The impact of banking regulatory policies on the expansion of shadow banking business in China

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Abstract: To better examine how shadow banking activities are affected by banking regulation, this paper uses the implementation of new regulatory standards in China's banking sector in 2011 as a quasi-natural experiment to test whether China's banking regulatory policies were effective in curbing shadow banking activities from 2007 to 2019 using data on banks' entrusted loans to measure the size of shadow banking business. The findings of this study are as follows: Firstly, the new regulatory standards had effectively inhibited the development of shadow banking business such as entrusted loans. Mechanism analysis showes that CAR had a significant positive impact on entrusted loans, once the CAR fell, the entrusted loans decreased. Meanwhile, the higher the LIR was, the more shadow banking activities Chinese banks were likely to engage in. Further insight reveales that among banks with larger assets and higher profitability, the impact of the new regulatory policies on shadow banking business was more significant. The results remain robust when the paper also consideres the policies issued in 2017 for shadow banking. The findings of this paper demonstrate the actual effect of China's regulation on shadow banking from a micro perspective and provide a scientific and theoretical basis for the implementation of regulatory policies.

Keywords: Shadow banking; Entrusted loans; Banking regulation; Systemic risk

1 Introduction

In recent years, China has gradually established and improved its banking regulatory system, and in order to effectively prevent systemic financial risks, China has been insisting on improving its banking regulatory system, which can also be seen from the outline of the latest 14th Five-Year Plan that China needs to "improve the modern financial regulatory system and improve the regulatory framework for full risk coverage" to deal with potential Risks. At the same time, with the continuous expansion of financial innovation activities, hidden risks in the financial system are gradually accumulating. In particular, it is important to pay attention to the insufficient supply of on-balance-sheet credit and the rapid expansion of off-balance-sheet activities in recent years. Then along with the cross-nesting of off-balance-sheet business and new business, it has become an important part of shadow banking activities, which has also triggered many researchers to pay great attention to shadow banking and the risks it brings (Yu et al., 2020; Zhuang & Zhang, 2021; Yu, 2021). Based on these backgrounds, this paper primarily examines from a theoretical analysis perspective whether China's banking regulation can curb the rapid development of shadow banking in the banking sector, thereby effectively reducing systemic risks. Unlike previous studies, this paper attempts to use the "Implementation of New Regulatory Standards in China's Banking Sector in 2011" as a quasi-natural experiment, and employs bank entrusted loan data to measure the scale of shadow banking activities assessing the effectiveness of China's banking regulatory policies in restraining shadow banking activities.

In both theoretical and policy research perspectives, shadow banking has become an important source of systemic risk due to its strong regulatory avoidance properties. Many scholars believe that the U.S. subprime mortgage crisis was caused by shadow banking, and the inadequate regulation of shadow banking became the main reason for the occurrence of the U.S. subprime mortgage crisis (Fève et al., 2019). At the same time, people have gradually realized that the shadow banking system formed through financial innovation has significant risk vulnerabilities. Since the funding sources of shadow

banks are highly influenced by market liquidity and less regulated, they are highly susceptible to systemic financial risks due to maturity mismatch, liquidity switching, credit switching and high leverage. High leverage increases the probability of a run on shadow banks, which in turn forces the early liquidation of assets causing asset markdowns for sale, and the decline in asset prices further leads to the weakening of shadow bank assets and liabilities (Gertler et al., 2016), which can increase economic volatility and affect financial and economic stability if transmitted to the commercial banking system and the real economy (Fève et al. 2019). Therefore, shadow banking has become an important issue of concern for academics and government regulators in recent years. Many scholars have conducted a lot of research around the issues of shadow banking's scale measurement, operation mechanism, risk and impact (Li, 2019; Zhang, 2013; Zhu et al., 2016; Zhou & Wang, 2021), but the current definition of shadow banking is quite dispersed and varies greatly in scope and magnitude. One widely accepted definition is from the International Financial Stability Board (IFSB), which states that shadow banking is a system of credit intermediation that operates outside of the banking regulatory framework, potentially leading to systemic risks and regulatory arbitrage, including various related institutions and business activities. In China, Shadow banking is essentially a "shadow" of commercial banks, with non-bank financial institutions serving merely as channels or carriers, transferring commercial bank funds off-balance sheet to evade regulatory constraints such as capital adequacy ratios, liquidity ratios, and loan provisioning ratios (Sun & Jia, 2015). Therefore, in this context, how Chinese banking regulation affects shadow banking activities has become an important issue for theoretical research.

Theoretically, banking regulatory measures originated from concerns over bank crises and attempted to prevent them through artificial regulation. Banks are inherently fragile and there is always a market failure if they are left free to develop, especially in recent times when banking crises have occurred frequently and caused great losses to the economic system (Lei, 2007). While general industry regulation tries to improve market efficiency by introducing market mechanisms, banking regulation is mainly devoted to preventing systemic risks, and its various regulatory measures do not help to improve efficiency. Even in the case of less mature banking regulation, the regulatory measures may have many drawbacks. For example, they distort the market behavior of the banking industry, bring high regulatory costs, and induce new risk factors (Shen & Li, 2005). Due to the systemic risks embedded in shadow banking and the impact of the financial crisis, a new wave of strong regulation was opened after the subprime mortgage crisis in the United States. The United States passed the Dodd-Frank Act in 2010, historically known as the toughest financial regulatory act in the post-war United States. The Act expands the powers of regulators and establishes a new Consumer Financial Protection Bureau to fully protect the legal rights of consumers. It also adopted the "Walker Rule" to restrict speculative trading by large financial institutions, especially to strengthen the regulation of financial derivatives.In addition to the Dodd-Frank Act, the Basel Accord, an important regulatory standard for the international banking industry, is being revised for the third time. Which requires members to complete the development and revision of regulatory regulations within two years; as a major member country, China issued the "Guidance on the Implementation of New Regulatory Standards for the Banking Industry in China" (hereinafter referred to as the Guidance) in 2011, based on the actual operation and supervision of the domestic banking industry. Guidance), which sets out clear requirements for specific regulatory indicators such as capital adequacy ratio, bar ratio and provision coverage ratio, hoping to promote the sound operation of the banking industry by improving prudential supervision standards in the banking sector.

At the same time, the pace of shadow banking in China has continued to grow at an alarming rate in the context of banking regulation. As shown in Figure 1, by the end of 2019, the scale of China's broad shadow banking reached 84.40 trillion yuan, and the scale of shadow banking consisting of entrusted loans, trust loans and bank acceptances also reached 22.22 trillion yuan.

Meanwhile, as seen in Figure 2, from 2007 to 2017, the scale of entrusted loans grew from 1.44 trillion yuan to 13.99 trillion yuan, an increase of nearly 10 times. So why is China's shadow banking still expanding rapidly against the backdrop of increasingly tough international banking regulation? What impact has the Guidance had on shadow banking? These are the questions that this paper hopes to answer through careful and scientific research.

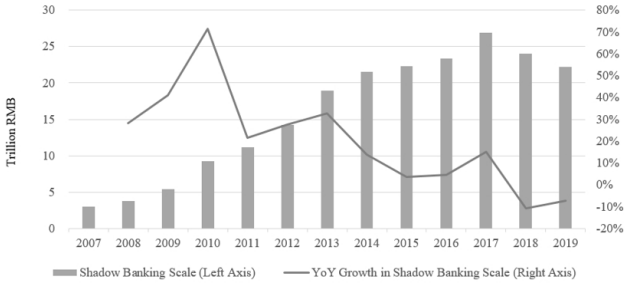

Figure 1 Scale and YoY Growth of Shadow Banking

Note: According to the statistical caliber of Chen et al. (2018), the size of shadow banking is the sum of entrusted loans, trust loans and bank acceptances.

Source: CEIC Economic Database.

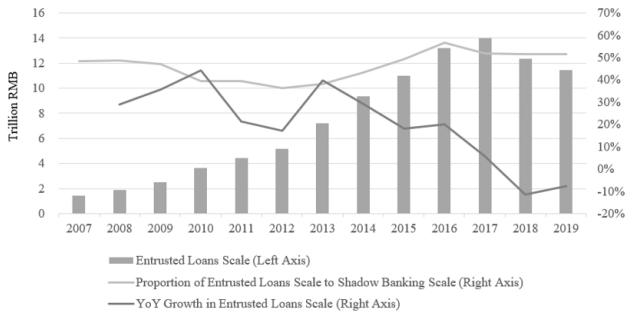

Figure 2 Scale and YoY Growth of Entrusted Loans

Note: According to the statistical caliber of Chen et al. (2018), the size of shadow banking is the sum of entrusted loans, trust loans and bank acceptances.

Source: CEIC Economic Database.

Specifically, this paper attempts to study the impact of the Guidance on shadow banking from the perspective of bank supervision, clarify its impact direction, and then analyze the impact mechanism to provide policy recommendations for the current and future adjustment of banking supervision policies. An important problem of previous literature research is that shadow banking behavior is relatively hidden, which makes it difficult to measure shadow banking and to obtain relevant data, so this paper attempts to measure the scale of shadow banking activities with entrusted loan data, a representative of shadow banking. Moreover, in order to get the estimation results accurately, this paper assesses the impact of the Guidance issued in 2011 on the shadow banking behavior by multi-period progressive DID method. Entrusted loans refer to loans provided by an entrustor who determines the loan recipient, purpose, amount, term, interest rate, etc., and are issued, monitored, and assisted in recovery by the trustee. In which the trustee only receives a fee, does not bear the risk of the loan and does not provide a guarantee (Allen et al., 2019). One of the common trustees is commercial banks. Commercial banks are involved in the entrusted loan business mainly for the regulation and management of the credit market. According to the relevant laws, one must hold a relevant license to operate the entrusted loan business, which also determines that entrusted loans must be issued through financial institutions such as commercial banks, which have obvious advantages in identifying the compliance of entrusted loans, qualification review, and borrower credit management. This can regulate lending behavior, maintain credit market order, and protect the legitimate rights and interests of both borrowers and lenders. However, after 2008, entrusted loans have been alienated into an important tool for commercial banks' regulatory arbitrage. Through irregular operations, commercial banks use funds from non-compliant sources or self-managed funds to issue entrusted loans, invest the funds in restricted areas or issue underwriting agreements, substantially bear the risks of entrusted loans, and gain high returns by circumventing credit standards and regulatory indicators such as the investment of funds, which is one of the reasons for the rapid growth of entrusted loans in recent years. According

Basel Accord III is committed to improving the quality and quantity of capital, establishing a stricter definition of capital and higher capital requirements, while introducing new liquidity rules and establishing a quantitative regulatory framework for liquidity risk in an attempt to fill regulatory gaps and prevent systemic risk.

to the information disclosure requirements of regulators, listed companies are required to disclose their involvement in entrusted loan business. Through the entrusted loan announcement, we can obtain the subject information of borrowers, lenders and trustees, entrusted loan amount, interest rate, borrowing period and other data, and then collate and obtain the amount of entrusted loans entrusted to be issued by the banking industry, which provides a good data support for the study of this paper.

The potential contributions of this paper are: (i) assessing the risk prevention objectives of bank regulatory policies from the perspective of shadow banking, providing a new perspective for the evaluation of banking regulatory policies; (ii) Quantitative study of the impact of bank regulation on shadow banking such as entrusted loans through empirical data to provide more empirical evidence. Currently, many articles focus on the impact of monetary policy on shadow banking and examine the effectiveness of monetary policy, with less attention given to the inducing effect of banking regulation on shadow banking, and some scholars often use DSGE models to deduce the impact of banking regulation on shadow banking (Qian et al., 2018; Fève et al. 2019; Peng & He, 2020; Hou & Huang, 2020), lacking empirical analysis based on experiential data. (iii) This paper scientifically analyzes the mechanisms and channels of bank regulation on entrusted loans to provide policy insights for banking regulation policy adjustment. It finds that there is a negative causal relationship between the policy implementation variable of the Guidance and the scale of entrusted loans, and the hard constraint requirements of do help achieve the regulatory goal of risk prevention and control. The conclusion remains valid after a series of robustness tests including controlling for sample selection bias, placebo tests, and substituting dependent variables. Further study finds that capital adequacy ratio has a positive effect on entrusted loans, and commercial banks limit the development of entrusted loans by expanding the coverage of risky assets, constraining the business space and increasing the cost of entrusted loans. The liquidity ratio also has a positive impact on entrusted loans, and the impact of provision coverage ratio on entrusted loans is not significant. The bank's regulatory polic the Guidancey has a more significant impact on the entrusted loan business of banks with larger assets and higher profitability. In addition, the specific regulatory initiatives implemented in 2017 for the shadow banking acitivities in the banking sector constitute an important part of the regulatory framework of the Guidance, collectively playing a crucial role in preventing systemic financial risks.

The remainder of the paper is organized as follows: Part 2 presents the policy background and related literature review, and proposes the research hypothesis of the paper; Part 3 introduces the sample selection and research design; Part 4 reports and discusses the empirical results; Part 5 conducts robustness tests; and Part 6 concludes and makes policy recommendations.

2 Policy background and related literature

2.1 Policy background

Financial crises have always accompanied banks, and banking development has never been free from risk. In the 1970s, in order to prevent the risk contagion caused by the cross-border operation of banks under the economic globalization, the Basel Committee was established in western countries, hoping to establish a cross-border banking regulatory cooperation mechanism and jointly prevent financial risks. The Basel Committee issued the Basel Accord I in 1988, which clearly proposed that the ratio of capital to risk-weighted assets should be no less than 8% and the ratio of core capital to risk-weighted assets should be no less than 4%, strengthening the awareness of capital regulation in the banking industry

The General Rules for Loans of the People's Bank of China, which came into effect in 1996, and the Circular on Issues Relating to the Business of Entrusted Loans of Commercial Banks (Circular No. 100), which was issued in 2000, contain clear provisions and requirements for the business of entrusted loans and the trustees of entrusted loans.

Information from the China Shadow Banking Report, published by Financial Regulation Research, December 2020.

and unifying the regulatory standards of the international banking industry. However, with the development of financial innovation, its rough measurement method no longer met the needs of banking supervision, and the international capital regulatory framework was further revised and improved in the 1990s, and Basel Accord II came into being. Basel Accord II established for the first time a risk measurement framework based on credit, market and operational risks, and at the same time required supervision and inspection of banks, strengthening the responsibilities of regulators and bank information disclosure requirements. However, due to its more complex model, there were problems such as regulatory arbitrage opportunities (Yang et al., 2018). These problems were fully exposed by the global financial crisis in 2008, and the Basel Committee went on to propose a new capital regulation and liquidity supervision scheme, namely Basel Accord III. Basel Accord III focuses on improving the quality and quantity of capital by establishing a stricter definition of capital and proposing higher capital requirements, including a common equity adequacy ratio of 4.5%, a Tier 1 capital adequacy ratio of 6%, and a total capital adequacy ratio of 8%, while introducing a 3% bar ratio regulatory requirement. In addition, Basel Accord III puts forward for the first time the international unified standard for quantitative liquidity risk regulation, and introduces the concept of macro-prudential regulation on the basis of micro-prudential regulation. The business model of commercial banks will change with the new regulatory concept, which affects the soundness of the banking system as well as the macroeconomic operation at the same time.

China's banking regulatory system is closely related to the international regulatory rules, and it has been improving the Chinese banking regulatory system on the basis of actively learning from international experience. China established the Banking Regulatory Commission in 2003 to regulate and supervise the banking industry. In the early stage, due to the lagging development of China's financial industry, banking supervision was still in the initial stage, with relatively simple regulatory content and devoted to improving the regulatory system and regulatory rules. However, with the development of financial innovation and the emergence of financial crisis, banking supervision gradually received attention. To align Chinese banking regulation with international standards, enhance the international competitiveness of domestic banks, and maintain the robustness of the banking system, the Banking Regulatory Commission actively followed the guiding principles of Basel III, closely integrating international experience with the actual operation and regulation of domestic banks, and issued the Guidance in 2011, specifying specific regulatory indicators such as capital adequacy ratio, liquidity, loan loss provision, and setting up differentiated transitional arrangements according to the situation of different institutions, with systemically important banks and non-systemically important banking financial institutions meeting the requirements of the new regulatory standards by the end of 2013 and 2016, respectively.

The Guidance emphasizes the accurate measurement of capital and risk-weighted assets in accordance with the newly revised Capital Adequacy Management Measures to comprehensively cover all types of risks and strengthen the micro-foundation for sound operation of the banking industry. On the one hand, the definition of capital is made stricter to improve the loss-absorbing capacity of regulatory capital, while the calculation method of risk-weighted assets is optimized, thereby expanding the scope of risks covered by capital. Commercial banks can use either the weighting method or the internal rating method to measure risk-weighted assets, and risk exposures not covered by the internal rating method need to be supplemented by the weighting method. The weighting method covers both the bank's on-balance sheet risk-weighted assets and off-balance sheet risk-weighted assets, and generally obtains the equivalent on-balance sheet assets by multiplying the notional amount of off-balance sheet items by the credit conversion factor, and then measures the risk-weighted assets according to the treatment of on-balance sheet assets. On the other hand, the capital adequacy ratio is increased and more stringent requirements are proposed compared to Basel Accord III.

The document states that the minimum requirements for core Tier 1 capital adequacy ratio, Tier 1 capital adequacy ratio and total capital adequacy ratio for commercial banks are 5%, 6% and 8%, respectively, while setting higher requirements for systemically important banks and non-systemically important banks, whose capital adequacy ratios cannot be lower than 11.50% and 10.50% under normal conditions, and countercyclical excess capital is also required in case of systemic excessive credit growth. In addition, on the basis of China's existing liquidity risk supervisory indicators, a multi-dimensional liquidity risk supervisory indicator and monitoring indicator system should be established. By introducing monitoring indicators such as liquidity coverage ratio and net stable funding ratio, an attempt is made to implement more effective supervision of liquidity risk. The Guidance further requires banking financial institutions to improve the regulation of loan loss provisioning, in which the loan provisioning ratio is not less than 2.5% and the provisioning coverage ratio is not less than 150%. At the same time, the regulatory requirements for loan loss provisioning need to be dynamically and differently adjusted according to the economic cycle, loan quality and profitability, so as to alleviate the pro-cyclicality of the banking system.

The regulatory policy attempts to promote the banking industry to change its development mode and sound operation, and enhance the effectiveness of banking supervision. Its distinctive feature is a shift from micro-prudential supervision to macro-prudential supervision, focusing more on the systemic risks of the banking industry as a whole rather than the risks faced by individual bank entities. It also considers the pro-cyclicality of commercial banks and proposes a counter-cyclical capital regulatory framework, which increases capital requirements for capital accumulation during economic booms and reduces capital requirements to release liquidity during economic downturns (Hou & Huang, 2020). The last is a broad counter-cyclical capital regulatory framework that considers the inclusion of shadow banking into the regulatory system to reduce shadow banking regulatory arbitrage opportunities, which mainly stems from the concern about shadow banking arising from financial innovation after the subprime mortgage crisis. However, in the actual implementation process, the regulation of shadow banking in China has lagged behind. China's financial sector development lags behind that of developed Western countries and faces different specific situations at the time of the subprime crisis. In Western countries, because of the full development of competition in the financial market, financial innovations have emerged, the financial chain has been lengthened, and the scale of shadow banking business is huge. Therefore, one of the focuses of Basel Accord III, which was revised after the international financial crisis, was to regulate shadow banking, restrict speculative transactions and strengthen the regulation of financial derivatives. However, at this time, China's financial innovation business was in the process of development, so it was not given a higher priority.

2.2 Literature Review

Regarding the impact of banking regulation on banks, existing studies focus on the impact of banking regulation on the operational efficiency of banks, such as the ratio of overhead costs to total assets in the banking industry. On the one hand, they suggest that there are distortions in resource allocation by banking regulation, only the extent of which varies depending on the specific measures. On the other hand, it focuses on whether bank regulation reduces risk, whether it reduces the non-performing loan ratio, and focuses on examining the stability and development of the banking industry. That is, banking regulation has two sides. On the one hand, it can effectively reduce the risk of the banking industry and prevent banking crises. On the other hand, some regulatory measures have certain drawbacks, for example, distorting the market behavior of the banking industry, high regulatory costs, and inducing new risk factors (Shen & Li, 2005).

The emergence of shadow banking is likely the result of multiple factors working together. Financial development and innovation promote the formation of shadow banking. When there is a credit crisis, governments relax regulations in the financial sector,

leading to intense market competition, and the emergence of various financial innovation products, tools, organizations, and operational methods, resulting in the growth of shadow banking. Excessive optimism and long-term low interest rate policies also promote the development of shadow banking (Verona et al., 2013). When a country's economy experiences a positive technology shock, economic activity and credit demand expand together. Traditional banks, however, are slower to raise additional funds, leading to an increase of leverage and credit spreads. At this time, shadow banking grows rapidly as a credit intermediation activity to meet the financing needs of the real economy (Fève et al., 2019). Bank regulation can also stimulate the expansion of shadow banking. According to the experience of developed countries, the regulatory measures adopted after a major crisis hinder banks' opportunities to make profits, and they in turn find ways to circumvent the regulation, commonly by launching new businesses or changing their traditional ways of operation (Shen & Li, 2005). Commercial banks can increase loan placement through shadow banking to improve the risky capital coverage ratio and at the same time circumvent the restrictions on the investment of high-risk loans, thus alleviating the pressure of regulatory assessment. They can also release the capital occupied by risky loans by holding shadow banking debts, thus meeting the capital adequacy requirements and achieving the purpose of circumventing regulation (Gao et al., 2018; Yu et al., 2017). The existence of shadow banking helps mitigate efficiency losses due to regulatory costs, and shadow banking activities will expand when banks face stricter regulation. Some scholars also point out that by gradually integrating shadow banking into the banking regulatory system, the extent of regulatory arbitrage in shadow banking can be limited, for example, shifting off-balance sheet business of commercial banks to on-balance sheet, incorporating capital adequacy constraints, and assigning different risk weights to different risky assets (Hou & Huang, 2020).

The core of Chinese shadow banking remains the shadow of commercial banks, and shadow banking businesses such as entrusted loans have long existed off-balance sheet. In the compliant entrusted loan business, commercial banks act as trustees to assist in the issuance, supervision of use and recovery of loans, receiving only intermediary service fees and not bearing investment risks (Allen et al., 2019). Entrusted loans, as a kind of off-balance sheet business, are based on the bank's own reputation and characterized by high degree of freedom, poor transparency, and highly concentrated transactions (Wu, 1998), whose impact on the economy has been a black box (Allen et al., 2019), with risks that can be significant or minimal, or in some cases, quite substantial. Regulators have also proposed a series of regulatory rules for off-balance-sheet business income due to its high volatility and high credit risk. The risk monitoring method for off-balance sheet business is clearly defined in the Supplement to Basel Accord I. Off-balance sheet business needs to be converted to on-balance sheet assets through credit risk conversion factors and risk-weighted, thus being included in the regulation of capital adequacy ratio, but there are few corresponding disclosures in the financial reports of the banking industry. Basel Accord III further refines the risk-weighting factors to quantify and strengthen off-balance sheet risk regulation (Zeng et al., 2020). Another Chinese document accompanying the Guidance, the Capital Adequacy Management Measures, also specifies the credit conversion factors for various off-balance sheet items of commercial banks to strengthen the regulation of off-balance sheet business.

Some scholars have also studied the impact of specific bank regulatory indicators on the banking sector. For example, increasing capital ratios may prompt banks to increase risk to compensate for the loss of utility from higher capital ratios. Meanwhile increasing capital ratios increases banks' opportunity costs and impair their ability to provide liquidity, so that the optimal capital ratios chosen by banks are generally lower than the socially required optimal levels (Lei, 2007). In practice, however, banks' actual capital ratios are higher than the minimum capital ratios required by regulation, which is due to the cost of random government supervision and inspection. Minimum capital adequacy regulation can induce banks that already meet the minimum regulatory requirements

to further improve their capital adequacy and reduce bank risk, but for banks that do not meet the regulatory requirements, the minimum capital adequacy ratio does not have the effect that regulators expect (Milne and Whalley, 2001). Liquidity regulation incentivizes banks to hold additional liquid assets that meet regulatory requirements and would lead to a decline in bank profitability (Neri, 2012). Liquidity regulation makes commercial banks that are net buyers in the interbank market and gain lower returns from credit business act as risk-averse entities, then making other banks risk-seeking, which would engage in high-risk credit distribution, leading to liquidity risk increase in the next period (Pausch, 2012). Allowance for loan losses is a provision made by banks to compensate for expected credit losses based on regulatory standards and directly reflects the bank's ability to cover credit risk.

In summary, the current research on bank regulation mainly focuses on the analysis of bank regulation on banks' operational efficiency and on-balance sheet risks such as non-performing loan ratio, but less on the impact of bank regulation on shadow banking, and lacks empirical analysis of empirical data. The analysis of specific regulatory indicators also focuses on the core indicator of capital adequacy ratio and lacks research on other indicators. Based on the above theoretical and empirical studies on bank regulation and shadow banking in China, this paper attempts to further examine the actual effects of this bank regulation policy, which has contributed to the expansion of shadow banking through regulatory arbitrage activities and thus increased systemic risk, analyzing the mechanisms of bank regulation and specific regulatory indicators on shadow banking activities such as entrusted loans, and conducting a policy evaluation of the Guidance issued in 2011, providing reasonable suggestions for the adjustment of China's banking supervision policies.

2.3 Theoretical analysis and hypothesis

According to the regulatory arbitrage theory of capital, capital has an important role in banking institutions and can be used to protect banks against unanticipated losses in their operations. However, the cost of capital is high. On the one hand, the cost of capital financing is generally higher than the cost of debt financing due to factors such as taxation, institutional costs and information asymmetry. On the other hand, capital cannot be lent normally or invested to earn returns like normal loans, but only could be used for risk reserves, so there is an inherent incentive for banks to circumvent capital regulation through financial innovation to reduce capital holdings (Song, 2009). With the advancement of banking regulatory policies, regulated institutions need to increase their capital holdings or reduce the proportion of risky assets to achieve the goals set by regulatory policies. Holding more capital will largely increase the opportunity cost of commercial banks and reduce their profit margin. With the motive of maximizing profits, commercial banks will choose to avoid regulatory taxes and will not significantly increase the level of capital holdings, so reducing the proportion of risk-weighted assets becomes a better choice. Banks often achieve the purpose of obtaining higher returns with less regulatory capital by holding assets with relatively lower risk weights and higher returns through asset swaps. At the same time, the deficiencies and loopholes of capital regulation are exploited to undercount or exclude some risk-weighted assets and artificially reduce the proportion of risk-weighted assets, thus increasing the capital adequacy ratio of banks, and enabling them to pursue higher risk arbitrage opportunities at a lower cost of capital (Song, 2009; Yu, et al., 2021). Since banking regulation focuses more on banks' traditional credit business and ignores shadow banking to a certain extent, commercial banks can precisely obtain high-interest credit business while circumventing regulatory mandatory requirements through complex shadow banking transactions, and thus shadow banking becomes an important tool for commercial banks' regulatory arbitrage (Guo & Zhao, 2017). Commercial banks can convert normal loans into unregulated types of loans. Through several times hands changing, they convert the aforementioned loans into beneficial rights and count them as interbank items, thus reducing risk provisioning and circumventing the assessment of regulatory indicators such as deposit-to-loan ratio. At the same time, the assets of interbank items have lower risk weights, which can

significantly reduce the risk capital employed. With the strengthening of banking supervision, the shadow banking business such as entrusted loans is also expanding. Therefore, this paper proposes the following research hypothesis.

Hypothesis 1: The implementation of the Guidance leads to regulatory arbitrage of commercial banks and stimulates the expansion of shadow banking activities, so the strengthening of bank regulation has a positive induced effect on entrusted loans and other shadow banking business.

On the other hand, the Guidance fully draws on the regulatory ideas of Basel Accord III, learns from the historical experience of the subprime mortgage crisis, and closes regulatory loopholes. Firstly, it improves the calculation method of capital adequacy ratio, changes regulatory capital from a two-tier classification to a three-tier classification, strictly enforces the deduction for core tier 1 capital, and improves the loss absorption capacity of regulatory capital. At the same time, it optimizes the calculation method for risk-weighted assets, expand the risk coverage of capital, and increase the risk weights for complex financial instruments such as trading activities, asset securitization, and over-the-counter derivatives trading. By expanding the scope of regulation beyond traditional lending, it reduces the types of businesses that banks can regulate for arbitrage, defining risk assets more rationally and identifying sources of risk, making banking operations more transparent and controllable. The new regulatory rules of the Guidance reduce regulatory loopholes by transferring commercial banks' off-balance sheet assets to on-balance sheet, and assigning different risk weights to different types of asset businesses, which could limit the regulatory arbitrage of shadow banking to some extent. Based on the above analysis, this paper puts forward the following research hypothesis.

Hypothesis 2: The Guidance by expanding the scope of regulation and refining the weights of risk assets, could effectively limit the expansion of shadow banking activities such as entrusted loans, and strengthened banking regulation has a negative inhibitory effect on shadow banking.

Next, this paper will conduct empirical tests using data on entrusted loans collected from 72 banks disclosed in public announcements by listed companies, to explore the impact effects and mechanisms of the Guidance on shadow banking activities such as entrusted loans, and further analyze whether the effect is heterogeneous among different types of commercial banks, then providing some policy insights for the development of banking regulatory policies.

3 Data and empirical design

3.1 Data source and sample selection

The entrusted loan data used in this paper comes from the Wind database. According to the regulatory requirements of the China Securities Regulatory Commission, listed companies must announce each entrusted loan transaction, while companies undertaking entrusted borrowing could choose to make announcements. There is no mandatory requirement from the regulatory authority. The entrusted loan announcement contains information on the lender, borrower and trustee, as well as disclosing information on loan characteristics such as loan amount, interest rate and whether the loans are related or not. According to the entrusted loan announcements issued by entrusted loan companies, after cleaning the original announcements and removing repayment announcements and duplicate announcements for existing entrusted loans, this paper reviewed over 2,000 original announcements and finally collected 1,865 transaction data. Based on the manually collected entrusted loan transaction data, this paper constructs the entrusted loan trustee dataset. By excluding entrusted loans involving non-banking custodial institutions and sorting the number and amount of entrusted loans by the name of the trustee bank, this paper calculated the average amount of each entrusted loan and matched other banking regulatory indicators and financial data, of which there are finally 72 banks, including 29 listed banks and 43 non-listed banks. Data on bank regulatory indicators such as capital adequacy ratio, liquidity ratio and provision coverage ratio, data on bank financial indicators, and data on GDP growth rate at the regional level are also obtained from the Wind database.

The sample interval of this paper is 2007-2019. According to the Guidance, the policy applies to all commercial banks in China, with reference to policy banks, rural cooperative banks (i.e., rural commercial banks), village banks, rural credit cooperatives, and foreign banks branches. Therefore, policy banks and rural cooperative banks (i.e., rural commercial banks) in the sample are always the control group. The sample does not include village banks, rural credit unions, and foreign bank branches due to the difficulty of obtaining data. The final control group includes a total of 2 policy banks and 10 rural commercial banks. Meanwhile, after the release of the Guidance in 2011, due to the transitional period arrangement, systemically important banks and non-systemically important banks had different timelines for meeting the new regulatory standards, with the former meeting them by the end of 2013 and the latter by 2016. However, no list of systemically important banks has been disclosed in China until 2019, and the assessment criteria for systemically important banks are also vague. Referring to the list of global systemically important banks published by the Financial Stability Board, this paper classifies Bank of China, Industrial and Commercial Bank of China, Agricultural Bank of China, and China Construction Bank as systemically important banks in China, which need to meet the new regulatory standards by the end of 2013, and the remaining commercial banks within the scope of the policy are required to meet the new regulatory standards by the end of 2016, thus determining the time when different banking entities were subject to the hard constraints of this regulatory policy. The details are shown in Table 1.

Table 1 Bank Group Setting

Group	Treatment time	Bank name
Treatment group	2013	Bank of China, Industrial and Commercial Bank of China, Agricultural Bank of China, China Construction Bank
Treatment group	2016	Baoshang Bank, Bank of Beijing, Bohai Bank, Chaoyang Bank, Chengdu Bank, Dongguan Bank, Bank of East Asia, Everbright Bank, Guangfa Bank, Bank of Guizhou, Harbin Bank, Hankou Bank, Bank of Hangzhou, Bank of Hubei, Huarong Xiangjiang Bank, Huarui Bank, Huaxia Bank, Huishang Bank, Jiangsu Bank, Bank of Jiangxi, Bank of Communications, Jinzhou Bank, Jincheng Bank, Bank of Jiujiang, Kunlun Bank, LaiShang Bank, LongJiang Bank, Luoyang Bank, Minsheng Bank, Mintai Bank, Bank of Nanjing, Ningbo Bank, PingAn Bank, Pingdingshan Bank, Pudong Development Bank, Qilu Bank, Rizhao Bank, Mizuho Bank, Bank of Xiamen, Bank of Shanghai, Shengjing Bank, Suzhou Bank, Bank of Tianjin, Urumqi Bank, Xi'an Bank, Industrial Bank, Postal Savings Bank of China, Chang'an Bank, Changsha Bank, China Merchants Bank, Chouzhou Commercial Bank, Zheshang Bank, Sino-German Bausparkasse Bank, CITIC Bank, Zhongyuan Bank, Bank of Chongqing
Control group		Chengdu Rural Commercial Bank, Ordos Rural Commercial Bank, Haikou United Rural Commercial Bank, Hangzhou United Rural Commercial Bank, Shanghai Rural Commercial Bank, Ma'anshan Rural Commercial Bank, Shandong Laiwu Rural Commercial Bank, Wuhu Yangzi Rural Commercial Bank, Chongqing Rural Commercial Bank, Changsha Rural Commercial Bank, China Development Bank, Agricultural Development Bank of China

3.2 Model setting and variable description

To test the impact of the policy requirement of the Guidance on the size of shadow banks such as entrusted loans, this paper uses a multi-period asymptotic DID approach to construct a two-way fixed effects model (1):

$$lnEL_{i,t}=\alpha_0+\alpha_1 DID_{i,t}+\beta_t X_{i,t}+\mu_i+\tau_t+\varepsilon_{i,t} \quad (1)$$

where the explained variable *lnEL* is the natural logarithm of the total amount of entrusted loans involved by bank *i* in year *t*. The explanatory variable *DID* indicates that different banks meet the requirements of the new regulatory standards in different years, controlling for bank fixed effects and year fixed effects, setting the treatment and control groups, and then estimating the treatment effects using the multi-period asymptotic DID method. *DID* is taken as 0 for policy banks and rural commercial banks in all years, while Bank of China, Industrial and Commercial Bank of China, Agricultural Bank, and Construction Bank in 2013 and subsequent years are taken as 1, and the remaining commercial banks are taken as 1 in 2016 and after. $X_{i,t}$ denotes control variables, including bank-level characteristic control variables such as capital adequacy ratio, liquidity ratio, loan provisioning ratio, and macroeconomic-level control variables such as real provincial GDP growth rate. μ_i denotes individual fixed effects, τ_t denotes time-fixed effects, and $\varepsilon_{i,t}$ denotes the residual term.

To further analyze the mechanism of the impact of bank regulatory policies on shadow banking such as entrusted loans, as well as to test the impact of each new regulatory standard on entrusted loans respectively, model (2) is constructed in this paper:

$$lnEL_{i,t}=\alpha_0+\alpha_1 DID_{i,t}+\alpha_2 DID\times CAR_{i,t}+\alpha_3 DID\times CAR1_{i,t}+\alpha_4 DID\times LIR_{i,t}+\alpha_5 DID\times LPR_{i,t}+\beta_i X_{i,t}+\mu_i+\tau_t+\varepsilon_{i,t} \quad (2)$$

Model (2) adds the interaction term of each specific regulatory indicator with the policy treatment effect DID to model (1), that is DID×CAR, DID×CAR1, DID×LIR, and DID×LPR, to identify the effects of specific regulatory indicators such as capital adequacy ratio and liquidity ratio on the size of entrusted loans after the implementation of bank regulatory policies. Where CAR1 denotes the tier 1 capital adequacy ratio. The descriptions

of the relevant variables are shown in Table 2.

Table 2 Variable Descriptions

Variable type	Variable identification	Variable name	Data description
Explained variables	*lnEL*	Logarithm of entrusted loan amount	ln (1+entrusted loan amount)
	lnEL	Logarithm of average entrusted loan amount	ln (1+average entrusted loan amount)
Explanatory variables	*DID*	Policy implementation variable	
Control variables	*CAR*	Capital adequacy ratio	Capital/risk assets
	CAR1	Tier 1 capital adequacy ratio	Tier 1 capital/risk assets
	CAR2	Core tier 1 capital adequacy ratio	Core tier 1 capital/risk assets
	LIR	Liquidity ratio	Liquid assets/liquid liabilities
	LPR	Loan provisioning ratio	Allowance for loan losses balance/loan balance
	NPL	Non-performing loan ratio	(Subordinated loan+doubtful loan+loss loan)/loan
	CIR	Cost to income ratio	Operating expenses / operating income
	lnK	Logarithm of asset size	ln (total assets)
	PGGDP	Annual provincial GDP growth rate	Annual province constant price GDP growth rate

4 Empirical results

4.1 descriptive statistics of data

The descriptive statistics of regression variables such as bank regulation and entrusted loans show (Table 3): the average scale of entrusted loan is 151 million yuan, with a standard deviation of 492 million yuan, indicating the large variability of entrusted loan size among banks. The mean values of core tier 1 capital adequacy ratio, tier 1 capital adequacy ratio and capital adequacy ratio of the banks are 10.80%, 11.12% and 13.30%, which are significantly higher than the regulatory standards of 5%, 6% and 8% in the Guidance, and the mean value of capital adequacy ratio is even higher than the regulatory standard of 11.5% for systemically important banks, with the maximum value being 40.30%, five times of the new regulatory standard. The average value of the liquidity ratio is 52.05%. The mean value of loan provisioning ratio is 2.90%, also higher than the minimum regulatory standard of 2.50% stipulated in the Guidance. The total number of observations for the panel data sample used in this paper is 936.

Table 3 Descriptive Statistics of the Main Regression Variables of Bank Regulation and Entrusted Loans

Variables	Observations	Average value	Standard deviation	Minimum value	Maximum value
lnEL	936	5.5196	8.6569	0	22.3621
DID	936	.2692	.4438	0	1
CAR	819	13.2999	3.0292	3.4000	40.3031
CAR1	802	11.1214	3.1890	2.3400	39.1047
CAR2	482	10.7973	2.4214	5.1500	22.7000
LIR	680	52.0475	15.2657	24.8300	120.1200
LPR	843	2.8968	1.2811	.1992	22.0191
NPL	825	1.4139	1.3509	.0040	23.5700
CIR	844	33.8676	11.3902	4.7530	206.0771
lnK	849	26.5851	1.9009	21.6875	31.0359
PGGDP	936	9.5843	3.1296	-2.5000	19.2000

Meanwhile, to visually present the changes in the scale of entrusted loans during the sample period, this paper conducts a statistical analysis of both the stock and the increment of the scale of entrusted loans, as shown in Figure 3. The macro data of the stock and increment of entrusted loan scale on the left axis are obtained from the social financing statistics released by the People's Bank of China, and it can be seen that the stock of entrusted loan scale began to increase rapidly from 2009, peaking at 13.97 trillion yuan in 2017, and then gradually declined. The data of the increment of entrusted loan scale reached the highest level of 2.62 trillion yuan in 2013, and then showed a fluctuating downward trend, with the incremental entrusted loans being negative after 2017. The data on the right axis are the summation data of entrusted loan increment in each year of the sample, which are collected manually from the entrusted loan announcements of listed enterprises, and the data also start to rise rapidly from 2009, reaching the highest level of 30.14 billion in 2014, and then start to decline year by year. The paper finds that the increment data collected from entrusted loan announcements is far less than the entrusted loan increment data published by the People's Bank of China. This discrepancy may be due to missing data from some entrusted loan announcements and the fact that non-bank financial trustees, an important component of entrusted loan transactions, are not included in the scope of this paper's research. However, in general, the change trend of entrusted loan increment data announced by the People's Bank of China and the entrusted loan increment data collected in this paper is consistent, so it does not affect the analysis and conclusion of this paper.

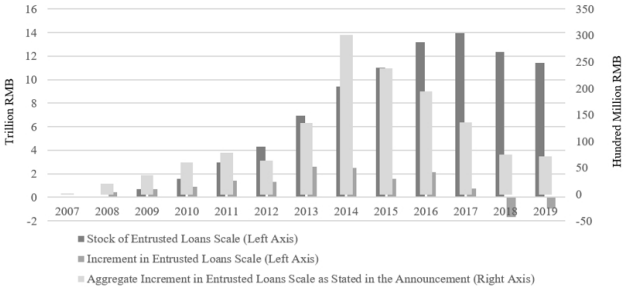

Figure 3 Scale of Entrusted Loans

Source: Data on the left axis are from social financing statistics published by the People's Bank of China, and data on the right axis are from manually collected data from listed companies' entrusted loan announcements.

Table 4 shows the annual mean changes in specific regulatory indicators for the 72 banks in the sample. Capital adequacy ratio gradually increased from 2007 to 2012, suddenly dropped to a lower point in 2013, and then slightly increased and remained in a relatively stable state. The trend of tier 1 capital adequacy ratio is consistent with the trend of capital adequacy ratio. The liquidity ratio shows a trend of fluctuating decline, reaching its lowest value in 2013, followed by a fluctuating increase. The loan provisioning ratio reached its lowest point in 2010 and has shown a more moderate growth trend since then.

Table 4 Annual Average Values of Regulatory Indicators of Banks in the Sample Unit: %

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
CAR	12.2398	13.0046	12.7609	13.9941	13.7484	13.7834	12.4121	13.0201	13.1088	13.1742	13.5429	13.6690	14.0975
CAR1	10.6017	10.9809	10.7182	12.0487	11.6392	11.5346	10.5695	10.8225	10.9344	10.9006	11.1059	11.1102	11.4570
LIR	48.3521	57.9602	50.6902	50.5185	49.3324	49.0628	47.3322	48.4775	52.2907	51.3566	51.1895	60.3171	64.3645
LPR	2.5538	2.4564	2.3369	2.2759	2.4689	2.7009	2.7924	3.0052	3.2273	3.3558	3.2581	3.3792	3.4288

4.2 Analysis of the main regression results

Table 5 presents the multi-period progressive DID regression results of the implementation variable of the Guidance regulatory policy and the scale of entrusted loans. This paper focuses on the signs and significance levels. The second column does not add any control variables, used to explore the effect of bank regulation on the size of entrusted loans without considering other factors, and the coefficient of the treatment variable DID is -0.41 and significant at the 5% level. In order to control the influence of other factors on the regression results of the main explanatory variables, the third column adds the control variables on the basis of the second column. The coefficient of DID is -0.33 and significant at the 5% level, indicating that compared to banks not affected by the new regulatory standards, banks constrained by the new standards have a significantly reduced scale of entrusted loans. This supports Hypothesis 2, where the mandatory requirements of the new regulatory policy help control the development of off-balance-sheet business and reduce systemic risk. For compliant entrusted loan activities, banks are not required to bear credit risk and not required to make provisions and capital. However, banks are not satisfied with carrying out normal entrusted loan business, and often use entrusted loans to obtain high returns through irregular ways, such as using their own funds, wealth management funds to issue entrusted loans, or issuing underwriting agreements for entrusted loans to substantially bear the risks. This part of entrusted loan business is clearly stipulated in the regulatory document "Commercial Bank Capital Management Measures (Trial)", that it is converted into on-balance sheet assets through a 100% credit conversion factor and capital is provided in accordance with a 100% risk weighting. Furthermore, banks as trustees facilitate more off-balance-sheet activities of shadow banking, with more and more entrusted loans being issued through special vehicles like asset management plans, fund trust plans, etc. Banks then purchase these entrusted loan rights as risk investments, included in the accounts receivable investment items on the balance sheet, bringing many off-balance-sheet shadow banking products onto the balance sheet(Chen et al., 2018). The Capital Management Measures for Commercial Banks (Trial) also clearly stipulates that capital is provided according to 100% risk weighting. After the implementation of the Guidance, the mandatory requirements of the new regulatory standards have limited the regulatory arbitrage space of shadow banking such as entrusted loans, and banks are forced to reduce such entrusted loan business, which can effectively curb the development of shadow banking activities and prevent the risks, which is consistent with the regulatory objective requirements.

Table 5 Multi-period Asymptotic DID Regression Results

Variables	lnEL	lnEL	$\ln\overline{EL}$	$\ln\overline{EL}$
DID	-0.4103**	-0.3349**	-0.4278***	-0.3480**
	(0.1601)	(0.1554)	(0.1656)	(0.1583)
Controls	NO	YES	NO	YES
Year FE	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Observations	936	650	936	650
R^2	0.4453	0.4249	0.4284	0.4100

Note: Numbers in parentheses are robust standard deviations; *, **, *** represent significant at the 10%, 5%, and 1% levels, respectively.

4.3 Further discussion

4.3.1 Microscopic influence mechanism of bank regulation on entrusted loan issuance

Based on the Guidance, the China Banking Regulatory Commission further specifies the requirements for meeting specific regulatory indicators such as capital adequacy ratio, liquidity ratio, and loan provisioning ratio. Table 6 further shows the impact of each new regulatory standard in model (2) on entrusted loan size, and the data in the second and third column report the regression results with entrusted loan size as the explanatory variable. The coefficient of the interaction term between capital adequacy ratio and the policy implementation variable DID is significantly positive at the 5% level, regardless of whether other influencing factors are controlled. The size of entrusted loans of commercial banks will decrease after the regulatory policy mandating a lower capital adequacy ratio. Capital adequacy ratio is the ratio of total capital to risk-weighted assets. The higher the capital adequacy ratio, the better the bank's risk coverage, but it will also bear more capital holding costs. When the capital adequacy ratio is low, banks are at greater risk of insolvency, and the potential benefits of increasing this indicator exceed the cost of allocating capital, which can improve operational efficiency. The new regulatory policy imposes strict capital deduction rules, resulting in the deduction of non-conforming capital, and expanding the scope of off-balance sheet business regulation, which could cover more risky assets in the measurement of weighted risk assets, bringing a shock to the capital adequacy ratio of commercial banks. At the same time, commercial banks face minimum capital adequacy regulation requirements and have to limit the scale of weighted risk assets, and the development of entrusted loans as off-balance sheet business will be inhibited and the scale of entrusted loans will be reduced. In the sample of this paper, the coefficient of the interaction term between tier 1 capital adequacy and policy implementation variable is negative but not robust.

After controlling for other influencing factors, the coefficient of the interaction term between the liquidity ratio and the policy implementation variable DID is significantly positive at the 5% level. The higher the liquidity ratio, the larger the commercial banks engage in entrusted loans after the new regulatory standard requirements being met. In an operating environment with high spreads, banks have extremely high opportunity costs of liquidity as most of their liquid assets have lower yields than other illiquid assets. When liquidity risk is effectively covered, the potential benefit of increasing the liquidity ratio is smaller than the opportunity cost of holding liquidity, which will reduce bank efficiency, when banks have a stronger willingness to engage in shadow banking business such as entrusted loans to improve profitability. In addition, no effect of the interaction term between loan provisioning ratio and policy implementation variable on the size of entrusted loans issued by banks is found.

Table 6 Regression Results of Interaction Terms of Specific Regulatory Standards and Policy Implementation Variable with Entrusted Loans

Variables	lnEL	lnEL	$\ln\overline{EL}$	$\ln\overline{EL}$
DID	-3.8076***	-4.2010***	-3.9355***	-4.3431***
	(1.4546)	(1.3774)	(1.4813)	(1.3969)
DID×CAR	0.3876**	0.4020**	0.3950**	0.4111**
	(0.1783)	(0.1789)	(0.1811)	(0.1824)
DID×CAR1	-0.2930**	-0.2066	-0.2955*	-0.2067
	(0.1493)	(0.1503)	(0.1516)	(0.1533)
DID×LIR	0.0290***	0.0237**	0.0299***	0.0243**
	(0.0109)	(0.0106)	(0.0110)	(0.0107)
DID×LPR	0.0406	-0.0893	0.0408	-0.0961
	(0.1678)	(0.1717)	(0.1736)	(0.1787)
Controls	NO	YES	NO	YES
Year FE	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Observations	633	625	633	625
R^2	0.4198	0.4354	0.4047	0.4211

Note: Numbers in parentheses are robust standard deviations; *, **, *** represent significant at the 10%, 5%, and 1% levels, respectively.

4.3.2 Heterogeneity analysis

This paper firstly divides the sample into two sub-sample groups according to the median size of banks and observes the heterogeneity of the impact of the Guidance on the scale of entrusted loans among banks of different sizes, as shown in Table 7. This paper finds that the bank regulatory policy is more significant for banks with larger asset size and can effectively curb the expansion of shadow banking such as entrusted loans. This phenomenon was not found in banks with smaller asset size. Banks with larger asset size generally belong to large banks, which have stronger state-owned attributes and are more willing to comply with the government regulatory

system to promote a healthy banking system (Chen et al., 2018). So they are able to actively incorporate off-balance-sheet shadow banking into their regulation and maintain financial stability when facing new regulatory standards. Meanwhile, large banks have more complete information technology and risk control capabilities, which enable them to make adjustments better when facing changes in regulatory policies (Zeng et al., 2020).

Table 7 Regression Results Distinguishing Different Bank Sizes

	Large asset size	Small asset size	Large asset size	Small asset size
Variables	lnEL	lnEL	$\ln\overline{EL}$	$\ln\overline{EL}$
DID	-0.2734*	0.7484	-0.2846*	0.7098
	(0.1470)	(0.8556)	(0.1494)	(0.8538)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Observations	294	241	294	241
R^2	0.3202	0.3440	0.3032	0.3396

Note: Numbers in parentheses are robust standard deviations; *, **, *** represent significant at the 10%, 5%, and 1% levels, respectively.

The cost-to-income ratio (CIR) is the ratio of bank operating and management expenses to operating income, which describes the cost paid for each unit of revenue earned by a bank and measures the bank's profitability. Generally, large state-owned banks have a lower cost-to-income ratio, while retail banks or banks with excellent incentive mechanisms have a higher cost-to-income ratio. The analysis found that banks with lower cost-to-income ratios and higher profitability significantly reduced the size of entrusted loans after being subject to this regulatory policy, while this phenomenon was not found in banks with higher cost-to-income ratios and lower profitability. For banks with higher profitability, they can fully rely on the market competition of on-balance sheet business to gain a greater profitability advantage, and the demand for high-risk off-balance sheet business is not as urgent as that of banks with lower profitability.

Table 8 Regression Results Differentiating High and Low CIR

Variables	High CIR	Low CIR	High CIR	Low CIR
	lnEL	lnEL	$\ln\overline{EL}$	$\ln\overline{EL}$
DID	-0.0569	-0.3951**	-0.0795	-0.4097**
	(0.3866)	(0.1848)	(0.3929)	(0.1880)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Observations	281	262	281	262
R^2	0.3907	0.4518	0.3775	0.4386

Note: Numbers in parentheses are robust standard deviations; *, **, *** represent significant at the 10%, 5%, and 1% levels, respectively.

4.3.3 Impact of other shadow banking regulatory initiatives

After 2016, the Central Economic Work Conference placed a higher emphasis on controlling financial risks. The report of the 19th National Congress in 2017 also explicitly identified three major challenges for future social development, one of which is preventing and resolving major risks, making the regulation of shadow banking activities an important task. In 2017, banking regulatory authorities introduced a series of regulatory measures against shadow banking, such as incorporating off-balance-sheet wealth management into "broad credit" and conducting assessments within the macro-prudential assessment system. Special rectification actions of "three violations, three arbitrage, four improper and ten problems" were carried out for the banking industry to rectify the violation of regulatory rules, regulatory arbitrage and short-change. These regulatory initiatives are important supplements to the Guidance and effectively regulate the continuously innovating shadow banking business. Therefore, this paper further modifies the policy implementation variable DID, assuming that all commercial banks except policy banks were impacted again by new regulatory measures in 2017, and then observes the subsequent impact of these measures on shadow banking activities such as entrusted loans. The study finds that in the regression equation with the logarithm of the scale of entrusted loans as the explained variable, the absolute value of the DID regression coefficient increased from 0.33 to 0.39. In the regression equation with the logarithm of the average scale of entrusted loans as the explained variable, the DID coefficient increased from 0.35 to 0.40, meaning the effect of the policy implementation variable on the scale of entrusted loans increased, and its significance level significantly improved. However, if the regulation of the Guidance is ignored and only the new regulatory initiatives released in 2017 are used as the policy implementation variable, the effect is found to be insignificant. Therefore, the paper considers that the new regulatory measures are endogenous to the regulatory framework of the Guidanc and form an important part

of it, which together play a significant role in rectifying financial disorder and preventing systemic financial risks.

Table 9 Three-phase Asymptotic DID Regression Results

Variables	lnEL	lnEL	$\ln\overline{EL}$	$\ln\overline{EL}$
DID	-0.4097***	-0.3859***	-0.4242***	-0.3971***
	(0.1548)	(0.1456)	(0.1609)	(0.1492)
Controls	NO	YES	NO	YES
Year FE	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Observations	936	650	936	650
R^2	0.4451	0.4256	0.4281	0.4106

Note: Numbers in parentheses are robust standard deviations; *, **, *** represent significant at the 10%, 5%, and 1% levels, respectively.

5 Robustness tests

5.1 Parallel trend test

Parallel trends is a key underlying assumption of the difference-in-difference approach, implying no significant difference between the treatment and control groups before policy implementation. The DID method must satisfy this assumption. Therefore, this paper conducts a parallel trends test using the event study approach (ESA) to control the impact of covariates and more clearly capture the temporal variation of policy effects. Due to the inconsistent transition periods for the entities subject to the Guidance, meaning the timing of the impact of this regulatory policy varies, individuals entering the experimental group are constantly changing, which complicates the determination of policy timing. The paper compares the current year with the time point when the individual is subjected to policy constraints, thus obtaining time dummy variables from 4 periods before to 2 periods after policy implementation for each individual, observing the changes in policy effects from 4 periods before to 2 periods after the banks receive treatment. This regression includes only banks in the treatment group. The first period before the policy implementation in the sample is used as the baseline group. The regression results show that the coefficients for the four periods before the implementation of the regulatory policy are not significantly different from zero, while those after policy implementation are significantly negative at the 5% level. That is, the regulatory policy has no impact on the scale of entrusted loans issued by banks before it took effect, and has a significant impact afterwards, validating the parallel trends assumption.

Variables	lnEL	$\ln\overline{EL}$
pre4	0.2802	0.2676
	(0.2957)	(0.3009)
pre3	0.2916	0.2828
	(0.2542)	(0.2614)
pre2	-0.2367	-0.2534
	(0.2980)	(0.3039)
current	-0.2166	-0.2348
	(0.2603)	(0.2683)
post1	-0.5580**	-0.5793**
	(0.2535)	(0.2599)
post2	-0.5560**	-0.5713**
	(0.2573)	(0.2618)
Controls	YES	YES
Year FE	YES	YES
Bank FE	YES	YES
Observations	650	650
R^2	0.4273	0.4124

Note: Numbers in parentheses are robust standard deviations; *, **, *** represent significant at the 10%, 5%, and 1% levels, respectively.

5.2 Heckman model

Since the sample data are obtained from manually collected entrusted loan announcements of listed companies, there may be sample selection bias, so this paper uses the Heckman two-step method to solve the sample selection problem (Xi et al., 2019). The first step is the selection equation, which uses the Probit model to estimate the effect of bank regulatory policies on whether banks are entrusted to issue entrusted loans and calculates the Inverse Mills Ratio (IMR) to identify the selection bias. The explained variable in equation (3) is the dummy variable of whether banks are entrusted with entrusted loans, and the dummy variable of "whether banks are entrusted with entrusted loans in the previous year" is included in the selection equation as an exclusive constraint variable drawing on previous empirical research methods, which has an impact on whether banks are entrusted with entrusted loans in the current year, but not directly on the size of entrusted loans in the current year, impacting only indirectly through the *IMR*. The

exclusion constraint variable is exogenous and has strong explanatory power for *DID*, and the inclusion of the exclusion constraint variable enables the estimated *IMR* to better detect and control for selection bias. Without the exclusion constraint variables, there may be problems of nonlinear identification bias and high covariance in *IMR*, which in turn might lead to wrong conclusions. The second step is a quantitative equation in which the *IMR* is added as a control variable to control the selection bias of the entrusted loan data, which in turn leads to a more accurate effect of bank regulatory policies on the size of entrusted loans. The control variables and other parameters in the selection equation and the quantitative equation are set as in model (1) and (2). The specific models are as follows:

$$pro\{Entrust_{i,t}=1\}=\alpha_0+\alpha_1 DID_{i,t}+\alpha_2 Entrust_{i,t-1}+\beta_i X_{i,t}+\mu_i+\tau_t+\varepsilon_{i,t} \quad (3)$$

$$lnEL_{i,t}=\alpha_0+\alpha_1 DID_{i,t}+\alpha_2 IMR_i+\beta_i X_{i,t}+\mu_i+\tau_t+\varepsilon_{i,t} \quad (4)$$

From the results of the two-step regression of the Heckman model in Table 11, the *IMR* in the second step of the regression is significant at the 1% level, indicating that there is indeed a sample selection problem in the data of this paper. After controlling for the sample selection bias, the bank regulatory policy implementation variable *DID* remains significantly negative at the 10% level, which means that the regression results above are robust.

Table 11 Heckman Regression Results

Variables	EL>0	lnEL	EL>0	$\overline{\ln EL}$
EntrustL1	-0.3511*		-0.3511*	
	(0.1985)		(0.1985)	
DID	0.4393	-0.2461*	0.4393	-0.2694*
	(0.5692)	(0.1492)	(0.5692)	(0.1508)
IMR		2.9662***		2.9733***
		(0.0980)		(0.0988)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Observations	552	552	552	552
R^2	0.3763	0.8748	0.3763	0.8724

Note: Numbers in parentheses are robust standard deviations; *, **, *** represent significant at the 10%, 5%, and 1% levels, respectively.

5.3 Placebo test

In addition, in order to exclude the influence of other factors on the shadow banking business such as entrusted loans, this paper further conducts a placebo test. By randomly generating an experimental group and constructing a "pseudo-policy dummy variable" for regression, if the coefficient of the "pseudo-policy dummy variable" is still significant in the fictitious case, the original estimation results are likely to be biased and the annual change in the size of entrusted loans are most likely influenced by other policy or random factors. Since this paper uses a multi-period difference-in-differences model, different individuals reach the criteria at different time points. So this paper first randomly selects individuals as the treatment group, then randomly selects time as the policy time point, and finally generates a "pseudo-policy dummy variable" for regression. The process is repeated 1000 times to obtain the estimated coefficients, standard errors and p-values of the 1000 groups of "pseudo-policy dummy variables", and the distribution of the estimated coefficients and corresponding p-values of the "pseudo-policy dummy variables" are plotted, as shown in Figure 4. The vertical dashed line is the true estimate value of the multi-period DID model -0.33, and the horizontal dashed line is the significance level of 0.1. From Figure 4, we can see that the true estimate of -0.3349 is an obvious outlier, and the p-values of most of the estimated coefficients are greater than 0.1 (insignificant at the 10% level), which indicates that the estimated results are not obtained by chance, and the hard constraint did have a dampening effect on the development of shadow banking such as entrusted loans.

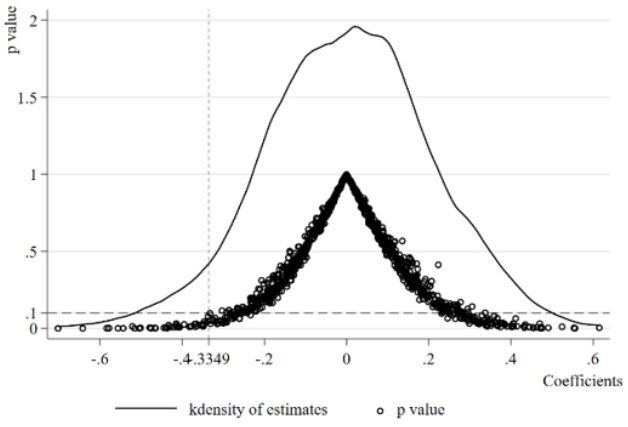

Figure 4 Placebo Test

5.4 Alternative measures of entrusted loan size

In the main regression, this paper uses the natural logarithm of the initial value of entrusted loan size for the regression analysis. In addition, this paper also counts the number of entrusted loans issued by each bank each year,

which in turn yields the average entrusted loan amount, and uses the average entrusted loan amount instead of the entrusted loan size for the regression analysis. As can be seen in Table 5, the coefficient of the policy treatment effect in the fourth column is significantly negative at the 1% level without adding control variables, and the coefficient of the policy treatment effect in the fifth column is significantly negative at the 5% level after controlling for other possible influencing factors. The mandatory requirement of the new regulatory policy inhibits the expansion of shadow banking such as entrusted loans, and they are negatively related. The results show that when using other measurement indicators, the new regulatory policy similarly restricts the development of shadow banking, consistently supporting Hypothesis 2. In subsequent further analyses and discussions, the average amount of entrusted loans is also used for synchronous regression, yielding consistently similar conclusions.

6 Conclusion and insight

The hidden nature of financial innovations and the cross-market contagion of risks make the prevention of systemic risks an important task for banking supervision. With the rapid expansion of the shadow banking system, which plays an increasingly important role in the global financial system, the potential risks embedded in the shadow banking system have also attracted great attention of financial regulators in various countries. Financial crisis in 2008 fully exposed the shortcomings of micro-prudential supervision policies that focused only on the risks of individual commercial banks before the financial crisis, and banking supervision in major countries around the world gradually shifted to macro-prudential supervision that focuses on the stability of the entire financial system and pays more attention to the correlation between financial institutions. In the aftermath of the financial crisis, supervisory authorities around the world are committed to constructing and implementing a macro-prudential regulatory policy system. The Basel Committee revised and improved Basel Accord II, gradually incorporated shadow banking into the banking regulatory system, and officially issued Basel Accord III in 2010. As a member of the Basel Committee, China has actively drawn on international experience and respected domestic banking business practices to gradually introduce a macro-prudential regulatory framework, and issued the "Guidance on the Implementation of New Regulatory Standards for the Banking Sector in China" in 2011, dedicated to promoting the sound operation of the banking sector. However, in the context of strengthening banking supervision, the scale of shadow banking in China is still growing rapidly. Therefore, this paper starts from the Guidance to explore the impacts and policy transmission mechanisms of macro-prudential regulatory policy on shadow banking activities such as entrusted loans, thereby providing insights for the implementation and adjustment of banking regulatory policies. Innovatively, this paper uses the implementation process of the Guidance as a "quasi-natural experiment," utilizing data on entrusted loans issued by 72 Chinese banks from 2007 to 2019 collected manually. It empirically tests the relationship between banking regulation and the scale of shadow banking activities such as entrusted loans through a multi-period difference-in-differences method, providing Chinese experience for the evaluation and mechanism analysis of the banking industry's macro-prudential regulatory policies.

The findings of this paper indicate that: (1)The mandatory requirement of the Guidance, a regulatory policy, effectively curbs commercial banks' shadow banking business and helps achieve the regulatory objective of preventing and controlling systemic risk. (2) In terms of specific impact mechanism, capital adequacy ratio has a significant positive impact on the scale of shadow banking such as entrusted loans. When subject to stricter regulation, the capital adequacy ratio is hit by the cost of holding capital and the expanded scope of measuring risky assets by banks, and commercial banks need to meet the regulatory requirements by reducing the scale of shadow banking activities. The liquidity ratio has a positive impact on the size of shadow banking such as entrusted loans. Improving the liquidity ratio increases the opportunity cost of commercial banks and motivates them to engage in entrusted loan business.

The effect of loan provisioning ratio on entrusted loans is not significant. (3)The Guidance has a heterogeneous impact on shadow banking activities after distinguishing bank size and profitability. Its inhibitory effect is more pronounced among banks with larger asset size and higher profitability. The coefficient of the policy implementation variable remain significant after considering the new regulatory initiatives for shadow banking introduced in 2017.

The findings of this paper have both theoretical value and practical significance. At the theoretical level, this paper enriches the research on the impact of bank regulation on shadow banking behavior and analyzes the policy transmission mechanism, providing a new perspective for assessing the effectiveness of bank regulation policies. At the practical level, the findings of this paper provide important policy insights for improving the banking regulatory system and monitoring potential systemic financial risks. Firstly, gradually incorporate different types of shadow banks into the regulatory system, formulate and implement targeted macro-prudential regulatory policies based on the risk characteristics of shadow banking, and implement flexible banking regulatory arrangements according to the size and profitability of different banks. Proactively identify different risk sources, expand the scope of traditional bank supervision, set risk weighting coefficients that match the risk characteristics of shadow banks themselves, and eliminate regulatory arbitrage of commercial banks to the maximum extent. Secondly, ontinuously improve the design of specific regulatory indicators and set the appropriate level of regulatory indicators. Although increasing the capital adequacy ratio helps enhance the ability to absorb risky assets, an excessively high capital adequacy ratio will increase regulatory costs and prompt commercial banks to turn to shadow banking for arbitrage activities. The capital adequacy ratio needs to find a balance between excessive risk-taking and excessive prudence in order to maximize social welfare. Finally, financial innovation is evolving and bank regulatory policies need to keep pace with the times. The business models for regulatory arbitrage are rapidly updated and hidden, and the Guidance also has regulatory flaws and loopholes. With the further revision of Basel Accord III, China needs to update its policy system timely, improve the modern financial regulatory system, fill the regulatory gaps, and then build up the regulatory framework for full risk coverage.

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