. Therefore, it is a passive liability. As in the case of the increasing EPU, enterprises reduce commercial credit supply, such as accounts receivable (D'Mello and Toscano, 2020); furthermore, as a precaution, commercial banks and other financial institutions tighten capital supply and reduce the funds deposited in commercial banks. Therefore, from the perspective of commercial banks, reducing interbank financial institutions' deposits reduces interbank deposits. Based on the above analysis, we propose the following research hypothesis:

**H<sub>3</sub>.** The increase in EPU can cause commercial banks to adjust the structure of interbank liabilities to hoard liquidity, leading to an increase in borrowed funds and financial assets sold for repurchase but a decrease in interbank deposits.

## 3. Research design

### 3.1. Sample selection and model setting

#### 3.1.1. Sample selection

This study collected data on China's banking industry from 2009 to 2017, including data on demand and time deposits from individuals and institutions. The data were derived from the annual reports of various banks. Macroeconomic and other indicators at the bank level were mainly obtained from the BankScope and CSMAR databases. After excluding banks with missing data, we obtained

unbalanced panel data for 117 commercial banks, including six large state-owned commercial banks, 12 joint-venture commercial banks, 66 urban commercial banks, 24 rural commercial banks, and 9 foreign banks. The ratio of the assets of the sample banks to the assets of the Chinese banking industry remains above 70% during the sample period, which is highly representative. To eliminate the influence of extreme values, we winsorize all continuous variables (quantile = 1%) in the regression analysis.

### 3.1.2. Model setting

The following panel data model controls the bank-fixed effects,<sup>5</sup> and all regression results are adjusted for clustering robust standard errors at the bank level:

$$Bank_{i,t} = \alpha_0 + \alpha_1 EPU_t + \alpha_2 X_{i,t-1} + FirmFE + \varepsilon_{i,t} \quad (1)$$

Among these, EPU (*EPU*) is the primary independent variable examined; the dependent variable, *Bank*, is a commercial bank-related variable that includes the related variables, such as liability structure. When examining the impact of EPU on the maturity structure of commercial banks' deposits, the dependent variables are the proportion of demand and time deposits. When examining the impact of EPU on the overall liability structure of commercial banks, the dependent variables include the proportion of borrowings from the central bank, the proportion of debentures payable, the proportion of interbank liabilities, and the proportion of deposits. Finally, when examining the interbank liability structure of commercial banks, the dependent variables are the proportion of borrowed funds, the proportion of sales for repurchase, and the proportion of interbank deposits. We examine the contemporaneous relationship between EPU and the commercial bank variable *Bank* because the liability structure examined in this article contains various current liabilities, which can be adjusted quickly in the short term. Therefore, it is more in line with this study's examination of commercial banks' liability structure adjustment behavior. To reduce the model's endogeneity resulting from the omitted variables, we control the bank-fixed effects in Model (1), and the control variables ( $X_{i,t-1}$ ) at the entity level of commercial banks all lag by one period.

### 3.2. Variable definitions

Table 1 shows the names, symbols, meanings, and calculation methods for the variables in our analysis.

Baker et al. (2016) developed the core variable of EPU (*EPU*), which Stanford University and the University of Chicago jointly released. The EPU index is constructed based on the frequency of occurrences of keywords related to policy uncertainty in the *South China Morning Post*, which is Hong Kong's most widely circulated English newspaper. The mainland government does not regulate Hong Kong's media, so the newspaper is perceived as highly authentic. The specific method for constructing the EPU index has two steps.

The first step is to determine the number of articles that cover keywords. First, if any of the following keywords, "China/Chinese," "economy/economic," or "uncertain," appear in the text, the program marks them. Second, it screens the marked articles again. If at least one keyword appears in "policy, spending, budget, political, interest rates, and reform" and "government, Beijing, and authorities" or if one or more keywords appear in "tax, regulation, Central Bank, People's Bank of China, deficit, and WTO," the final number of articles related to EPU can be obtained.

The second step is to divide the selected articles by the total number of articles in the current month to obtain the final monthly EPU index. To obtain the annual data of *EPU*, we refer to the general practice in the literature. Accordingly, the annual EPU indicator is obtained by the average monthly data divided by 100, as proposed by Baker et al. (2016). We utilize the EPU based on mainland Chinese newspapers and the change in the annual EPU index to conduct the following robustness test.

We also employ entity bank-level control variables, total assets of commercial banks (*Size*), return on assets (*ROA*), capital adequacy ratio (*CAR*), net interest income ratio (*NIAR*), non-performing loan ratio (*NPLR*), and equity-to-asset ratio (*Equi*). At the macro level, time series control variables, consumer price index (*CPI*), GDP growth rate (*GDP*), and M2 growth rate (*M2*), are used. Introducing these macro time series control variables helps eliminate the influence of the dependent variable of the time trend. Adding the annual time control variable absorbs the impact of EPU and causes a severe multi-collinearity problem in the model; thus, the time-fixed effect is no longer controlled. All the control variables in the model are lagged by one period, so we add an "L" before the control variables in the regression results tables.

Table 2 shows the descriptive statistics of the main variables in this study. In the liability structure, deposits account for the largest proportion, with a median of 74.72%, consistent with deposits being the primary funding source for Chinese commercial banks. Regarding the deposit maturity structure, the average value of time deposits (36.77%) accounts for a slightly higher proportion than demand deposits (30.89%).<sup>6</sup> Demand deposits constitute a higher proportion of the maturity structure of company deposits, indicating that companies mainly hold cash in the form of demand deposits. Interbank liabilities possess an average ratio of 17.57%, the second-largest source of liabilities after deposits, and interbank deposits account for the largest proportion of interbank liabilities. Regarding the maximum and minimum interbank liabilities, the former is 48.84%, and the latter is 17.1%, indicating that the scale of interbank liabilities of different Chinese commercial banks varies greatly in different periods. The average proportion of debentures payable was 3.87%. Still, a distinct difference remains between the minimum and maximum values, 1.43% and 23.42%, respectively; this indicates

<sup>5</sup> As the adjustment of the liability structure of commercial banks may be dynamic, we conduct a robustness test based on the dynamic panel model in the following section.

<sup>6</sup> In addition to time and demand deposits, a few commercial banks also had a relatively high proportion of structured deposits. Therefore, the sum of the proportion of time deposits and demand deposits in the same year may be less than 100%.

**Table 1**  
Definition of main variables.

Variable type	Variable meaning	Variable symbol	Variable name	Variable calculation method
Dependent variable	Overall liability structure	<i>CBBorrowing</i>	Borrowing from the central bank	Borrowing from the central bank / ending total liabilities
		<i>Debentures</i>	Debentures payable	Debentures payable / Ending total liabilities
		<i>IBliabilities</i>	Interbank liabilities	Interbank liabilities / Ending total liabilities
	Interbank liability structure	<i>Deposit</i>	Deposits	Deposits / Ending total liabilities
		<i>DepositFund</i>	Borrowed funds	Borrowed funds / Ending total liabilities
		<i>Repur</i>	Sales for repurchases	Financial assets sold for repurchase / Ending total liabilities
		<i>BankDeposit</i>	Interbank deposits	Interbank deposits / Ending total liabilities
		Deposit maturity structure	<i>DemandDeposit</i>	Demand deposits
	<i>TimeDeposit</i>		Time deposits	Time deposits / Ending total liabilities
	<i>FTDeposit</i>		Company demand deposits	Company demand deposits / Ending total liabilities
	<i>FDDeposit</i>		Company time deposits	Company time deposits / Ending total liabilities
	<i>PTDeposit</i>		Personal demand deposits	Personal demand deposits / Ending total liabilities
	Independent variable	Economic policy uncertainty	<i>PDDeposit</i>	Personal time deposits
<i>EPU</i>			Economic policy uncertainty	Baker's monthly EPU data are averaged and divided by 100 to get the annual data
Other control variables		<i>Size</i>	Total bank assets	Natural logarithm of total bank assets
		<i>ROA</i>	Return on Assets	Net profit / total assets
		<i>CAR</i>	Capital adequacy ratio	Capital adequacy ratio
		<i>NIAR</i>	Net interest income ratio	Net interest income / total assets
		<i>NPLR</i>	Non-performing loan ratio	Non-performing loans / total loans
		<i>Equi</i>	Equity-to-asset ratio	Owners' equity / total assets
		<i>CPI</i>	Consumer Price Index	Annual consumer price index
		<i>GDP</i>	GDP growth rate	The year-on-year growth rate of annual gross domestic product
<i>M2</i>	M2 growth rate	The year-on-year growth rate of broad money supply M2		

Notes: (1) This table displays the names, symbols, meanings, and calculation methods of this paper's main variables. For the overall liability structure of commercial banks, the dependent variables include *CBBorrowing*, *DepositFund*, *Debentures*, *IBliabilities*, and *Deposit*. Regarding the interbank liability structure of commercial banks, the dependent variables include *DepositFund*, *Repur*, and *BankDeposit*. Commercial bank deposits' maturity structure includes the dependent variables of *DemandDeposit* and *TimeDeposit*. (2) The core independent of economic policy uncertainty (*EPU*) is developed by Baker et al. (2016) and has been widely used by researchers (Nguyen and Phan, 2017; Bonaime et al., 2018). (3) In terms of control variables, this paper employed entity bank-level control variables, including total assets of commercial banks, return on assets, capital adequacy ratio, net interest income ratio, non-performing loan ratio, and equity-to-asset ratio. At the macro level, time series control variables, such as the consumer price index, GDP growth rate, and M2 growth rate, were utilized.

**Table 2**  
Variable descriptive statistics.

Variables	Sample size	Mean	Std. dev.	Min	Median	Max
<i>TimeDeposit</i>	752	36.77	11.57	11.84	35.94	71.24
<i>DemandDeposit</i>	752	30.89	11.56	0.71	30.37	71.94
<i>FTDeposit</i>	744	43.07	18.20	7.56	43.09	91.02
<i>FDDeposit</i>	744	55.88	18.12	5.42	56.03	89.87
<i>PTDeposit</i>	744	66.66	14.32	4.23	67.11	95.32
<i>PDDeposit</i>	744	32.76	13.79	3.209	32.06	92.74
<i>CBBorrowing</i>	727	0.63	1.21	0	0.09	6.08
<i>Debentures</i>	768	3.87	5.32	0	1.43	23.41
<i>IBliabilities</i>	758	17.57	10.20	0.003	17.10	48.84
<i>Deposit</i>	791	74.59	12.15	43.51	74.72	97.72
<i>DepositFund</i>	767	2.24	4.63	0	0.86	31.56
<i>Repur</i>	778	5.03	5.10	0	3.76	30.83
<i>BankDeposit</i>	790	10.29	8.19	0	8.74	34.69
<i>EPU</i>	793	2.12	1.02	0.99	1.81	3.65
<i>Size</i>	793	26.12	1.70	22.30	25.82	30.40
<i>ROA</i>	793	0.92	0.35	0.04	0.93	2.06
<i>CAR</i>	793	13.82	6.23	8.27	12.63	95.84
<i>NIAR</i>	793	2.23	0.73	0.42	2.18	5.18
<i>NPLR</i>	793	1.32	0.92	0	1.18	7.88
<i>Equi</i>	793	7.23	2.88	2.77	6.63	33.44
<i>CPI</i>	793	102.3	1.316	99.30	102	105.4
<i>GDP</i>	793	7.75	1.12	6.7	7.3	10.4
<i>M2</i>	793	13.83	4.50	8.17	13.34	27.58

that the relative scale of debenture issuance by different banks exhibits a notable difference. The average proportion of loans from the central bank was 0.63%. While the proportion is small, loans from the central bank, as the lender of the last resort for commercial banks, play an important role in short-term commercial financing. Table 2 shows the statistical information of the other variables, which cannot be individually explained.

### 3.3. Correlation analysis

Table 3 reports the correlation coefficients between related variables. Other correlation coefficients are relatively small except for the relatively high correlation coefficient between *CAR* and *Equi* (0.753).<sup>7</sup> *EPU* negatively correlates with *GDP* and *M2*. Compared with *CBBorrowing*, *Debentures*, *DepositFund*, and *Repur* are positive.

## 4. Empirical results and analysis

### 4.1. *EPU* and the maturity structure of commercial banks' deposits

Our previous analysis asserts that the changes in the deposit maturity structure of commercial banks are caused by the important external factors of changes in depositors' behavior concerning the economic uncertainty environment, which directly causes adjustments in the liability structure of commercial banks. Therefore, we first analyze the structural changes in demand and time deposits from the perspective of deposit maturity; Table 4 shows the results. Columns (1) and (2) of Table 4 show that when the dependent variable is the demand deposits, the regression coefficient of *EPU* is significantly positive. In contrast, the regression coefficient of *EPU* is significantly negative when the dependent variable is the time deposits.

These results indicate that the scale of demand deposits in commercial banks increases significantly with the increase in *EPU*, while the scale of time deposits decreases significantly, consistent with  $H_1$ . To fully illustrate this change in commercial banks' liability structure, we demonstrate this conclusion from the perspective of the deposit business structure. From this perspective, deposits can be divided into company and personal deposits, further subdivided into time and demand deposits, as shown in Columns (3)–(6) of Table 4.

From the perspective of company deposits, Table 4 shows that with company time deposits as the dependent variable, the regression coefficient of *EPU* in Column (3) is significantly negative. In contrast, the regression coefficient of *EPU* in Column (4) is significantly positive when company demand deposits is the dependent variable. Thus, for company deposits, the scale of time deposits drops significantly with the increase in *EPU*, while the scale of demand deposits rises significantly; this is consistent with Columns (1)–(2) of Table 3. Similarly, from the perspective of personal deposits, consistent findings can be drawn for the regression results in Columns (5)–(6) of Table 3. Due to preventive demand motives, enterprises and individuals change their cash-holding behavior and mainly adopt demand deposits for cash hoarding to cope with the impact of uncertainty from an *EPU* increase. This practice causes significant changes in the deposit structure of commercial banks, as mentioned above, which proves  $H_1$ .

Under the impact of *EPU*, changes in depositor behavior make the deposits of commercial banks short term. Customer deposits are the most critical source of funds for Chinese commercial banks, and they occupy a prominent position in these banks' funding sources. Therefore, the short-term structure of deposit maturity can substantially impact commercial banks' operation and management; thus, we believe that, under the impact of the shortening of the customer deposit maturity structure, commercial banks use other channels and methods to raise funds to supplement capital sources to cope with the impact of liquidity risks. This approach is the direct cause and internal logic underlying commercial banks' adjustment of their liability structure. The following sections further examine the specific methods for adjusting commercial banks' liability structure.

### 4.2. *EPU* and the liability structure of commercial banks

#### 4.2.1. The impact of *EPU* on the overall liability structure of commercial banks

In the context of increasing *EPU*, this section analyzes commercial banks' methods to supplement funding sources to cope with the impact of shortened commercial bank deposit structure. We also determine whether commercial banks adjust their liability structure to respond to the shortened deposit structure and, in addition to affecting the maturity structure of deposits, whether the increase in *EPU* affects the total deposits of commercial banks.

We examine the impact of *EPU* on four major types of commercial banks' liability structure: borrowings from the central bank, debentures payable, interbank liabilities, and deposits. Table 5 shows the regression results. First, the impact of *EPU* on borrowings from the central bank and debentures payable is analyzed, as shown in Columns (1)–(2) of Table 5. When the dependent variable borrows from the central bank, the regression coefficient of *EPU* in Column (1) is 0.359 and is significantly positive; hence, as the uncertainty of economic policy increases, the scale of commercial banks' borrowings from the central bank increases significantly. Regarding debentures payable, the regression coefficient of *EPU* in Column (2) is 1.885, which is significantly positive; hence, as the uncertainty of economic policy increases, the scale of debentures payable by commercial banks increases significantly, and the regression coefficient of the latter is significantly greater than that of the former.

<sup>7</sup> In the robustness section, we delete the control variable equity-to-asset ratio (*Equi*) and reconduct the regression, and we find that the measurement results in this paper remain unchanged, suggesting that the problem of collinearity between variables is small.

**Table 3**  
Pearson's correlation coefficient matrix.

Variables	TimeDeposit	DemandDeposit	CBBorrowing	Debentures	IBliabilities	Deposit	DepositFund	Repur	BankDeposit	EPU	Size	ROA	CAR	NIAR	NPLR	Equi	CPI	GDP	M2	
TimeDeposit	1.000																			
DemandDeposit	-0.231***	1.000																		
CBBorrowing	-0.105***	-0.129***	1.000																	
Debentures	-0.252***	-0.149***	0.307***	1.000																
IBliabilities	-0.358***	-0.472***	-0.029	0.008	1.000															
Deposit	0.398***	0.505***	-0.203***	-0.450***	-0.788***	1.000														
DepositFund	0.104***	-0.341***	-0.005	-0.011	0.317***	-0.274***	1.000													
Repur	-0.278***	-0.123***	-0.097***	-0.024	0.475***	-0.340***	-0.113***	1.000												
BankDeposit	-0.313***	-0.321***	0.032	0.046	0.756***	-0.608***	-0.125***	0.009	1.000											
EPU	-0.055	-0.143***	0.436***	0.605***	-0.009	-0.294***	0.097***	0.035	-0.046	1.000										
Size	-0.198***	0.041	0.260***	0.245***	0.170***	-0.243***	-0.143***	-0.121***	0.364***	0.130***	1.000									
ROA	-0.071*	0.341***	-0.097***	-0.176***	-0.271***	0.311***	-0.405***	-0.006	-0.104***	-0.254***	0.092***	1.000								
CAR	0.128***	-0.207***	-0.058	-0.116***	0.148***	-0.064*	0.604***	0.005	-0.214***	-0.015	-0.292***	-0.289***	1.000							
NIAR	0.051	0.336***	-0.119***	-0.219***	-0.430***	0.456***	-0.281***	-0.195***	-0.269***	-0.299***	-0.208***	0.595***	-0.084**	1.000						
NPLR	0.063*	0.076**	0.079**	0.076**	-0.170***	0.042	0.049	-0.125***	-0.179***	0.126***	-0.104***	-0.308***	0.135***	-0.031	1.000					
Equi	0.250***	-0.183***	-0.047	-0.142***	0.018	0.024	0.607***	-0.140***	-0.263***	0.001	-0.372***	-0.184***	0.753***	0.023	0.104***	1.000				
CPI	-0.021	0.098***	-0.161***	-0.252***	0.040	0.144***	-0.055	0.133***	-0.009	-0.182***	-0.066*	0.214***	0.049	0.183***	-0.203***	0.013	1.000			
GDP	-0.092**	0.383***	-0.341***	-0.475***	-0.076**	0.342***	-0.086**	0.048	-0.097***	-0.594***	-0.097***	0.179***	0.011	0.177***	-0.111***	-0.074**	0.468***	1.000		
M2	-0.076**	0.358***	-0.348***	-0.432***	-0.075**	0.292***	-0.068*	0.000	-0.075**	-0.556***	-0.084**	0.097***	-0.011	0.136***	-0.022	-0.078**	0.017	0.804***	1.000	

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Note: (1) Pearson's correlation coefficient matrix. (2) \*\*\*, \*\*, and \* represent statistical significance at 1%, 5%, and 10% levels, respectively.

**Table 4**  
The impact of EPU on the deposit maturity structure of commercial banks.

Variables	Deposit maturity structure		Company deposit structure		Personal deposit structure	
	<i>TimeDeposit</i>	<i>DemandDeposit</i>	<i>FTDeposit</i>	<i>FDDeposit</i>	<i>PTDeposit</i>	<i>PDDeposit</i>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>EPU</i>	−1.721*** (−5.29)	1.975*** (7.92)	−3.024*** (−7.69)	2.901*** (7.20)	−2.207*** (−6.32)	2.181*** (6.47)
<i>L.Size</i>	1.090 (0.74)	−6.553*** (−3.96)	10.420*** (2.92)	−9.347*** (−3.14)	4.201** (2.23)	−4.134** (−2.34)
<i>L.ROA</i>	−0.151 (−0.10)	1.437 (1.01)	−0.204 (−0.09)	−1.726 (−0.83)	−3.780* (−1.93)	2.897 (1.33)
<i>L.CAR</i>	−0.381* (−1.78)	−0.270** (−2.44)	0.207 (1.26)	−0.238 (−1.59)	0.273** (1.99)	−0.274** (−2.02)
<i>L.NIAR</i>	1.646** (2.19)	−0.522 (−0.82)	0.852 (1.04)	−0.488 (−0.57)	2.173* (1.84)	−2.227* (−1.90)
<i>L.NPLR</i>	0.191 (0.43)	0.612 (1.63)	−0.511 (−0.76)	0.466 (0.71)	−0.254 (−0.52)	−0.0651 (−0.14)
<i>L.Equi</i>	0.601 (1.53)	0.0777 (0.30)	0.641** (2.34)	−0.588** (−2.19)	−0.290 (−0.93)	0.319 (1.06)
<i>L.CPI</i>	0.416 (1.63)	−0.647** (−2.14)	0.966*** (3.64)	−0.898*** (−3.49)	0.013 (0.04)	0.035 (0.11)
<i>L.GDP</i>	−0.986 (−1.65)	2.903*** (4.38)	−2.815*** (−2.90)	2.716*** (3.29)	−1.593** (−2.13)	1.354* (1.86)
<i>L.M2</i>	0.025 (0.21)	−0.031 (−0.24)	0.275 (1.36)	−0.191 (−1.00)	0.137 (0.87)	−0.060 (−0.44)
Constant	−26.11 (−0.62)	243.6*** (4.78)	−311.1*** (−3.15)	376.1*** (4.49)	−31.68 (−0.49)	126.5** (2.04)
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	752	752	744	744	744	744
R-squared	0.121	0.447	0.399	0.391	0.138	0.159
Number of banks	114	114	114	114	114	114

Notes: (1) This table reports the impact of EPU on the deposit maturity structure of commercial banks based on three deposit samples: the overall deposit sample, the company deposit sub-sample, and the personal deposit sub-sample, respectively. (2) The dependent variables for the overall deposit maturity structure include *TimeDeposit* and *DemandDeposit*, as shown in Columns (1)–(2). The dependent variables for the company deposit include *FTDeposit* and *FDDeposit*, as shown in Columns (3)–(4). The dependent variables for personal deposit include *PTDeposit* and *PDDeposit*, as shown in Columns (5)–(6). (3) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at 1%, 5%, and 10% levels, respectively.

The increase in EPU causes commercial banks to actively adjust the liability structure and obtain funds by issuing bonds and increasing borrowing from the central bank. Furthermore, comparing the regression coefficients indicates that with an increase in EPU, the increase in the scale of debentures payable is much greater than the increase in the scale of loans from the central bank. This result indicates that commercial banks mainly obtain long-term financing through the issuance of debentures. As the uncertainty of economic policy increases, commercial banks supplement their funding sources by increasing their borrowings from the central bank. They also issue bonds to cope with the impact of liquidity tension caused by the shortening of the deposit structure, which corroborates H<sub>2</sub>.

Column (4) in Table 5 shows the regression results of the deposits. While the regression coefficient is insignificant, the underlying reasons are noteworthy. The regression coefficient of EPU in Column (4) is insignificant for the absorption of deposits, indicating that, with the increase in EPU, the size of commercial banks' deposits has not changed significantly. In contrast, the analysis results in Table 4 show that EPU severely impacts the maturity structure of deposits, raising the question of why the size of deposits does not change significantly.

This question relates to China's deposits' maturity structure and the degree and direction of EPU's impact. On the one hand, Table 4 shows that when the dependent variables are the demand and time deposits, the regression coefficients of *EPU* are 1.975 and −1.721, respectively. On the other hand, their change directions are opposite, and the difference in regression coefficients is minimal; thus, when EPU increases, demand and time deposits change in opposite directions, with the degree of changes being similar. On the other hand, from the perspective of the deposit maturity structure of Chinese commercial banks, demand deposits and time deposits are the same. For example, the average proportions of time deposits in the total deposits of this study's sample banks in 2015, 2016, and 2017 were 54.01%, 52.44%, and 51.51%, respectively; this is closer to the scale of demand deposits. Furthermore, no distinct differences were found between the proportions of time and demand deposits for the other years. Therefore, due to the similar scale of demand deposits and time deposits in China, under the impact of EPU, their changes in opposite directions and of similar degrees offset each other, resulting in a relatively stable scale of deposits free of significant changes.

While EPU does not significantly impact the size of deposits of commercial banks, it seriously impacts the maturity structure of deposits, resulting in a substantial increase in the scale of demand deposits and a significant decrease in the scale of time deposits. These impacts shorten the deposit maturity structure and force commercial banks to use other channels and methods to replenish their funds, which is the direct cause of commercial banks' liability structure adjustment. Therefore, this new finding has important implications for understanding the adjustment of commercial banks' liability structure and risk management in an uncertain

**Table 5**  
Impact of EPU on the overall liability structure of commercial banks.

Variables	<u>CBBorrowing</u>	<u>Debentures</u>	<u>IBliabilities</u>	<u>Deposit</u>
	(1)	(2)	(3)	(4)
<i>EPU</i>	<b>0.359***</b> (4.81)	<b>1.885***</b> (9.84)	<b>-1.323***</b> (-3.94)	<b>-0.326</b> (-0.89)
<i>L.Size</i>	0.124 (0.52)	6.124*** (6.52)	1.998 (0.98)	-8.399*** (-4.29)
<i>L.ROA</i>	-0.314* (-1.84)	-1.558** (-2.03)	-0.693 (-0.44)	3.570** (2.04)
<i>L.CAR</i>	0.006 (0.69)	-0.041 (-1.25)	0.258** (2.42)	-0.215* (-1.76)
<i>L.NIAR</i>	0.078 (0.79)	1.358*** (3.70)	-2.246*** (-2.96)	1.680 (1.61)
<i>L.NPLR</i>	0.003 (0.04)	0.397* (1.87)	-1.280*** (-2.87)	0.428 (0.83)
<i>L.Equi</i>	0.062*** (3.04)	0.234*** (3.08)	0.142 (0.55)	-0.598** (-2.26)
<i>L.CPI</i>	-0.147*** (-4.25)	-0.643*** (-6.11)	1.108*** (3.70)	-0.336 (-1.23)
<i>L.GDP</i>	0.204** (2.32)	1.388*** (4.90)	-3.008*** (-4.07)	2.503*** (3.47)
<i>L.M2</i>	-0.082*** (-3.93)	-0.030 (-0.40)	0.349** (2.24)	-0.456*** (-2.96)
Constant	10.89 (1.48)	-106.8*** (-3.66)	-123.6** (-2.08)	313.9*** (5.92)
Bank-fixed effect	Yes	Yes	Yes	Yes
Sample size	727	768	758	791
R-squared	0.284	0.627	0.156	0.403
Number of banks	116	117	117	117

Notes: (1) This table displays the impact of EPU on the overall liability structure of commercial banks, including *CBBorrowing*, *DepositFund*, *Debentures*, *IBliabilities*, and *Deposit*, as shown in Columns (1)–(4), respectively. (2) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at 1%, 5%, and 10% levels, respectively.

**Table 6**  
Impact of EPU on the interbank liability structure of commercial banks.

Variables	<u>DepositFund</u>	<u>Repur</u>	<u>BankDeposit</u>
	(1)	(2)	(3)
<i>EPU</i>	<b>0.358***</b> (3.69)	<b>0.443***</b> (2.76)	<b>-1.939***</b> (-5.54)
<i>L.Size</i>	0.949** (2.11)	-2.021** (-2.47)	3.112** (2.06)
<i>L.ROA</i>	0.064 (0.17)	-1.522 (-1.56)	1.120 (0.96)
<i>L.CAR</i>	-0.003 (-0.08)	0.177*** (2.71)	0.029 (0.28)
<i>L.NIAR</i>	0.116 (0.59)	-0.463 (-1.06)	-2.069*** (-3.51)
<i>L.NPLR</i>	0.001 (0.01)	-0.554** (-2.31)	-0.669** (-2.02)
<i>L.Equi</i>	0.067 (0.54)	0.005 (0.04)	0.110 (0.62)
<i>L.CPI</i>	-0.079 (-1.06)	0.362** (2.20)	0.844*** (4.11)
<i>L.GDP</i>	0.238 (1.15)	-0.506 (-1.38)	-2.749*** (-4.66)
<i>L.M2</i>	0.014 (0.38)	0.007 (0.09)	0.345*** (3.17)
Constant	-17.88 (-1.37)	24.08 (0.93)	-132.60*** (-2.97)
Bank-fixed effect	Yes	Yes	Yes
Sample size	767	778	790
R-squared	0.093	0.118	0.202
Number of banks	117	117	117

Notes: (1) This table reports the impact of EPU on the interbank liability structure of commercial banks, which includes *DepositFund*, *Repur*, and *BankDeposit*, as shown in Columns (1)–(3), respectively. (2) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at 1%, 5%, and 10% levels, respectively.

**Table 7**  
Interbank liability structure of commercial banks.

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
borrowed funds	11.48	9.39	11.69	11.48	9.48	10.82	11.54	12.44	13.81
sales for repurchase	28.02	34.95	34.61	34.38	28.68	27.57	28.37	34.98	34.63
interbank deposits	60.50	55.66	53.70	54.14	61.84	61.61	60.09	52.58	51.56

Notes: This table displays the interbank liability structure of commercial banks, including the proportions of borrowed funds, the sales for repurchase, and interbank deposits. We compare the proportion of interbank deposits with the sum of the proportions of borrowed funds and sales for repurchase to show that the scale of interbank deposits is generally larger than the summed scale of borrowed funds and sales for repurchase.

environment.

#### 4.2.2. Impact of EPU on the interbank liability structure of commercial banks

Next, we analyze the impact of EPU on interbank liabilities. We first explored the overall impact of EPU on interbank liabilities. Table 5, Column (3) shows the regression results. The regression coefficient of EPU in Column (3) for the interbank liabilities is significantly negative; hence, as the uncertainty of economic policies increases, the scale of the interbank liabilities of commercial banks drops significantly, which may imply that when EPU rises, commercial banks do not increase the financing from interbank financial institutions but reduce interbank financing. This result contradicts the logic that commercial banks proactively obtain funds by increasing their borrowings from the central bank and issuing bonds.

Therefore, we further subdivide interbank liabilities into borrowed funds, assets sold for repurchase, and interbank deposits and examine the impact of EPU on these three elements; Table 6 shows the regression results. When the dependent variable is the borrowed funds or the financial assets sold for repurchase agreements, the regression coefficients of EPU in Columns (1) and (2) of Table 6 are significantly positive. This result shows that the scale of commercial banks' borrowed funds and financial assets sold for repurchase grows significantly with EPU increases. The structure of the interbank liabilities of commercial banks changes with the increase in EPU. The significant increase in the scale of borrowed funds and financial assets sold for repurchase indicates that commercial banks obtain funds through interbank lending and sell financial assets to increase liquidity hoarding. This finding is consistent with the logic that commercial banks proactively adjust liabilities and supplement capital sources to hoard liquidity when EPU increases.

Column (3) of Table 6 shows that when the dependent variable is the proportion of interbank deposits, the regression coefficient of EPU is significantly negative. This result indicates that, as EPU increases, the scale of the interbank deposits of commercial banks drops significantly. As interbank deposits are funds deposited by other financial institutions in commercial banks, similar to public deposits, they have the attributes of passive liabilities; therefore, a significant decrease in the scale of interbank deposits indicates that other financial institutions have reduced the funds deposited in commercial banks. This result shows that the increase in EPU causes interbank financial institutions to reduce the supply of funds, confirming the internal logic of liquidity hoarding.

The results of the changes in the interbank liability structure in Table 6 show that, with the increase in EPU, commercial banks actively increase liquidity acquisition by increasing borrowed funds and selling financial assets for repurchase. They also lower the liquidity supply by reducing the funds deposited in interbank financial institutions, producing a significant liquidity-hoarding effect, corroborating H<sub>3</sub>.

The significantly negative regression coefficients of interbank liabilities in Table 5 are related to the interbank liability structure of Chinese commercial banks. Furthermore, EPU's impact causes its change in direction and magnitude. On the one hand, from the perspective of the structure of China's interbank liabilities, interbank deposits have the largest scale compared to borrowed funds and sales for repurchase. For example, among this study's sample banks, the sum of the proportions of borrowed funds and financial assets sold for repurchases from 2015, 2016, and 2017 were 39.91%, 47.42%, and 48.44%, respectively, while interbank deposits comprised 60.09%, 52.58%, and 51.56%, respectively. Therefore, the scale of interbank deposits exceeds the sum of the previous two. Consistent findings can also be drawn from other years' data (Table 7).

On the other hand, regarding the changes in the three types of interbank liabilities concerning EPU, Table 6 shows that the scale of borrowed funds and financial assets sold for repurchases increased significantly with the increase in EPU; however, the regression coefficients of EPU for these scales are 0.358 and 0.443, respectively, and the increase is relatively small. Furthermore, the scale of interbank deposits significantly reduced, and the regression coefficient of EPU was  $-1.939$ , indicating a decrease significantly exceeding the sum of borrowed funds and financial assets sold for repurchases. Therefore, owing to the large scale of interbank deposits by Chinese commercial banks, the substantial decline, and the increase in EPU, the scale of interbank liabilities generally shows a downward trend.

**Table 8**  
The impact of EPU on the liability liquidity hoarding of commercial banks.

Variables	<i>LiabilityLH1</i>	<i>LiabilityLH2</i>	<i>IBliabilityLH1</i>	<i>IBliabilityLH2</i>
	(1)	(2)	(3)	(4)
<i>EPU</i>	<b>10.580***</b> (10.53)	<b>3.794***</b> (7.73)	<b>3.938***</b> (5.88)	<b>2.848***</b> (6.16)
<i>L.Size</i>	24.810*** (5.09)	4.900* (1.98)	-4.982** (-2.14)	-4.382*** (-2.66)
<i>L.ROA</i>	-3.305 (-0.83)	0.566 (0.25)	-4.107 (-1.53)	-2.706 (-1.62)
<i>L.CAR</i>	-0.392*** (-2.83)	-0.293*** (-2.65)	0.390 (1.43)	0.162 (0.92)
<i>L.NIAR</i>	8.246*** (3.83)	4.029*** (3.30)	1.230 (0.88)	1.566* (1.82)
<i>L.NPLR</i>	2.693** (2.14)	1.317** (2.01)	-0.478 (-0.77)	0.0894 (0.22)
<i>L.Equi</i>	0.877** (2.03)	-0.026 (-0.09)	0.079 (0.14)	-0.002 (-0.01)
<i>L.CPI</i>	-3.888*** (-5.74)	-1.630*** (-4.08)	-0.255 (-0.59)	-0.509* (-1.91)
<i>L.GDP</i>	10.720*** (6.97)	5.628*** (6.38)	2.192* (1.73)	2.340*** (2.91)
<i>L.M2</i>	-0.819* (-1.84)	-0.566** (-2.44)	-0.291 (-1.34)	-0.296** (-2.19)
Constant	-262.7 (-1.64)	71.6 (0.89)	135.7* (1.86)	139.1*** (2.78)
Bank-fixed effect	Yes	Yes	Yes	Yes
Sample size	716	716	758	758
R-squared	0.520	0.218	0.137	0.182
Number of banks	116	116	117	117

Notes: (1) This table displays the impact of EPU on the liability liquidity hoarding of commercial banks. We study the liquidity-hoarding behavior of commercial banks from both the overall liability liquidity-hoarding aspect and the interbank liability liquidity-hoarding aspect. We consider two different weights to calculate the measures for both of these two liquidity-hoarding indexes, as shown in Columns (1)–(2) and Columns (3)–(4), respectively. (2) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at 1%, 5%, and 10% levels, respectively.

#### 4.3. EPU and the liability liquidity hoarding of commercial banks

After analyzing the changes in commercial banks' liability structure, we investigate the economic consequences under EPU from the perspective of central banks' liability liquidity hoarding. For this purpose, concerning the Berger et al. (2022b) method, we construct the liability liquidity-hoarding index with the weighted average of the proportion of borrowings from the central bank, debentures payable, interbank liabilities, and deposits. This approach allows us to examine the degree of liquidity hoarding of the overall liabilities. We use the weighted average of the proportion of borrowed funds, sales for repurchase, and interbank deposits to construct the index of liquidity hoarding of interbank liabilities for examining the degree of liquidity hoarding of interbank liabilities.<sup>8</sup> Interbank deposits are passive liabilities, whereas borrowed funds and sales for repurchase are active liabilities; therefore, we improve upon the calculation method of Berger et al. (2022b) to remain consistent with the perspective and logic of the liquidity hoarding of commercial banks herein. The sign of the proportion of interbank deposits is set to negative when calculating the index mentioned above. Table 8 presents the regression results.

First, we analyze the impact of EPU on the overall liquidity hoarding of commercial banks. Column (1) of Table 8 shows that when the dependent variable is the overall liability liquidity hoarding, the regression coefficient of EPU is significantly positive, indicating that the degree of liability liquidity hoarding increases with EPU from the perspective of the overall liability structure. Similarly, Column (2) replaces the weight of the overall liability liquidity-hoarding index. As a result, the regression coefficient of EPU was also significantly positive. From the perspective of the liquidity hoarding of interbank liabilities, Column (3) of Table 8 shows that the regression coefficient of EPU is significantly positive when the dependent variable is the liquidity hoarding of interbank liabilities. Therefore, the liquidity hoarding of commercial banks' interbank liabilities increases with EPU.

<sup>8</sup> The overall liability liquidity hoarding index of commercial banks is expressed by the weighted average of the proportion of loans from the central bank, the proportion of debentures payable, the proportion of interbank liabilities, and the proportion of deposits:  $LiabilityLH = w_1CBBorrowing + w_2Debentures + w_3Debtentures + w_4Deposit$ . The four weights of *LiabilityLH1* are 4, 3, 2, and 1, respectively, and *LiabilityLH2* has a weight of 1. The commercial banks' interbank liability liquidity hoarding index is expressed by the weighted average of the proportion of borrowed funds, the proportion of sales for repurchase, and the proportion of interbank deposits:  $IBliabilityLH = w_1DepositFund + w_2Repur - w_3BankDeposit$ . The three weights of *IBliabilityLH1* are 3, 2, and 1, respectively, and *IBliabilityLH1* has a weight of 1.

**Table 9**  
The heterogeneous impact of EPU on the deposit maturity structure of commercial banks.

Variables	<i>DemandDeposit</i>	<i>TimeDeposit</i>
	(1)	(2)
<i>EPU</i> *large commercial banks dummy	2.210*** (3.88)	-2.379*** (-4.02)
<i>EPU</i> *joint-venture commercial bank dummy	2.834*** (4.44)	-3.517*** (-5.28)
<i>EPU</i> *urban commercial banks dummy	1.109*** (3.29)	-0.805* (-1.74)
<i>EPU</i> *rural commercial bank dummy	1.991*** (4.41)	-2.465*** (-5.09)
<i>L.Size</i>	-6.038*** (-3.63)	0.417 (0.28)
<i>L.ROA</i>	1.031 (0.69)	0.253 (0.15)
<i>L.CAR</i>	-0.299** (-2.57)	-0.354* (-1.69)
<i>L.NIAR</i>	-0.692 (-1.04)	1.664** (2.24)
<i>L.NPLR</i>	0.698* (1.82)	0.155 (0.35)
<i>L.Equi</i>	0.0885 (0.35)	0.607 (1.56)
<i>L.CPI</i>	-0.603** (-1.99)	0.414* (1.66)
<i>L.GDP</i>	2.738*** (3.91)	-1.045 (-1.58)
<i>L.M2</i>	0.00630 (0.05)	-0.0223 (-0.18)
Constant	228.4*** (4.50)	-8.578 (-0.21)
Bank-fixed effect	Yes	Yes
Sample size	752	752
R-squared	0.440	0.144
Number of banks	114	114

Notes: (1) This table displays the heterogeneous impact of EPU on the deposit maturity structure of commercial banks. *DemandDeposit* and *TimeDeposit* measure the deposit maturity structure, as shown in Columns (1) and (2), respectively. The heterogeneous impacts of EPU on five types of banks are considered, including large commercial banks, joint-venture commercial banks, urban commercial banks, rural commercial banks, and foreign banks. (2) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at 1%, 5%, and 10% levels, respectively.

Similarly, Column (4) replaces the weight of the interbank liability liquidity-hoarding index; the regression coefficient of *EPU* is also significantly positive. In addition, Table 8 examines various setting methods for liquidity-hoarding weights, and the results are consistent. The increase in EPU leads commercial banks to adjust their liability structure and supplement funding sources in various ways, resulting in significant liability liquidity-hoarding effects.

#### 4.4. The heterogeneous impact of EPU on the liability structure of commercial banks

In China's banking system, considerable differences exist in the sizes of various banks, potentially causing the bank's liability structure adjustment to show varying degrees of EPU sensitivity. For example, large banks have better capital strength and more business outlets than small banks, and the implicit state credit guarantee behind them is evident; this can send a "too big to fail" signal to other countries. Therefore, large banks have more stable deposit sources, subject to more negligible impacts from uncertainty on their deposits. Moreover, larger banks have channels to promptly obtain accurate policy information and can make reasonable market expectations based on this, reducing errors in risk decisions. In addition, large banks are more important in economic and social development, focus more on risk management, are more conservative, and participate less in high-risk businesses. Therefore, we further investigate the heterogeneous impact of EPU on the adjustment of commercial banks' liability structure from the bank-scale perspective. For this, we perform a heterogeneity analysis of five types of banks: large commercial banks, joint-venture banks, urban banks, rural commercial banks, and foreign banks.

##### 4.4.1. The heterogeneous impact of EPU on the deposit maturity structure of commercial banks

First, we investigate the heterogeneity impact of EPU on the term structure of commercial bank deposits; Table 9 shows the results. The interaction terms between different bank-scale virtual variables and *EPU* are significantly positive for the proportion of demand deposits. Conversely, bank-scale virtual variables' interactions with the *EPU* items are significantly negative for the time-deposit ratio,

**Table 10**  
The heterogeneous impact of EPU on the overall liability structure of commercial banks.

Variables	<i>CBBorrowing</i>	<i>Debentures</i>	<i>DepositFund</i>	<i>Repur</i>	<i>BankDeposit</i>	<i>Deposit</i>
	(1)	(2)	(3)	(4)	(5)	(6)
EPU*large commercial banks dummy	0.979*** (3.11)	0.00575 (0.03)	0.251 (1.46)	0.157 (0.63)	-1.705*** (-3.15)	0.0501 (0.07)
EPU*joint-venture commercial bank dummy	1.160*** (6.55)	1.558*** (4.39)	0.346*** (2.94)	-0.109 (-0.39)	-1.480** (-2.18)	-1.174 (-1.43)
EPU*urban commercial banks dummy	0.126 (1.64)	2.289*** (8.57)	0.330** (2.13)	0.295 (1.36)	-2.178*** (-4.65)	-0.261 (-0.54)
Epu*rural commercial bank dummy	0.275* (1.86)	1.795*** (4.23)	0.273** (2.47)	0.712** (2.46)	-1.676*** (-4.05)	-0.124 (-0.18)
<i>L.Size</i>	0.410** (2.20)	5.109*** (5.49)	0.878* (1.94)	-1.952** (-2.27)	3.796** (2.31)	-8.246*** (-4.12)
<i>L.ROA</i>	-0.475*** (-3.21)	-1.394* (-1.87)	0.0496 (0.12)	-1.434 (-1.44)	0.916 (0.76)	3.724** (2.09)
<i>L.CAR</i>	0.00416 (0.45)	-0.0423 (-1.32)	-0.00656 (-0.15)	0.181*** (2.73)	0.0425 (0.44)	-0.209* (-1.70)
<i>L.NIAR</i>	0.0736 (0.81)	1.240*** (3.31)	0.0677 (0.36)	-0.470 (-1.05)	-1.871*** (-3.10)	1.742* (1.69)
<i>L.NPLR</i>	-0.0528 (-0.66)	0.472** (2.11)	0.0145 (0.16)	-0.432* (-1.77)	-0.742** (-2.05)	0.493 (0.94)
<i>L.Equi</i>	0.0545*** (2.78)	0.220*** (2.85)	0.0623 (0.49)	0.00999 (0.08)	0.157 (0.84)	-0.586** (-2.20)
<i>L.CPI</i>	-0.154*** (-4.53)	-0.618*** (-5.72)	-0.0699 (-0.98)	0.395** (2.39)	0.811*** (3.92)	-0.318 (-1.16)
<i>L.GDP</i>	0.267*** (3.35)	1.108*** (3.89)	0.177 (0.89)	-0.583 (-1.54)	-2.476*** (-4.14)	2.535*** (3.57)
<i>L.M2</i>	-0.0625*** (-3.57)	-0.0792 (-1.03)	0.0121 (0.31)	0.00710 (0.09)	0.375*** (3.31)	-0.453*** (-2.88)
Constant	3.831 (0.70)	-79.96*** (-2.77)	-16.10 (-1.21)	19.46 (0.74)	-150.6*** (-3.12)	307.1*** (5.68)
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	727	768	767	778	790	791
R-squared	0.401	0.640	0.087	0.119	0.201	0.404
Number of banks	116	117	117	117	117	117

Notes: (1) This table displays the heterogeneous impact of EPU on the overall liability structure of commercial banks. The overall structure of liability consists of four types of liabilities measured by *CBBorrowing*, *DepositFund*, *Debentures*, *IBLiabilities*, and *Deposit*, in which *DepositFund*, *Repur*, and *BankDeposit*, measure the structure of interbank liability, as shown in Columns (3)–(5) respectively. The heterogeneous impacts of EPU on five types of banks are considered: large commercial banks, joint-venture commercial banks, urban commercial banks, rural commercial banks, and foreign banks. (2) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at 1%, 5%, and 10% levels, respectively.

indicating that the enhancement of EPU may lead to increased demand deposits and decreased time deposits. However, the difference lies in the magnitude of the coefficient. The absolute value of the interaction term is the largest for the joint-venture commercial bank, indicating that the impact of the increasing EPU on their deposit maturity structure is the greatest. Implicit state credit guarantees typically underpin large commercial banks; thus, they are relatively less sensitive to the impact of EPU. Regarding city commercial banks, the interaction value is the smallest in magnitude regarding their proportion of demand deposits and the proportion of time deposits. It may be that the credibility and convenience of large commercial banks and joint-venture banks are likely better for urban residents than city commercial banks, indicating that city commercial banks are generally less preferred by city residents. Therefore, they are also the least exposed to EPU.

#### 4.4.2. The heterogeneous impact of EPU on the overall liability structure of commercial banks

We further investigate the heterogeneous impact of EPU on the overall liability structure of commercial banks. Table 10 shows the regression results. For joint-venture commercial banks, the coefficients of the interaction terms in Columns (1), (2), (3), and (5) are all significantly positive, indicating a relatively strong response to EPU fluctuations. Joint-venture commercial banks tend to use borrowings from the central bank, bond issuance, peer borrowings, and increasing repurchases to combat the risk of uncertainty during periods of EPU; however, their response is relatively moderate, and the interaction term is only significantly positive in Column (1) compared to large commercial banks. This result indicates that large commercial banks, owing to their stronger risk-management ability, only borrow money from the central bank when the EPU increases. These findings show that an increase in EPU is more likely to incite a liquidity-hoarding reaction in relatively small banks. In contrast, the impact on large commercial banks is relatively minimal.

**Table 11**  
Use of two-stage least squares method (2SLS).

Panel A						
Variables	<i>EPU</i>	<i>CBBorrowing</i>	<i>EPU</i>	<i>Debentures</i>	<i>EPU</i>	<i>DepositFund</i>
	1 stage	2 stage	1 stage	2 stage	1 stage	2 stage
	(1)	(2)	(3)	(4)	(5)	(6)
<i>USEPU</i>	1.778*** (36.55)		1.803*** (37.36)		1.789*** (37.32)	
<i>EPU</i>		0.194*** (3.06)		1.340*** (5.50)		-0.043 (-0.21)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	727	727	768	768	767	767
R-squared	0.791	0.245	0.800	0.399	0.800	0.450
F value	270.8		302.2		303.0	
Cragg-Donald Wald F statistic(10% CV)	1809.295 (16.38)		1856.823 (16.38)		1834.109(16.38)	
Panel B						
Variables	<i>EPU</i>	<i>Repur</i>	<i>EPU</i>	<i>BankDeposit</i>	<i>EPU</i>	<i>Deposit</i>
	1 stage	2 stage	1 stage	2 stage	1 stage	2 stage
	(7)	(8)	(9)	(10)	(11)	(12)
<i>USEPU</i>	1.806*** (37.61)		1.818*** (37.91)		1.820*** (37.93)	
<i>EPU</i>		0.960*** (3.48)		-1.320*** (-3.18)		-0.391 (-0.67)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	778	778	790	790	791	791
R-squared	0.801	0.158	0.804	0.247	0.804	0.320
F value	309.2		319.2		319.8	
Cragg-Donald Wald F statistic(10% CV)	1878.108 (16.38)		1912.564 (16.38)		1912.882 (16.38)	

Notes: (1) This table reports the robust checks of the impact of EPU on the overall liability structure of commercial banks using the 2SLS method. We use the US EPU index that Baker et al. (2016) developed as an instrumental variable in the first stage. (2) The liabilities structures are measured by *CBBorrowing*, *Debentures*, *DepositFund*, *Repur*, *BankDeposit*, and *Deposit*, respectively. The results are displayed in panels A and B. (3) We also report the Cragg-Donald Wald F Statistic and its critical values at the 10% level (in parentheses) to illustrate the validity of our instrumental variables. (4) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at 1%, 5%, and 10% levels, respectively.

#### 4.5. Endogeneity

This study may have endogeneity problems. Liquidity hoarding on the liability side of banks at the micro level is unlikely to affect the EPU level at the macro level; thus, there may be no bidirectional causality problem between EPU and liquidity-hoarding behavior on the liability side of banks. Nonetheless, the debt restructuring of EPU and banks may be affected by economic uncertainties or uncertainties from other sources; omitted variables may cause endogeneity problems. To alleviate the estimation bias caused by omitted variables, we control for variables reflecting macroeconomic conditions in the benchmark regression. Moreover, we used the instrumental variable approach to alleviate the endogeneity problem.

Following Wang et al. (2014), we adopted the EPU index of the United States (*USEPU*) as an instrumental variable to solve the endogeneity problem because uncertainty in US economic policy is highly correlated with uncertainty in Chinese economic policy. For example, Maćkowiak (2007) found that the interest and exchange rates of emerging market countries would be significantly affected by the monetary policy of the US. Such external shocks are an important source of macroeconomic volatility in emerging market countries. Therefore, adopting the *USEPU* as the instrumental variable for China's EPU index meets the correlation requirement. Moreover, as China's financial market is mainly closed to other countries, the *USEPU* only affects the debt structure of Chinese commercial banks by affecting China's EPU; it will not directly affect this study's variables. Therefore, this study's instrumental variables meet the exogeneity requirements. We used the two-stage least squares method (2SLS) with the *USEPU* as an instrumental variable. Table 11 shows the results, indicating that in addition to the proportion of borrowed funds, loans from the central bank, bonds payable, sales for repurchase, and interbank deposits, the regression coefficient of *USEPU* in the first stage regression results is significantly positive.

Furthermore, the Cragg-Donald Wald F statistic is 1878.108, much higher than the Stock-Yogo 10% threshold of 16.38, rejecting the null hypothesis of weak instrumental variables. This finding indicates that the instrumental variables selected in this study meet the

correlation requirements; hence, the instrumental variable is valid. The EPU regression coefficients in the second stage are all significant, and the signs are consistent with the above. This result is consistent with the earlier results.

#### 4.6. Robustness tests

We conducted a placebo test following Berger et al. (2022b) to alleviate the possibility that our results are incidental. The specific method involves sampling the actual EPU data to generate new EPU data. Then, based on the new EPU data from random sampling, we run regressions to obtain the new coefficients. This simulation was repeated 100 times, and the distribution of the pseudo-EPU regression coefficient estimates was plotted. We found that the center of the estimated coefficient distribution is close to zero. Therefore, the regression results of the pseudo-EPU obtained based on random sampling are insignificant, indicating that the estimation results of the primary regression are unlikely to be incidental.

We conducted comprehensive robustness tests regarding the regression results of commercial banks' liability structure adjustment. We included the following treatments: excluding the impact of economic uncertainty, excluding large state-owned commercial banks, using the dynamic panel model, use of the annual geometric average EPU index, and the EPU index built based on mainland Chinese newspapers. Furthermore, we lagged the EPU by one period and controlled for time-fixed effects. The detailed results are presented in the Appendix.

### 5. Conclusion

This study systematically examined the motivations, internal logic, and specific methods behind commercial banks adjusting their liability structure in uncertain environments. Our findings have important implications for risk management, monetary policy implementation, and preventing systemic financial risks. The increase in EPU leads to depositors holding more cash for precautionary reasons, which increases demand deposits and decreases time deposits, thereby shortening the deposit maturity structure. Moreover, this negatively affects smaller banks more, increasing liability liquidity risk for commercial banks.

Shortening the deposit maturity structure forces commercial banks to rely on other forms of liability for financing, particularly interbank liabilities, which are more prone to triggering liquidity risks. Interbank liabilities are the second-largest source of funds for Chinese commercial banks, with deposits being the largest; however, interbank liabilities are highly affected by factors, such as market interest rates and financial supervision, which are unstable and have short maturities. This susceptibility makes them critical triggers for the liability liquidity risks of commercial banks. For instance, Baoshang Bank—which filed for bankruptcy—had interbank liabilities near 50% of its total liabilities at the end of Q3 2017. In contrast, the interbank liability ratio for the whole banking industry was around 20% and only 10% for large state-owned commercial banks. Therefore, excessive reliance on interbank liability financing is an important reason for the increase in liquidity risks of small and medium-sized banks, such as Baoshang Bank, and may lead to systemic financial risks.

Furthermore, shortening the deposit maturity structure of commercial banks may also lead to risks in their asset allocation. Under the impact of uncertainty, due to the reduced stability of commercial banks' funding sources, the maturity mismatch between short-term lending and long-term loans can be exacerbated if commercial banks do not adjust their asset allocation accordingly. Therefore, commercial banks should focus on adjusting their asset allocation strategies. With increased EPU, a more conservative asset allocation strategy should be adopted, and greater attention should be paid to matching the maturity of assets and liabilities, particularly the loan maturity structure. Shortening the loan maturity structure appropriately during increased EPU can prevent repayment and credit risks.

In an EPU environment, the central bank should focus more on commercial banks' liquidity and credit risks. As their lender of last resort, the central bank uses various monetary policy tools to provide funds, which is a critical mechanism for easing the tight liquidity of commercial banks. China's central bank also created flexible monetary policy tools, such as the Standing Lending Facility and the Medium-term Lending Facility, which can replenish commercial banks' liquidity and ease liquidity tension, which is crucial in preventing liquidity and systemic financial risks in the financial system.

Financing through debentures is a vital source of long-term funds for Chinese commercial banks, playing a significant role in commercial banks' funding. Therefore, further development of the debenture market, particularly the interbank market, significantly reduces risks in the banking sector and improves commercial banks' capital allocation efficiency.

#### CRediT authorship contribution statement

**Wei Deng:** Conceptualization, Formal analysis, Investigation, Writing – original draft. **Lei Gao:** Conceptualization, Methodology, Writing – review & editing, Software. **Fei Xing:** Methodology, Resources, Writing – review & editing, Visualization, Supervision, Project administration, Funding acquisition. **Ming Yang:** Data curation, Investigation, Validation.

#### Declaration of Competing Interest

None.

#### Data availability

Data will be made available on request.

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## Appendix A. Appendix

### A.1. Robustness test

We conducted comprehensive robustness tests for commercial banks' regression results concerning the liability structure adjustment. We excluded the impact of economic uncertainty, excluded large state-owned commercial banks, used the dynamic panel model, and the annual geometric average EPU and EPU indexes built based on mainland Chinese newspapers. Furthermore, we lagged the EPU by one period and controlled for time-fixed effects. The concrete results were as follows.

### A.2. Excluding the impact of economic uncertainty

A concern is that economic uncertainty rather than EPU may influence our regression results. EPU is usually positively correlated with economic uncertainty (Gulen and Ion, 2016). Following Bonaime et al. (2018), we further control the CVIX of China's stock market in the model. The results in Table A.1 show that the study's main conclusions remain unchanged after controlling for economic uncertainty, suggesting that other sources of uncertainty are unlikely to be the main reason behind our results.

**Table A.1**

Exclude the impact of economic uncertainty.

Variables	<u>CBBorrowing</u>	<u>Debentures</u>	<u>DepositFund</u>	<u>Repur</u>	<u>BankDeposit</u>	<u>Deposit</u>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>EPU</i>	<b>0.250***</b> (3.63)	<b>1.400***</b> (8.04)	<b>0.285***</b> (3.14)	<b>0.642***</b> (3.39)	<b>-1.190***</b> (-3.55)	<b>-0.393</b> (-1.10)
<i>CVIX</i>	0.0643*** (3.13)	0.289*** (4.07)	0.0419 (1.25)	-0.118 (-1.49)	-0.449*** (-4.30)	0.0399 (0.27)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	727	768	767	778	790	791
R-squared	0.293	0.636	0.094	0.120	0.219	0.403
Number of banks	116	117	117	117	117	117

Notes: (1) CVIX is China's stock market volatility index, measuring economic uncertainty. We add this control variable to the control variables to exclude the impact of economic uncertainty. (2) The liabilities structures are measured by CBBorrowing, Debentures, DepositFund, Repur, BankDeposit, and Deposit, respectively. (3) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

### A.3. Excluding large state-owned commercial banks

China's large state-owned commercial banks may be "too big to fail," and their liquidity risk and stability may be the main drivers for frequent policy adjustments; thus, the EPU may not be strictly exogenous to these large state-owned commercial banks. To alleviate this concern, we remove the sample of large state-owned commercial banks and conduct the regressions again. The results in Table A.2 show that the main results remain unchanged. This result indicates that the influence of large state-owned commercial banks on EPU cannot explain this study's main conclusions.

**Table A.2**

Exclude large state-owned commercial banks.

Variables	<u>CBBorrowing</u>	<u>Debentures</u>	<u>DepositFund</u>	<u>Repur</u>	<u>BankDeposit</u>	<u>Deposit</u>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>EPU</i>	<b>0.331***</b> (4.30)	<b>2.014***</b> (10.32)	<b>0.376***</b> (3.68)	<b>0.466***</b> (2.78)	<b>-2.022***</b> (-5.57)	<b>-0.341</b> (-0.90)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	685	729	724	736	747	791
R-squared	0.261	0.636	0.094	0.119	0.214	0.403
Number of banks	111	112	112	112	112	0.400

Notes: (1) The table shows the results of excluding six large commercial banks from the sample. (2) The liabilities structures are measured by *CBBorrowing*, *Debentures*, *DepositFund*, *Repur*, *BankDeposit*, and *Deposit*, respectively. (3) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

A.4. Using the dynamic panel model

Our model may have endogeneity issues; the adjustment of the liability structure of commercial banks may be dynamic. Therefore, we control for potential endogeneity issues in our regression model by implementing a differential generalized method of moments (GMM) estimation.

Our regression model was as follows:

$$Bank_{i,t} = \alpha_0 + \rho Bank_{i,t-1} + \alpha_1 EPU_t + \alpha_2 X_{i,t-1} + FirmFE + \varepsilon_{i,t} \tag{A.1}$$

Table A.3 shows the regression results. The consistency of differential GMM depends on whether the hypothesis conditions are met, which requires two hypothesis tests. First, the Hansen overidentification constraints test determined the validity of the instrumental variables. The null hypothesis of this test is that the instrumental variables are not correlated with the error terms. Second, the second-order serial correlation of the random error terms of the differential equations was tested using the Arellano–Bond autocorrelation test. The null hypothesis is that there is no second-order serial correlation in the random error terms of the first-order difference equations. If the null hypothesis is not rejected, the instrumental variables are valid, and the model is set correctly. For this purpose, we report the p-values of the Hansen test, which show no overidentification problem. We also show the results of the Arellano–Bond test. The p-values of the first-order autocorrelation AR (1) and second-order autocorrelation AR (2) tests show that our identification strategy is effective. Hence, the regression coefficients of *EPU* in Columns (1)–(5) of Table A.3 are all significant, with the signs being consistent with the above result, indicating that the results based on Model (1) are robust.

**Table A.3**  
Use the dynamic panel model.

Variables	<i>CBBorrowing</i>	<i>Debentures</i>	<i>DepositFund</i>	<i>Repur</i>	<i>BankDeposit</i>	<i>Deposit</i>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>EPU</i>	0.212** (2.47)	0.755*** (3.27)	0.321*** (2.77)	0.664*** (3.80)	-0.949*** (-2.65)	-0.552 (-1.46)
<i>CBBorrowing</i> <sub>t-1</sub>	0.272** (2.15)					
<i>Debentures</i> <sub>t-1</sub>		0.577*** (3.82)				
<i>DepositFund</i> <sub>t-1</sub>			0.312** (2.43)			
<i>Repur</i> <sub>t-1</sub>				0.337*** (3.38)		
<i>BankDeposit</i> <sub>t-1</sub>					0.559*** (4.41)	
<i>Deposit</i> <sub>t-1</sub>						0.414*** (4.25)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Hansen P	0.119	0.282	0.217	0.354	0.186	0.398
AR(1) P	0.004	0.004	0.039	0.002	0.000	0.003
AR(2) P	0.312	0.818	0.626	0.420	0.730	0.923
Sample size	369	511	505	527	540	541
Number of banks	99	108	108	109	109	109

Notes: (1) This table presents robust checks of the impact of *EPU* on the liability structure of commercial banks by using a dynamic panel model. (2) The liabilities structures are measured by *CBBorrowing*, *Debentures*, *DepositFund*, *Repur*, *BankDeposit*, and *Deposit*, respectively. (3) We take the *EPU* and the first lag value of the dependent variable as endogenous variables and use the *xtabond2* command in STATA 15 to estimate the dynamic panel model with the differential GMM method. We report the p-values of the Hansen test, which show no overidentification problem. At the same time, we show the Arellano–Bond test results, and the p-values of the first-order autocorrelation AR (1) and second-order autocorrelation AR (2) tests show that our identification strategy is effective. (4) The T-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at 1%, 5%, and 10% levels, respectively.

A.5. Using other methods to construct the annual indicators of *EPU*

Following Wu et al. (2020), we use the annual geometric mean to construct the *EPU* index; Table A.4 presents the regression results. The regression coefficient of *EPU* is significantly positive for borrowings from the central bank, debentures payable, borrowed funds, and sales for repurchase. In contrast, the regression coefficient of *EPU* is significantly negative for interbank deposits, which is consistent with previous results.

Table A.4

Robustness tests using other methods to construct annual indicators of EPU.

Variables	<u>CBBorrowing</u>	<u>Debentures</u>	<u>DepositFund</u>	<u>Repur</u>	<u>BankDeposit</u>	<u>Deposit</u>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>EPU</i>	<b>0.057***</b> (4.70)	<b>0.285***</b> (10.07)	<b>0.052***</b> (4.00)	<b>0.073***</b> (2.93)	<b>-0.266***</b> (-5.12)	<b>-0.060</b> (-1.04)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	727	768	767	778	790	791
R-squared	0.285	0.623	0.090	0.119	0.188	0.403
Number of banks	116	117	117	117	117	117

Notes: (1) The EPU data in this table are based on the geometric average of monthly data. (2) The liabilities structures are measured by *CBBorrowing*, *Debentures*, *DepositFund*, *Repur*, *BankDeposit*, and *Deposit*, respectively. (3) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

#### A.6. Using the EPU index based on mainland Chinese newspapers

The China EPU index built by Baker et al. (2016) is based on Hong Kong's *South China Morning Post*. Davis et al. (2019) constructed a similar EPU index based on the *People's Daily* and *Guangming Daily*, which are mainland Chinese newspapers. Therefore, this study used the EPU index (*MainlandEPU1*) based on mainland Chinese newspapers for the robustness test; the results are shown in Table A.5. Except for the EPU coefficient of the sales for repurchase not being significant, the other results are consistent with the previous discussions.

Table A.5

Robustness tests using the EPU index from Davis et al. (2019).

Variables	<u>CBBorrowing</u>	<u>Debentures</u>	<u>DepositFund</u>	<u>Repur</u>	<u>BankDeposit</u>	<u>Deposit</u>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>EPU2</i>	<b>0.814***</b> (4.98)	<b>4.009***</b> (8.06)	<b>0.788***</b> (2.71)	<b>0.303</b> (0.68)	<b>-5.068***</b> (-6.26)	<b>0.0180</b> (0.02)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	727	768	767	778	790	791
R-squared	0.272	0.603	0.087	0.110	0.205	0.402
Number of banks	116	117	117	117	117	117

Notes:(1) The EPU index of this table is constructed by Davis et al. (2019) based on newspapers in mainland China. (2) The liabilities structures are measured by *CBBorrowing*, *Debentures*, *DepositFund*, *Repur*, *BankDeposit*, and *Deposit*, respectively. (3) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

Based on Baker et al.'s (2016) method, Huang and Luk (2020) constructed an EPU index (*MainlandEPU2*) based on ten mainland Chinese newspapers: *Beijing Youth Daily*, *Guangzhou Daily*, *Jiefang Daily*, *People's Daily Overseas Edition*, *Shanghai Morning Post*, *Southern Metropolis Daily*, *The Beijing News*, *Today Evening Post*, *Wen Hui Daily*, and *Yangcheng Evening News*. This study used this EPU index (*MainlandEPU2*) for the robustness test; Table A.6 presents the results, indicating that this study's primary results are robust.

Table A.6

Robustness tests using the EPU index from Huang and Luk (2020).

Variables	<u>CBBorrowing</u>	<u>Debentures</u>	<u>DepositFund</u>	<u>Repur</u>	<u>BankDeposit</u>	<u>Deposit</u>
	(1)	(2)	(3)	(4)	(5)	(6)
<i>EPU3</i>	<b>0.289</b> (1.00)	<b>7.771***</b> (7.56)	<b>2.160***</b> (3.24)	<b>7.199***</b> (3.74)	<b>-6.991***</b> (-2.77)	<b>-6.926*</b> (-1.92)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	727	768	767	778	790	791
R-squared	0.224	0.558	0.077	0.127	0.141	0.405
Number of banks	116	117	117	117	117	117

Notes: (1) The EPU index of this table is constructed by Huang and Luk (2020) based on newspapers in mainland China. Compared with the EPU index constructed by Davis et al. (2019), this EPU is based on more information from newspapers in mainland China. (2) The liabilities structures are measured by *CBBorrowing*, *Debentures*, *DepositFund*, *Repur*, *BankDeposit*, and *Deposit*, respectively. (3) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

### A.7. Lagging EPU by one period

Commercial banks may need time to adjust their debt structure, so we regress on EPU with one lag. The results are shown in Table A.7, and the main results of this study are robust.

**Table A.7**

Robustness tests using the first lag of the EPU index.

Variables	<u>CBBorrowing</u>	<u>Debentures</u>	<u>DepositFund</u>	<u>Repur</u>	<u>BankDeposit</u>	<u>Deposit</u>
	(1)	(2)	(3)	(4)	(5)	(6)
<b>L.EPU</b>	<b>0.680***</b>	<b>3.977***</b>	<b>0.494***</b>	<b>-0.175</b>	<b>-0.178</b>	<b>-5.052***</b>
	(7.91)	(13.87)	(3.03)	(-0.47)	(-0.43)	(-8.24)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	614	643	642	652	661	662
R-squared	0.356	0.642	0.050	0.078	0.205	0.409
Number of banks	114	115	115	115	115	115

Notes:(1) This table shows the regression results of EPU with one-stage lag (*L.EPU*). (2) The liabilities structures are measured by *CBBorrowing*, *Debentures*, *DepositFund*, *Repur*, *BankDeposit*, and *Deposit*, respectively. (3) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

### A.8. Controlling of time-fixed effects

To avoid multi-collinearity problems, we do not control for time-fixed effects, instead controlling for variables reflecting macroeconomic conditions; however, there may be temporal heterogeneity regardless of macroeconomic conditions. Therefore, for the sake of robustness, we further control for time-fixed effects and delete three control variables, namely the CPI, the GDP growth rate (*GDP*), and the M2 growth rate (*M2*). Table A.8 reports the results and shows that this study's primary results are robust.

**Table A.8**

Robustness tests controlling for time-fixed effects.

Variables	<u>CBBorrowing</u>	<u>Debentures</u>	<u>DepositFund</u>	<u>Repur</u>	<u>BankDeposit</u>	<u>Deposit</u>
	(1)	(2)	(3)	(4)	(5)	(6)
<b>EPU</b>	<b>0.694***</b>	<b>4.062***</b>	<b>0.524***</b>	<b>0.121</b>	<b>-0.603</b>	<b>-3.562***</b>
	(7.67)	(13.64)	(2.67)	(0.42)	(-1.43)	(-3.91)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Sample size	727	768	767	778	790	791
R-squared	0.325	0.639	0.060	0.105	0.213	0.386
Number of banks	116	117	117	117	117	117

Notes: (1) This table shows the regression results controlling for year-fixed effects. (2) The liabilities structures are measured by *CBBorrowing*, *Debentures*, *DepositFund*, *Repur*, *BankDeposit*, and *Deposit*, respectively. (3) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

### A.9. Excluding foreign banks

Foreign banks face uncertainty shocks from the operating jurisdiction (i.e., China) and their home countries. For instance, after the subprime crisis, many foreign banks retreated due to the significant losses suffered by their parent companies in their home countries. Therefore, we exclude foreign banks from the sample for robustness checks. The results are shown in Table A.9, revealing that this study's main results are robust.

**Table A.9**

Robustness tests excluding foreign banks.

Variables	<u>CBBorrowing</u>	<u>Debentures</u>	<u>DepositFund</u>	<u>Repur</u>	<u>BankDeposit</u>	<u>Deposit</u>
	(1)	(2)	(3)	(4)	(5)	(6)
<b>EPU</b>	<b>0.358***</b>	<b>1.927***</b>	<b>0.436***</b>	<b>0.478***</b>	<b>-2.166***</b>	<b>-0.266</b>
	(4.55)	(9.52)	(4.56)	(2.81)	(-5.69)	(-0.66)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes

(continued on next page)

Table A.9 (continued)

Variables	<u>CBBorrowing</u>	<u>Debentures</u>	<u>DepositFund</u>	<u>Repur</u>	<u>BankDeposit</u>	<u>Deposit</u>
	(1)	(2)	(3)	(4)	(5)	(6)
Sample size	727	768	767	778	790	791
R-squared	0.288	0.636	0.149	0.138	0.238	0.414
Number of banks	116	117	117	117	117	117

Notes: (1) This table shows the regression results excluding foreign banks. (2) The liabilities structures are measured by *CBBorrowing*, *Debentures*, *DepositFund*, *Repur*, *BankDeposit*, and *Deposit*, respectively. (3) The t-statistics calculated based on robust standard errors are reported in parentheses. \*\*\*, \*\*, and \* represent statistical significance at the 1%, 5%, and 10% levels, respectively.

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