National Accounting Review

NAR, 6(1): 116–147.
DOI: 10.3934/NAR.2024006
Received: 31 October 2023
Revised: 20 February 2024
Accepted: 01 March 2024
Published: 07 March 2024

https://www.aimspress.com/journal/NAR

Research article

Revisiting the monetary transmission mechanism via banking from the perspective of credit creation

Hua Zhong[1], Zijian Feng[1,2], Zifan Wang[1] and Yougui Wang[1,*]

[1] School of Systems Science, Beijing Normal University, Beijing 100875, P. R. China

[2] Physics Department, University of Fribourg Chemin du Musée 3, 1700 Fribourg, Switzerland

* **Correspondence:** Email: ygwang@bnu.edu.cn.

Abstract: Many transmission channels of monetary policy have been proposed to enrich and deepen the understanding of its mechanisms. However, some channels have not been clarified, particularly for those unconventional quantitative policies implemented after 2008 financial crisis. In this paper, we develop a unified model of a credit economy where bank regulations and decisions and loanable funds market are placed at a central position, while stocks and flows are incorporated with each other to formulate banks' credit creation and circulation. We find that bank regulations can induce some new channels of monetary transmission by imposing credit constraints, including the new bank capital channel, the credit supply channel, the new bank balance sheet channel, and the new bank risk-taking channel. Comparing these channels with the traditional ones, we underscore the impact of bank regulations on monetary transmission. As aggregate demand can be decomposed into two monetary flows generated by money circulation and bank lending respectively, the direct channels of monetary transmission to aggregate demand can be renewed as follows: the money channel, the narrow money circulation channel, the new bank lending channel, and the repayment channel. In addition, based on the relevant data from the United States, we have conducted vector autoregressive (VAR) impulse response analysis to confirm the effectiveness of some direct channels. Our work not only aids in revisiting the monetary transmission from a credit view but also facilitates the assessment of efficiency of monetary policy.

Keywords: monetary policy; monetary transmission channels; credit creation; bank regulation; loanable funds market

JEL Codes: E10, E43, E44, E51, E52, E58, G21, G28

1. Introduction

Monetary policy always occupies an important position in macroeconomics. Although the practice of monetary policy primarily focuses on interest rate adjustment (Taylor, 1993), banks play a crucial role in the effectiveness of monetary policy (Kashyap and Stein, 1997; Peek et al., 2013). After the global financial crisis, the interest rate dropped to the "zero lower bound," forcing central banks to use unconventional monetary policies like quantitative easing and other measures to ramp up economic recovery. To rescue the recent crisis caused by the Covid-19 pandemic, the central banks implemented tremendous unconventional policies. Although the scale of those policies was unprecedented, the outcomes have been proven to be much uncertainty than anticipated. The lack of awareness of policy-makers about banking function can be attributed to the inefficiency. Several economists recognized that the existing macroeconomic models ignored the roles of banks and debt, so they attempted to improve the understanding the mechanism of monetary transmission by integrating banks into the macroeconomic models (Woodford, 2010; Gertler and Karadi, 2011). Nevertheless, banks are still taken as financial intermediaries in the integrated models (Gertler and Kiyotaki, 2010, 2015). Banks are credit creators rather than financial intermediaries. Even though such a fundamental idea has been revived (McLeay et al., 2014a, 2014b), so far, it has not yet been accepted by many monetary policymakers (Jakab and Kumhof, 2015; Kumhof and Wang, 2021).

In the aftermath of the financial crisis, the main objective of the major central banks was to prevent the economy from experiencing the great recession by stimulating aggregate demand through massive rescue plans and expansionary monetary policies. Meanwhile, rigorous bank regulations were introduced to enhance financial stability and reduce systemic risks (Dermine, 2013; BCBS, 2013). However, the regulatory requirements could impose constraints on targeted variables of banks' balance sheets, the ability of banks to create credit was subsequently restrained (Berger and Bouwman, 2013; Li et al., 2017; Xiong et al., 2020). Therefore, how to balance the conflicting aims of the two policies and make them coordinate with each other to achieve the best policy effect is also a challenge of policymakers and researchers. Recently, some studies have examined the effects of Basel III on money supply (Xiong et al., 2017; Xiong et al., 2020) and on the bank lending channel (Xiong and Wang, 2022). These studies provided a theoretical and analytical framework for understanding the interaction between quantitative monetary policy and bank regulations.

The view of credit creation of banking argues that banks can create deposits and loans simultaneously when they lend funds to borrowers (Werner, 2014). However, most of the literature on monetary policies focused only on the impact of money on the economy and ignored the role of debt in macroeconomic performance (Friedman, 1982; Bernardo and Campiglio, 2013; Keen, 2016). The impact of the financial sector on aggregate demand is mainly reflected in its function of credit creation, and thus how debt affects aggregate demand is a key issue that needs to be addressed. In fact, there are a few economists who have attempted to incorporate debt into macroeconomic models from different perspectives and visions. However, there is no consensus on the integration issue so far. Based on the traditional IS-LM model, some economists argued that the loan market (or bond markets) could be included, thus allowing the relationship between loan rates (or bond rates) and aggregate income to be established (Brunner and Meltzer, 1972; Bernanke and Blinder, 1988). Keen (2016) discovered that an

increase in debt is closely related to changes in GDP. Xing et al. (2021) decomposed total expenditure from the perspective of financing sources, and they obtained the respective contributions of money and debt to aggregate demand. This result also provides a basis for analyzing the direct impacts on aggregate demand that a monetary policy has.

In general, a monetary policy aims to increase aggregate income by stimulating aggregate demand, so a question is raised regarding how a monetary policy implemented by the central bank can achieve this goal. To address this question, this paper attempts to put forward a unified framework of the credit system, on which the separate transmission channels of monetary policy can relate to each other. Specifically, the credit system consists of five modules: the federal funds market, bank regulations and decisions, the loanable funds market, dynamics of credit creation, and decomposition of aggregate demand. Therefore, the transmission channels of each monetary policy from the central bank to aggregate demand and the linkages among these channels can be identified.

The contributions of our paper can be summarized as follows:

1. We revisit the transmission mechanism of monetary policy from the perspective of credit creation of banks.
2. We put forward a unified model of the credit system to identify the transmission channels which are consistently connected with each other.
3. We examine how multiple regulations impact the credit capacity of the banking system and thus govern the supply of loanable funds, which is the hub of the transmission of monetary policy to aggregate demand.
4. We propose an alternative approach to decomposing aggregate demand from the perspective of financing sources and then formulate four direct channels on aggregate demand in a closed economy.
5. We conduct vector autoregressive (VAR) impulse response analysis to verify the effectiveness of some direct channels based on the relevant data from the United States.

The structure of the paper is organized as follows. Section 2 is the literature review. Section 3 is an overview of the unified credit system. Section 4 analyzes the transmission channels of monetary policy. Section 5 presents the empirical results. Section 6 is a part of discussion. Section 7 concludes the paper.

2. Literature review

2.1. Credit creation

For the research of banking functions, the earliest version of credit creation theory of banking can be traced back to the mid-nineteenth century. Macleod (1866) first proposed that banks can create money out of thin air, and he regarded banks as the typical agents of credit creation. The theory of bank credit creation was popular in the late 19th and early 20th centuries, mainly in the context of publications of Wicksell (1898, 1907) and Schumpeter (1912). They argued that banks do not need deposits or reserves to make loans; instead, loans and deposits are created simultaneously through bank lending (Werner, 2016).

However, this theory did not become a prevailing approach to describing the money creation process of banks. With the emergence of the theory of financial intermediary and the theory of fractional reserve in the later periods, the theory of credit creation was discarded gradually in the

circle of mainstream economics. Nevertheless, it was used as a kind of heterodoxy view by a minority of economists. To date, the mainstream view of banks insists that they are financial intermediaries. This theory was originated by Gurley and Shaw (1955, 1960), Tobin (1964), and Tobin and Brainard (1963), who argued that the differences between banks and financial intermediaries are only in degree, not in kind. In other words, both make loans by absorbing deposits from savers. Even after the financial crisis, mainstream economists still take the intermediary view even though the doctrine of credit creation could explain macroeconomic performance very well. It is worth noting that a series of papers had sprung up, emphasizing the role of banks in credit creation. Several economists from the Bank of England took the lead in reiterating the concept of credit creation and highlighted the true role of banks. Later, they also attempted to integrate credit creation theory with dynamic stochastic general equilibrium (DSGE) models (Jakab and Kumhof, 2015, 2019). In addition, Kumhof and Wang (2021) analyzed the impact of zero interest rates on the supply of loanable funds and inflation based on credit creation.

2.2. Bank regulations

In this paper, we adopt the banking theory of credit creation for our analysis, which argues that banks are credit creators at both micro and macro levels. It is worth noting that the theory does not assert that banks can create credit without limit. Bank lending will be constrained by seeking profits and safeguarding against risks (Goodhart, 2010). As banks pursue profits, they are exposed to liquidity and solvency risks. After the financial crisis, to mitigate intrinsic financial instability and strengthen the ability of banks to resist risks, the Basel Committee on Banking Supervision (BCBS) put forward Basel III to reinforce supervision of the banking system. Specifically, Basel III imposed stringent requirements on capital adequacy and introduced leverage ratio requirement. It also proposed liquidity regulations, such as liquidity coverage ratio and net stable funds ratio requirements (BCBS, 2013). The macroeconomic implications of these bank regulations have attracted much attention. One straightforward result is that by setting higher requirements on bank capital and high liquid assets, these regulations could indirectly increase the user cost of bank capital (Krug et al., 2015). More importantly, although the fundamental purpose of bank regulations is to enhance financial stability and reduce systemic risks, the ability of credit creation has been restrained due to the various constraints imposed by bank regulations on the balance sheets of banks (Xiong et al., 2017; Xiong et al., 2020).

There were a series of studies that have engaged in research on the influence of bank regulations on credit creation after the introduction of Basel accord. Based on the data of Greek banking system, Panagopoulos (2010) examined the impact of Basel II capital regulation on money supply and demonstrated that money supply could be explained by post-Keynesian structural endogenous money theory. Berger and Bouwman (2013) discovered that interactions and mutual influences between various regulations and multiple regulations would collectively affect the supply of loanable funds. Li et al. (2017) elaborated how the requirement of liquidity coverage ratio in Basel III restrains credit creation. Xiong et al. (2017, 2020) also identified that all the requirements of liquidity coverage ratio, net stable fund ratio, capital adequacy ratio, and leverage ratio have a respective constraining effect on credit creation. The impacts of multiple regulations on credit creation were also investigated with a multi-agent model. It was found that the heterogeneity of bank capital and liquidity led to a reduction in overall deposits through numerical simulations (Xing et al., 2020).

2.3. Money, debt, and aggregate demand

Money and debt contribute to aggregate income in their respective ways. However, most monetary economics literature emphasizes money while ignoring debt (Stiglitz, 2018). Debt was the major culprit of the global financial crisis and the European Union debt crisis. Moreover, the countries involved in the financial crisis had common characteristics of soaring debt and high default rates. Therefore, one of the challenges for macroeconomists to integrate debt with macroeconomic models is to understand why high burden of debt could lead to an economic collapse (Rogoff, 2010).

In fact, a small branch of economists attempted to explain how debt impacts aggregate demand. Fisher first proposed the theory of debt deflation, emphasizing the role of debt in the deflation process (Fisher, 1933). Unfortunately, this pioneering work gathered few followers in almost half a century. The prominent recurrence of such attention in mainstream economics was the empirical findings of Friedman (1982) and Bernanke (1983), who pointed out that credit had a close relationship with total output. Also, a series of works investigated how credit contributed to expenditures and especially examined the relationship between loans and aggregate demand (Blinder and Stiglitz, 1983; Bernanke and Blinder, 1988). Just after the financial crisis, Eggertsson and Krugman (2012) presented a simple new Keynesian model of debt-driven slumps, in which rapid deleveraging of agents depressed aggregate demand. Jodrà et al. (2013) highlighted the importance of the financial sector in the modern business cycle and investigated how credit accumulation impacts aggregate output. Mian and Sufi (2011, 2012, 2020) empirically examined the impact of debt on aggregate demand as well as its transmission mechanism.

Steve Keen, a prominent post-Keynesian economist, argued that the increment of debt was the main reason for the expansion of aggregate demand and showed us that the variation in debt had a direct impact on the growth of aggregate demand (Keen, 2016). Bernardo et al. (2013) suggested that the increment in debt was equal to the difference between aggregate demand and aggregate income. The level of economic activities will also increase when an incremental increase in debt stimulates aggregate demand. Xing et al. (2021) developed a macroeconomic model from the perspective of financing sources of expenditures to understand the corresponding parts of money and debt on aggregate demand.

However, debt is a double-edged sword that can also negatively impact aggregate demand. As argued by Palley (1997) and Rogoff (2010), in the early stages of debt formation, it has a positive effect on aggregate demand; however, as debt progressively accumulates, the burden of repayments and interests increase, which would depress aggregate demand. In particular, a crisis could be attributed to the accumulation of debt by the non-government sector (Jodrà et al., 2013; Mian et al., 2020). In fact, Minsky (1982) proposed a key mechanism that pushed the economy towards the crisis. Koo (2011) coined the term *balance sheet recession*, explaining that excessive debt can trigger asset bubbles and economic recessions.

2.4. Traditional monetary transmission channels

Monetary transmission channels refer to the pathways through which a central bank influences economic agents and the overall economic activities by adjusting its monetary policy tools. These channels transmit the shocks of monetary policy throughout the entire economic system, aiming to achieve the macroeconomic goals set by the central bank, such as maintaining price stability, promoting employment, and supporting economic growth (Goyal and Parab, 2021).

One of the most common transmission channels of monetary policy is the interest rate channel. The mechanism of this channel is that the central bank intends to drive the long-term interest rates by manipulating short-term interest rates, thereby influencing the user's cost and subsequently inducing changes in investment and aggregate demand. Therefore, the sensitivity of long-term interest rates to changes in short term interest rates, and the elasticity of investment demand plays a crucial role in determining the efficacy of this channel (Boivin et al., 2010). However, some countries encountered the dilemma of zero lower bound, where short term interest rates are already near or have reached zero. This predicament limits the central bank's ability to further lower rates to stimulate the economy, potentially causing the interest rate channel to become ineffective. Consequently, central banks embark on an exploration of alternative monetary transmission channels, such as the credit channel, to achieve their policy objectives.

The credit channel, initially proposed by Bernanke and Blinder (1988), refers to the central bank's utilization of monetary policy to influence bank loans, consequently exerting an impact on aggregate demand through consumption and investment. The credit channel comprises two distinct channels: the bank lending channel and the balance sheet channel. In the traditional bank lending channel, tight monetary measures such as setting a higher required reserve ratio leads to a reduction in the amount of deposits, which ultimate resulting in a corresponding decrease in the amount of loans (Meh and Moran, 2004; Chen, 2001). The traditional balance sheet channel encompasses both the firms' balance sheet channel and the banks' balance sheet channel. The channel of the firms' balance sheets emphasizes how changes in monetary policy, particularly interest rate adjustments, can influence firms' financial decisions and investment choices by affecting borrowing costs and asset value. With the increased role of banks in the aftermath of the global financial crisis, some economists have proposed the banks' balance sheet channel, which suggests that the central bank's monetary policy can shape the structure of a bank's balance sheet, thereby affecting the supply of loanable funds (Jiménez et al., 2012). Notably, these credit channels, which encompass the bank lending channel and two forms of balance sheet channels, are traditionally predicated on the assumption that banks operate as financial intermediaries (Romer et al., 1990; Kashyap and Stein, 1994). However, with the evolving understanding of the role of banks over time, economists have raised questions regarding whether banks primarily serve as financial intermediaries or creators of credit (McLeay et al., 2014a, 2014b; Jakab and Kumhof, 2019). Consequently, the effectiveness of these credit channels has come under scrutiny.

Apart from the debate regarding the role of banks, some economists have pointed out that the level of bank capital also can influence banks' supply of loanable funds (Tanaka, 2002; Honda, 2004). Consequently, the bank capital channel has emerged as a topic of interest. The mechanism of this channel is closely related to the bank lending channel, with a key distinction being that monetary policy acts on bank capital rather than deposits to influence aggregate demand (Rasche and Johannes, 2012). In the context of the bank capital channel, monetary shocks led to changes in net interest margins, and ultimately influence bank capital (Gambacorta and Mistrulli, 2004; Chami and Cosimano, 2010; Orzechowski, 2019). As research in the bank capital channel deepens, some literature introduced risk-taking channel (Rajan, 2006; Boivin et al., 2010). This channel highlights that low interest rate can influence banks to allocate a greater portion of their portfolios to high-risk assets in pursuit of higher returns, ultimately resulting in an intensification of risk-taking behavior within the banking sector.

Furthermore, many researchers have conducted empirical analyses based on data from different countries and sectors to examine the effectiveness and applicability of monetary policy (Gunji and Yuan, 2010; Ahrend and Goujard, 2015). However, it remains difficult to attain a universally applicable or unified conclusion regarding its effectiveness, whether in theoretical or empirical analysis. It is worth noting that some studies have already indicated that within the process of monetary transmission, effectiveness is not solely contingent upon changes in the targeted policy variables themselves but is also influenced by other important variables (Kopecky and VanHoose, 2004). Particularly relevant to the transmission channels of monetary policy through banks, given the interconnectedness of various components within banks' balance sheets, alterations to one variable due to policy shocks can trigger changes in other balance sheet components and the overall structure. These factors significantly impact the effectiveness of monetary policy. Thus, it can be deduced that the transmission channels are not self-contained; there exist interdependencies among different channels. To delve deeper into the transmission mechanisms of these channels and their mutual interactions, it is essential to incorporate the transmission processes of these channels into a unified model. Such a model will contribute to the development of a novel framework for assessing policy effects, thereby enhancing our comprehensive understanding of the mechanisms governing the impact of monetary policy.

3. Overview of the unified credit system

Monetary policy is an important tool of government intervention; however, the effectiveness of monetary policy has been declining or vague since the financial crisis. The realization of monetary policy objectives relies on the effective transmission from monetary policy to aggregate demand. Therefore, a reliable evaluation of the effectiveness of monetary policy depends on a proper understanding of its transmission mechanism. Although many transmission channels have been proposed, these channels have always been disconnected with each other and lack a unified theoretical analytical framework. In this section, we try to develop a macro-credit economic model that integrates all transmission channels of monetary policy together, thereby obtaining a new framework for assessing the effectiveness of monetary policy. Figure 1 illustrates the transmission paths of monetary policy from the central bank to aggregate demand. Specifically, we divide the entire pass-through into five parts based on the perspective of credit creation: (1) the federal funds market, (2) bank regulations and decisions, (3) the loanable funds market, (4) dynamics of credit creation, and (5) decomposition of aggregate demand. We will analyze the operation process of each part in detail as follows.

3.1. The federal funds market

The federal funds market describes the interbank market for lending and borrowing reserves. The interest rate paid on interbank lending is known as federal funds rate, and changes in this rate respond sensitively and effectively to the position of banks' liquidity (Swanson, 2023). As the dominated part of the federal funds market, the central bank's role in the functioning of the federal funds market is manifested in the following ways.

As shown in Figure 2, the discount rate (i_d) and excess reserve rate (i_{or}) set by the central bank are the supper and lower bounds on the federal funds rate. The central bank keeps the funds' rate level (i_{ff}^*) steady around the target rate (i_{ff}^t) by adjusting the reserves held by banks. Figure 2 shows how supply of and demand for reserve funds yields the equilibrium rate i_{ff}^*. The willingness interest rates

of suppliers cannot be lower than the excess reserve rate i_{or}, and the willingness interest rates of borrowers cannot be higher than the discount rate i_d. Therefore, the effective federal funds rate must range from the excess reserve rate to the discount rate.

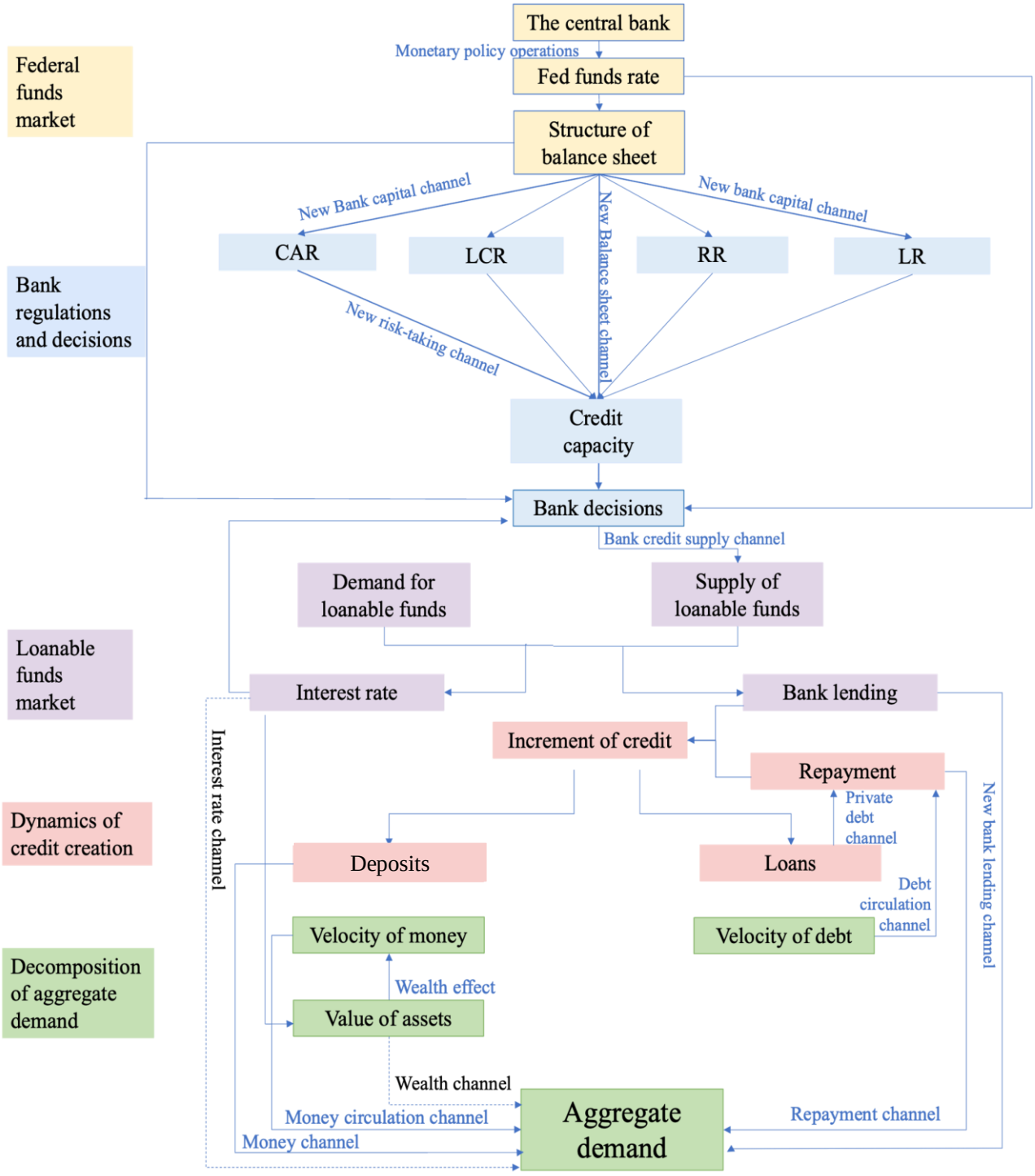

Figure 1. The unified credit system. There are five modules in the system, each represented by a color. The crucial components in each module are marked in the same color. The dot lines represent discarded channels, while the solid lines with captions are reformulated channels.

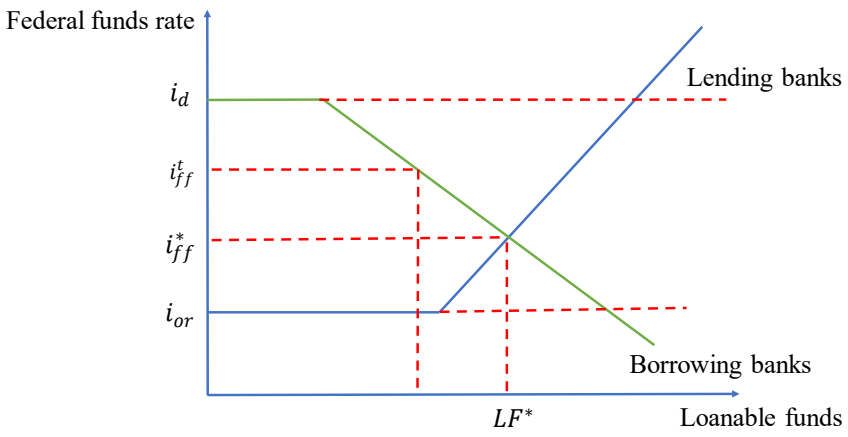

Figure 2. The equilibrium of federal funds market, where the X-axis represents the quantity of loanable funds and the Y-axis corresponds to the federal funds rate.

If the federal funds rate is not consistent with the target rate, the central bank has two choices, one is to adjust its target rate to approach the equilibrium one, the other is to drive the federal funds rate to be close to the target one by changing the amount of reserves in the banking system through some monetary operations. Therefore, the central bank can influence the banks' supply of loanable funds via both price and quantitative channels.

The price channel lies on the fact that the decision of banks on the supply of loanable funds depends on the federal funds rate, which is the level of interest rate at which reserves are traded among commercial banks. This rate can be considered as a cost component in the profit formation of commercial banks. Thus, it affects those commercial banks who lack reserves when they make their decisions on the supply of loanable funds.

The central bank also governs the supply of commercial banks' loanable funds through the quantitative channels. Since different banks face different liquidity conditions, some banks with liquidity shortages will choose to borrow from those banks with sufficient liquidity and pay overnight interest rate when liquidating. By keeping the federal funds rate constant, the central bank needs to accommodate the demand of commercial banks for reserves, that is, the central bank will maintain the level of federal funds rate by managing reserves in the banking system. Meanwhile this operation also changes banks' balance sheet structure, which determines the supply of loanable funds.

In addition, to ensure that banks have sufficient reserves when faced with customer withdrawals and liquidation of funds, the central bank binds the ratio of commercial banks' reserves to their deposits. Suppose commercial banks undertake a credit expansion, the supply of liquidity will decrease, and the demand for liquidity will increase, leading to an increase in the federal funds rate. In this case, unless the central bank raises the target rate, it has to inject a certain amount of reserves to drive interest rates down to the target rate. This indicates that a credit expansion would increase demand for reserves under the regime of interest rate control.

3.2. Bank regulations and decisions

Bank decision-making is a complex process that yields banks' supply of loanable funds in the market. Traditional analysis of bank decisions has centered around assessing the supply of loanable

funds in light of banks' profit maximization endeavors. Banks capitalize on the interest rate spread, the difference between the rates of loans and deposits, to generate profits. However, bank decision-making is not solely driven by profit maximization; bank regulations also play an important role in these decisions. Bank regulations introduce constraints and requisites for credit creation, aiming to ensure the stability of the financial system. These regulations contribute to the formation of credit capacity, which is defined as the maximum amount of outstanding loans. The level of credit capacity indirectly restricts the level of credit creation of banks. Thus, we can argue two main factors that shape banks' decision-making processes: the principle of profit maximization, intricately linked to interest rate spread, and the impact of bank regulations, which impose quantity restriction on the supply of loanable funds. While a lot of research explored how profit maximization impacts the supply of loanable funds, our focus in this section shifts to investigating how bank regulations constrain it.

The required reserve ratio (RR) regulation is a quantitative tool that is widely used by the central banks for managing the banks' supply of loanable funds. This regulation mandates that banks should hold reserves more than the product of the required reserve ratio and the total deposits held by them. This requirement specifies the credit capacity of banks by constraining their available funds. Furthermore, the regulatory authorities have introduced Basel III regulations, which encompass the liquidity coverage ratio (LCR), the capital adequacy ratio (CAR), and the leverage ratio (LR) requirements. These bank regulations, like the reserve ratio requirement, have a binding effect on the credit creation of banks.

To illustrate the impacts of these bank regulations on the supply of loanable funds and the exact expressions of respective credit capacity, we use a simplified balance sheet for analysis. The assets in the balance sheet include only loans (L) and reserves (R), while the liabilities contain deposits (D) and equity (E). For simplicity, we specify the ratio of equity to reserves as $e = \frac{E}{R}$.

3.2.1. The required reserve ratio and credit capacity

The impact of the reserve ratio regulation on credit creation can be understood when the central bank sets the required reserve ratio, the actual reserve ratio (r) which meets this requirement should be greater than the minimum reserve ratio stipulated by the central bank (r_{min}). Then, the maximum volume of loans for a bank is the reciprocal of the required reserve ratio multiplied by the number of reserves it holds. Thus, the formula of the credit capacity with the constraint of the required reserve ratio L_{max}^{RR} can be expressed as (Xiong, et al., 2020)

$$L_{max}^{RR} = \left(\frac{1}{r_{min}} + e - 1\right) R, \tag{1}$$

3.2.2. The required liquidity coverage ratio and credit capacity

The liquidity coverage ratio is defined as the ratio of the level of high-quality liquid assets ($HQLA$) to the total net cash outflow ($NCOF$) over 30 days in a stressed condition. Basel III specifically requires individual banks to hold a sufficient amount of highly liquid assets that can be easily and immediately converted into cash at little or no loss of value to ensure that banks can meet 30-day liquidity needs in the event of financial distress. Given the potential amount of cash loss caused by unanticipated deposit withdrawal and the amount of cash inflow obtained from repayments, the net cash outflow within 30 days is determined as the effective requirement for liquid assets. Therefore,

through the above analysis of the composition of liquid assets and the specific sources of cash flows, the expression of the credit capacity of a bank with the liquidity coverage ratio requirement L_{max}^{LCR} can be written as (Xiong, et al., 2020).

$$L_{max}^{LCR} = \begin{cases} \dfrac{4}{\mu LCR_{min}}, & \lambda \le 1.5\mu,, e > 1 - \dfrac{4\lambda - 6\mu}{\mu\lambda LCR_{min}} \ or \ \lambda > 1.5\mu, e \ge 1; \\ \dfrac{\lambda(1-e)}{\lambda - 1.5\mu}, & \lambda < 1.5\mu, 1 < e < 1 - \dfrac{4\lambda - 6\mu}{\mu\lambda LCR_{min}} \ or \ \lambda > 1.5\mu, 1 - \dfrac{4\lambda - 6\mu}{\mu\lambda LCR_{min}} \le e < 1; \\ \dfrac{\lambda(1-e)LCR_{min} + 2}{(2\mu - \lambda)LCR_{min}}, & \lambda \le 1.5\mu, 1 - \dfrac{2}{\lambda LCR_{min}} < e < 1 - \dfrac{4\lambda - 6\mu}{\mu\lambda LCR_{min}}. \end{cases} \quad (2)$$

where λ is the repayment rate, μ represents the outflow proportion of deposits, and LCR_{min} denotes the minimum requirement of *LCR*.

3.2.3. The required capital adequacy ratio and credit capacity

The capital adequacy regulation requires banks to hold sufficient capital to prevent solvency risks. That is, the actual capital adequacy ratio (CAR) must be greater than the minimum capital adequacy ratio (CAR_{min}). The capital buffer needed against solvency risk in a bank is equal to the amount of various risky assets multiplied by the corresponding coefficient of the risk degree. Based on the above formula, the maximum amount of bank credit under CAR requirement L_{max}^{CAR} can be obtained (Xiong, et al., 2020), which is given by

$$L_{max}^{CAR} = \frac{E}{\gamma * CAR_{min}}, \quad (3)$$

where γ is the coefficient of risk weight of loans.

3.2.4. The required leverage ratio and credit capacity

We make a similar analysis for the impact of leverage ratio regulation on credit capacity. The leverage ratio is defined as the ratio of total assets to the bank's capital in the balance sheet. Thus, the leverage ratio regulation requires that the actual leverage ratio (LR) of a bank is not less than the minimum requirement (LR_{min}). The total asset is the sum of loans and reserves in the simplified balance sheet. Then given the level of bank capital, the credit capacity of the bank with the leverage ratio requirement L_{max}^{LR} can be easily expressed as follows (Xiong, et al., 2020).

$$L_{max}^{LR} = \left(\frac{1}{LR_{min}} - \frac{1}{e}\right)E, \quad (4)$$

Like the preceding analysis, it becomes evident that each requirement can form a distinct credit capacity. Additionally, recent studies have indicated that these regulations do not operate in isolation; instead, they collectively determine the capacity for credit creation (Xiong and Wang, 2018). In cases where credit creation is bounded by multiple regulations, the effective credit capacity of banks is governed by the tightest regulation.

3.3. The loanable funds market

The primary function of the loanable funds market is to transfer liquidity between surplus units and deficit units and promote aggregate demand. In this paper, we chose the supply of loanable funds as the intermediary variable in the entire transmission of monetary policy.

The crossing of the supply of and the demand for loanable funds determines total lending and interest rate. Specifically, there are three agents who supply loanable funds: households, banks, and non-bank financial intermediaries. However, this paper focuses on the monetary policy transmission mechanism through banks. All monetary transmissions are via the supply of loanable funds from banks to aggregate demand. Therefore, we assume that the only agent who provides loanable funds is commercial banks. Banks can provide funds without absorbing deposits, so their supply of loanable funds can be expressed as,

$$LF_s = p(i) * (L_{max} - L) + RP, \tag{5}$$

where L_{max} denotes the credit capacity of banks and L is the actual amount of loans. Therefore, $L_C - L$ represents the gap between them, which turns out to be the space for banks to create the new loanable funds. As repayments RP occur, the outstanding loans would be deleted, and thus the space is enlarged. As a result, the supply of available funds also increases. p is the coefficient that specifies the utilization ratio of this kind of availability. In addition, as other conditions remain the same, the amount of the supply of loanable funds has a positive relationship with the interest rate, so the supply of loanable funds is an upward-sloping curve. This characteristic is embodied in the function of $p(i)$, the utilization ratio of availability funds is positively dependent on the interest rate.

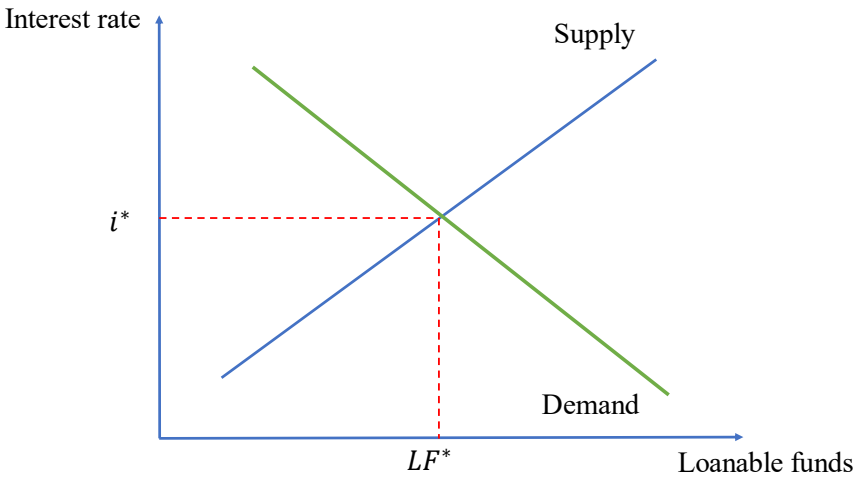

Figure 3. The equilibrium of loanable funds market. The green line represents the demand curve while the blue line is the supply curve. The point where these two curves intersect signifies the equilibrium of the market, which corresponds to both the equilibrium loanable funds and the equilibrium interest rate.

On the other hand, demand for loanable funds might come from households, firms, and illiquid financial institutions. All borrowing decisions depend on aggregate income in a positive way but on

the interest rate in a reverse way. As a result, the expression of loanable funds demanded in terms of interest rate and income can be given by

$$LF_D = \theta \cdot \frac{Y}{i} + \psi, \tag{6}$$

where θ is associated with the slope of the demand curve, i denotes the interest rate, and ψ is a constant variable. An increase in the interest rate would lead to a decrease in the loanable funds demanded. Figure 3 shows that the intersection of the two curves is the market equilibrium point, which corresponds to the equilibrium interest rate i^* and the actual level of total lending, which is denoted by LF^*. Since banks are the sole supplier of loanable funds, the total lending is narrowed to be bank lending as shown in Figure 1.

3.4. Dynamics of credit creation

The main aim of this paper is to examine monetary transmission mechanism from the perspective of credit creation. A fundamental characteristic of credit creation is that banks create deposits and loans simultaneously. To provide a more comprehensive explanation of this process and to explore the subsequent impacts of deposits and loans on aggregate demand, we make a detailed dynamic analysis of the credit creation process in this section, utilizing the principle of stock-flow consistency. This approach facilitates a clearer elucidation of the dynamic changes in deposits and loans.

In the analysis of the dynamic function of loans, it is evident that the flow variable of bank lending BL contributes to an increase in the stock variable of loans. Conversely, the bank's loan stock decreases as repayments RP are accomplished. As a result, we can describe the dynamics of loans stock as follows:

$$LF_D = \theta \cdot \frac{Y}{i} + \psi, \tag{7}$$

Additionally, during the process of bank lending, the amount of loans experience changes and the stock of deposits also correspondingly undergoes adjustments of the same magnitude. Similarly, during the repayment process, the stock of loans and the stock of deposits decreases in tandem. As a result, we can find that the formula of deposits' dynamic function is the same as that of loans, and thus the change of loans equals to the change of deposits, which can be expressed as:

$$\Delta D = BL - RP, \tag{8}$$

In summary, the process of credit creation fundamentally operates as a mechanism that simultaneously generates assets and liabilities of banks. When banks engage in lending, they create money, whereas during the repayment process, the corresponding part of money is destroyed.

3.5. Decomposition of aggregate demand

In this part, we review an income-expenditure iteration model that includes households, banks, and firms. This model decomposes aggregate demand according to the financing sources of expenditures and derives the respective contributions of money and debt to aggregate demand (Xing, et al., 2021). The total expenditure consists of consumption C and investment I, and each has its financing sources. The consumption of households is funded by their deposits (M) and disposable income (Y_d). Thus, its function can be written as,

$$C = \alpha M + \beta Y_d, \tag{9}$$

where α represents the marginal propensity to consume with respect to deposits and β is that with respect to disposable income Y_d. In addition, we assume that firms would not retain revenue except for repayments RP, so the disposable income of households can be given by

$$Y_d = Y - RP, \tag{10}$$

We further assume that firms only spend on capital goods, and the only financing source of investment is bank lending. Thus, we have the following identity:

$$I = BL, \tag{11}$$

Repayments are the obligation for firms to repay their debt (Le Heron and Mouakil, 2008), and they can be represented by

$$RP = \lambda L, \tag{12}$$

Thus, combining with the identity function of total income and total expenditure, we have the equilibrium income as follows:

$$Y^* = \frac{\alpha}{1-\beta} M + \frac{1}{1-\beta} BL - \frac{\beta}{1-\beta} \lambda L, \tag{13}$$

Based on the result presented in Equation 13, the equilibrium income is composed of the following three monetary flows: the first is generated by money circulation, the second is multiplied by bank lending, and the last is a subtrahend caused by repayments. Therefore, based on this equation, we can further infer that there are four items that can directly impact aggregate demand: the amount of money, the narrow velocity of money the repayments, and the bank lending resulting from the loanable funds market.

4. Analyzing the transmission channels of monetary policy

As shown in Figure 1, all the channels of monetary transmission can be identified by following the netting of the credit system. Banks and their decisions are located at the hub of monetary transmission, and thus all channels are associated with the banks' supply of loanable funds. We differ from traditional analysis of monetary transmission, which regards banks as financial intermediaries and argues that monetary policy affects the volume of loans by deposit collection. Instead, we argue that banks are credit creators who can create deposits and lend them simultaneously. In our view, the transmission chains of monetary policy are completely different from the traditional ones. For instance, the traditional credit channel, whether the bank lending channel or the balance sheet channel, was supposed to be from deposits to loans (Bernanke and Gertler, 1995). In contrast, all the reformulated credit channels are transmitted through the following chain: monetary policy shocks → loans and deposits → aggregate demand.

4.1. Bank regulations and monetary policy channels

In the depicted module of bank regulations and decisions, we took into account not only bank profitability in the traditional banking decision-making process but also the influence of credit capacity

shaped by banking regulations on credit creation of banks. Consequently, the transmission channels of monetary policy via banks also undergo reforms, with the reformulated channels being transmitted to the supply of loanable funds through credit capacity. Through the interplay of the supply of and demand for loanable funds, monetary policy shocks exert an influence on bank lending. In this part, we conduct a comparative analysis of traditional and reformulated monetary policy transmission via banks based on bank regulations and decisions and the loanable funds market in Figure 1.

4.1.1. The bank credit supply channel

The bank credit supply channel describes the complex process underlying banks' decisions regarding the supply of loanable funds. In the preceding analysis, bank decision-making is influenced by two pivotal factors: bank profit maximization and bank regulations. Specifically, since the federal funds rate is related to the user cost of liquidity positions, the willingness of a bank to make a change in its balance sheet must rely on it. The expansion of the balance sheet implies an increase in demand for liquidity (and/or less supply of liquidity), while the shrinkage of the balance sheet indicates a decline in liquidity demand (and/or more liquidity supply). As a result, the federal funds rate can affect the banks' decisions to expand their balance sheets or not and thus the supply of loanable funds. Concurrently, bank regulations limit the maximum amount of outstanding loans. As a monetary shock changes the structure of the balance sheets, it would alter the volume of credit capacity. With the interplay of these two factors (the pursuit for profits and credit capacity), they collectively determine banks' supply of loanable funds.

In the analysis of traditional monetary transmission channels, the traditional bank lending channel refers to the bank decision-making process, and it argues that monetary policy shock can affect deposits and then influence the decision to make loans. In contrast, we introduced the module of loanable funds market in our analysis, and the bank credit supply channel pays more attention to how banks make decisions on the supply of loanable funds as a response to a monetary shock. Furthermore, the traditional bank lending channel is based on the perspective of financial intermediation. The bank credit supply channel is based on the perspective of credit creation, and it suggests that a monetary shock can shape the structure of balance sheets of banks, which form a level of profit-maximizing loans and credit capacity induced by bank regulations. Subsequently, banks make decisions on the level of loanable funds to supply. Through the dynamic interplay of supply and demand in the loanable funds market, we can ultimately determine the level of bank lending, which will contribute directly to aggregate demand.

Similar to our bank credit supply channel, Disyatat (2011) presented an alternative one on the perspective of credit creation. However, he focused on the price channel through which monetary policy impacts on aggregate demand. In contrast, the bank credit supply channel follows a quantitative route. Table 1 provides a comparison analysis among the traditional bank lending channel, Disyatat's price-focused reformulated bank lending channel, and the quantitative focus of the bank credit supply channel presented in this paper.

Table 1. Comparison of various bank lending channels and the bank credit supply channel.

	The traditional bank lending channel	The reformulated bank lending channel in Disyatat (2011)	The bank credit supply channel
The role of banks	Financial intermediaries	Credit creators	Credit creators
Regulatory constraints	Reserve requirement	Not necessary	Multiple prudential regulations
Causality	Monetary shocks → changes in the level of deposits → changes in the supply of loans → changes in investment → changes in aggregate demand.	Monetary shocks → changes in the deposits rate → changes in the external financing premium of the bank → changes in the loan rate → changes in the supply of loans.	Monetary shocks → changes in the structure of balance sheet → (1) changes in bank profit; (2) changes in credit capacity → changes in banks' decision → changes in the supply of loanable funds.

4.1.2. The reformulated balance sheet channel

As highlighted in the bank credit supply channel, the decisions made by banks are shaped by regulations and the principle of profit maximization, both of which are themselves influenced by the structure of balance sheets. Therefore, we can identify that bank balance sheets also affect credit capacity and the supply of loanable funds, which is emphasized in the reformulated bank credit supply channel. However, the reformulated balance sheet channel and the bank credit supply channel exhibit distinctions. The former underscores the process of changes in credit capacity resulting from alternations in the balance sheets under banking regulations and the pursuit of maximum profits. In contrast, the latter focuses on how banks make decisions that affect the supply of loanable funds as credit capacity changes. As a result, the transmission process of the reformulated bank balance sheet channel takes its effect through the bank credit supply channel.

The traditional balance sheet channel emphasizes that the balance sheet directly influences the bank's profit, whereas the reformulated balance sheet channel focuses on the impact of the variations of balance sheet structure on credit capacity. Specifically, the transmission mechanism can be expressed as the implementation of the central bank's monetary policy changes the number of reserves and the balance sheet structure of commercial banks. At the same time, the bank regulations also impose constraints on banks' balance sheet due to the requirements on these stock items of banks to be adjusted. Therefore, credit capacity is determined by the current position of balance sheets, which in turn has an impact on aggregate demand through bank decisions on the supply of loanable funds.

In summary, the traditional balance sheet channel assumes that monetary policy impacts the balance sheet structure of firms and eventually changes aggregate demand. In addition, some economists are aware that monetary shocks also have an impact on the balance sheet structure of banks. They have therefore proposed the bank balance sheet channel, which emphasizes the impact of the structure of banks' balance sheets on their profit decisions and the supply of loanable funds (Jiménez, et al., 2012; Kapan and Minoiu, 2018). The main difference from the existing bank's balance sheet channel is that we not only consider the influence of bank profit maximization on the supply of loanable funds, but also consider the role of bank regulation as a constraint on banks' credit creation, arguing that the transmission process of the reformulated bank balance sheet channel is through the bank

decisions, which is the outcome of the combination of profit seeking and bank regulations, and subsequently affect the supply of loanable funds based on credit capacity. In order to compare the operations of the traditional balance sheet channel and the newly proposed balance sheet channel, we use Table 2 to show the differences between them.

Table 2. Comparison of various balance sheet channels.

	The traditional balance sheet channel (via firms)	The traditional balance sheet channel (via banks)	The reformulated balance sheet channel
The role of banks	Not necessary	Not necessary	Credit creators
Regulatory constraints	Not necessary	Not necessary	Multiple prudential regulations
Causality	Monetary shocks → changes in interest rate → changes in asset price → changes in net worth of firms → changes in bank loans → changes in external financing premium → changes in investment → changes in aggregate demand.	Monetary shocks → changes in the structure of balance sheet → changes in bank profit → changes in supply of loans.	Monetary shocks → changes in the balance sheet structure → (1) changes in bank profit; (2) Basel Accord → changes in credit capacity → changes in banks' decisions → changes in the supply of loanable funds.

4.1.3. The reformulated bank capital channel

Referring to the credit channels put forward by Bernanke and Gertler (1995), we also reformulate a series of channels of monetary transmission through banks based on the view of credit creation, which is also the changes in aggregate demand due to the impact of monetary shocks on bank credit. The bank capital channel reformulated in this paper is closely linked to bank regulations. In this part, we take capital adequacy ratio (CAR) regulation and leverage ratio (LR) regulation in Basel III as examples to analyze the transmission mechanism of the new bank capital channel. Therefore, it matches the line from the structure of balance sheet to the CAR and the LR in Figure 1. According to the definition of CAR and LR, these regulations impose constraints on the ratio of bank capital to total assets or bank capital to risk-weighted assets, which influence credit capacity eventually. The reformulated bank capital channel emphasizes the positive relationship between the size of bank capital and resulting credit capacity. The larger the amount of bank capital is, the greater the credit capacity. Specifically, the transmission mechanism of the reformulated bank capital channel is that bank capital will affect credit capacity resulting from the requirements of the CAR and LR, which is then transmitted to the supply of loanable funds through bank decisions and ultimately has an impact on aggregate demand. In other words, bank capital is a part of a bank's balance sheet that acts in conjunction with multiple regulations on credit capacity.

In summary, the traditional bank capital channel considers the impact of monetary policy on bank capital mainly by affecting banks' net interest margin. In addition, the traditional bank capital channel regards banks as financial intermediaries; thus, changes in the size of bank capital first cause changes in bank deposits, which in turn affect the amount of loans. In contrast, the reformulated bank capital

channel is associated with bank regulations, emphasizing the impacts of credit capacity. Next, credit capacity affects bank decisions yielding the supply of loanable funds in the loanable funds market. Finally, it will impact aggregate demand even through many routes. Table 3 shows the differences between the traditional bank capital channel and the reformulated bank capital channel.

Table 3. Comparison of the traditional and reformulated bank capital channels.

	The traditional bank capital channel	The reformulated bank capital channel
The role of banks	Financial intermediaries	Credit creators
Regulatory constraints	Not necessary	*CAR* and *LR* regulations
Causality	Monetary shocks → changes in the interest rate spreads → changes in the level of bank capital → changes in deposits → changes in loans → changes in bank lending.	Monetary shocks → changes in the level of bank capital → *CAR* and *LR* regulations → changes in credit capacity → changes in the supply of loanable funds.

4.1.4. The reformulated risk-taking channel

In our work, the reformulated risk-taking channel refers mainly to the buffering function of bank capital against default risks (Calem and Rob, 1999). It is related to the line between CAR and credit capacity in Figure 1. Sufficient bank capital can cope with possible negative shocks on bank credit since banks hold risky assets.

As mentioned before, the transmission mechanism of the reformulated bank capital channel can be reflected through CAR and LR regulations. The transmission mechanism of the reformulated risk- taking channel also takes its effect through CAR regulation. Although these two channels are influenced by capital regulations, the emphasis of these two channels are quite different. The transmission process of the bank capital channel emphasizes the existence of a positive relationship between bank capital and credit expansion. However, the transmission mechanism of the risk-taking channel is configured based on a specific amount of bank capital. In response to monetary shocks, adjustments occur in the risk-weighted coefficients, would change the level of credit capacity and the supply of loanable funds. Through the workings of the loanable funds market, the interplay between supply and demand ultimately determines the overall level of bank lending. Therefore, the transmission mechanism of the new risk-taking channel can be characterized by the risk-taking actions of banks, which can shape their supply of loanable funds through *CAR* regulation.

To conclude, the traditional risk-taking channel, by identifying low return assets and high valuation of firms with low interest rates, will make banks take more risk in seeking higher profits. The reformulated risk-taking channel refers to the impact of the level of risk-weighted coefficients on credit capacity as the amount of capital is fixed. Table 4 shows the specific differences between the traditional risk-taking channel and the reformulated one in this paper.

Table 4. Comparison of the traditional and reformulated risk-taking channels.

	The traditional risk-taking channel	The reformulated risk-taking channel
The role of banks	Financial intermediaries	Credit creators
Regulatory constraints	Not necessary	CAR regulation
Causality	(1) Monetary shocks → changes in interest rate → changes in the value of assets and collateral → changes in the cost of firms → changes in profits of firms → changes in cash flow of firms → changes in the valuation of firms → changes in the perception of future volatility and risk → changes in measurement of risky for banks → changes in the level of risk-taking.	Monetary shocks → changes in the level of risk-weighted coefficients → CAR regulation → changes in credit capacity → changes in the supply of loanable funds.

4.2. Reformulating direct channels to aggregate demand

The previous discussion explored the monetary policy channels through which monetary shocks are transmitted, involving bank regulations and the loanable funds market. These channels are targeted at bank lending. In practice, the mechanism of transmitting monetary shocks from loanable funds market to aggregate demand entails two additional core modules: the dynamics of credit creation and decomposition of aggregate demand. As depicted in Figure 1, we will specifically analyze the monetary transmission channels that directly impact aggregate demand within these two core modules.

According to the decomposition of aggregate demand shown in Section 3, we can derive four exclusive monetary channels in a closed economy, including the money channel, the narrow money circulation channel, the repayment channel, and the new bank lending channel. It is worth emphasizing that the repayment channel is a combination of the private debt and debt circulation channels. All possible paths in the transmission process from monetary policy shocks to aggregate demand are covered by the combined effect of these channels. We centralize our focus on the credit creation process of banks, as illustrated in the modules displaying the dynamics of credit creation. Despite the simultaneous generation of loans and deposits through credit expansion, each follows distinct channels. Similarly, repayments play a crucial role in shaping aggregate demand, constituting a direct channel to it.

4.2.1. The new bank lending channel

In the context of the new bank lending channel, it describes that bank lending can directly impact on aggregate demand. While the traditional narrow credit channel also emphasized the bank lending can influence aggregate demand directly, it associates bank lending with being influenced by interest rates. However, in our new bank lending channel, the levels of bank lending and interest rates are outcomes of the loanable funds market, which are determined by both the supply of and demand for loanable funds as shown in Figure 1. Therefore, the transmission of the new bank lending channel can be described as follows: The flow of bank lending significantly influences aggregate demand, particularly when it is directed towards consumption and investment. This causes a multiplier effect

within the iterative process of income-expenditure. The transmission chain can be expressed as: Bank lending → consumption and investment → multiplier effect → aggregate demand.

4.2.2. The repayment channel

As for the part of aggregate demand, repayments mainly affect aggregate demand through reducing disposable income. As shown in Equation (10), repayments are a leakage term that will reduce disposable income, which will decrease the level of consumption and negatively affect aggregate demand. It can be presented as follows:

Repayments → disposable income → consumption → aggregate demand.

Therefore, the mechanism of the repayment channel can be depicted as:

Repayments → aggregate demand.

In addition, this channel can be further divided into the private debt and debt circulation channels. The former emphasizes the contribution of debt stock, and the latter emphasizes the impact of the debt repayment rate (shown as λ in Equation 12). The separate transmission mechanisms are presented as follows:

Outstanding loans → repayments → aggregate demand.

The velocity of debt circulation → repayments → aggregate demand.

4.2.3. The money channel

The monetarist school led by Friedman proposed the traditional monetarism channel which argues that the central bank can control the money supply. As demand for money remains constant, the increase in the supply of money will lead to the amount of money held by the public being more than the amount of money they are willing to hold. Therefore, the public will use excess money to purchase various financial and physical assets, which will yield more expenditure.

The reformulated money channel in this paper suggests that money is mainly the financing source for consumption and investment in the economy. In other words, the amount of money created by banks will impact the expenditure and thus affect aggregate demand. This channel takes its effect with the narrow velocity of money together, which has a separate channel and will be described in next section. By comparing the traditional and reformulated money channels, it is clear that the core of the traditional channel is the central bank's control over the money supply. In contrast, the reformulated channel focuses on the role of money as a source of expenditure on aggregate demand from the perspective of credit creation. The specific differences in the transmission mechanism between these two channels can be expressed in Table 5.

Table 5. Comparison of the traditional monetarism and reformulated money channels.

	The traditional monetarism channel	The reformulated money channel
The role of banks	Financial intermediaries	Credit creators
Causality	Monetary shocks → changes in money supply (> money demand) → changes in expenditure → changes in aggregate demand.	Credit creation of banks → changes in deposits → changes in consumption and investment → changes in aggregate demand.

4.2.4. The narrow money circulation channel

Unlike the money channel, which focuses on the transmission process from deposits to aggregate demand, the monetary circulation channel contains the impact of financial assets on aggregate demand. Specifically, we reject the traditional interest rate channel as well as the wealth channel and argue that both act on the narrow money circulation channel by affecting the value of financial assets and then the narrow velocity of money circulation, which ultimately impacts aggregate demand.

The traditional channels relate to our reformulated narrow money circulation channel include the interest rate and wealth channels. To distinguish the differences more clearly between traditional and reformulated channels, we first briefly review the transmission mechanism of the traditional interest rate and wealth channels. The traditional interest rate channel considers that interest rates can have a negative relation with investment and thus is supposed to have a direct impact on aggregate demand, and its transmission mechanism can be expressed as follows:

Interest rate → (investment) → aggregate demand.

Regarding the wealth channel, it was developed from the life cycle hypothesis proposed by Modigliani. The rising value of assets is accompanied by the wealth effect, causing households to increase their current consumption by maximizing their lifetime utility, increasing aggregate demand. The specific transmission mechanism is as follows:

Value of assets → wealth effect → consumption → aggregate demand.

The transmission mechanism of the newly proposed narrow money circulation channel is based on the negative relationship between the interest rate and asset price, which means that changes in the interest rate will influence the value of assets directly. Moreover, the value of assets affects aggregate demand through the narrow velocity of money circulation. There is a wealth effect in the transmission process from the value of assets to the narrow velocity of money circulation. The transmission mechanism of the narrow money circulation channel can be expressed as follows:

Interest rate → value of assets → wealth effect → narrow velocity of money → aggregate demand.

As a result, the interest rate channel and the wealth channel cannot be regarded as direct channels anymore, so we mark these two channels in dash lines in Figure 1.

It is worth noting that we define the velocity of money narrowly. Since total income has two parts, one is generated by money circulation in a narrow way. Hence, both money and its velocity contribute to this part. The referred narrow velocity of money differs from that used in the quantity theory of money, in which the product of money and velocity is exactly equal to total income. Now, the product of money and velocity is only a part of aggregate demand.

4.3. Summary of direct channels on aggregate demand

In summary, the traditional channels of monetary policy transmission that act directly on aggregate demand in a closed economy include the wealth channel, the interest rate channel, and the narrow credit channel and the monetarism channel affect aggregate demand via various routes. In our view, the most important intermediate hub of monetary transmissions is the supply of loanable funds, so there is a bundle of channels that impact aggregate demand through this hub. As bank lending is yielded by the loanable funds market, it affects aggregate demand through several channels, including direct and indirect ones. The direct channels are identified as the money channel, the narrow money circulation channel, the new bank lending channel, and the repayment channel. We use Table 6 to

make an illustrative comparison between the traditional direct channels of monetary transmission and the reformulated ones in this paper.

Table 6. Comparison of the traditional and reformulated direct channels on aggregate demand.

	The transmission mechanism of the traditional monetary channels that affects aggregate demand directly	The transmission mechanism of the reformulated monetary channels that affect aggregate demand directly
The role of banks	Financial intermediaries	Credit creators
Causality	(1) The interest rate channel: interest rate → investment → aggregate demand. (2) The wealth channel: assets value → consumption → aggregate demand. (3) The narrow credit channel: bank lending → consumption and investment → aggregate demand. (4) The monetarism channel: Monetary shocks → changes in money supply (> money demand.) → changes in expenditure → changes in aggregate demand.	(1) The money channel: Credit creation of banks → increase in deposits → consumption and investment → aggregate demand. (2) The narrow money circulation channel: the narrow velocity of money circulation → aggregate demand. (3) The new bank lending channel: Loanable funds market → bank lending → consumption and investment → multiplier effect → aggregate demand. (4) The repayment channel: Repayments → disposable income → consumption → aggregate demand.

5. Empirical analysis

We have developed a vector autoregression (VAR) impulse response model, comprising eight variables, which include repayment rate, disposable income, GDP, outstanding loans, total consumption and investment, total bank lending, and bank deposits. The analyses explore the interdependencies among these variables. The data are sourced from two distinct databases: the Federal Deposit Insurance Corporation (FDIC) and the Federal Reserve Economic Data (FRED). Specifically, outstanding loans and deposits are obtained from FDIC, while data about disposable income, GDP, the federal funds rate, and total consumption and investment are acquired from FRED database. All data are quarterly and cover the period from the fourth quarter of 1997 to the first quarter of 2023, encompassing a total of 102 observations. It is worth noting that our empirical analysis focuses solely on channels that can influence GDP directly. This is due to the unavailability of data for variables such as credit capacity and supply of loanable funds in other modules.

Repayments and levels of bank lending are calculated based on varying term lengths of bank loans obtained from FDIC. Specifically, repayments are derived as a result of the following calculations:

$$RP(t+1) = \sum_i \frac{1}{\eta_i} L_i(t), \tag{14}$$

where η_i represents the average maturity date for different loan categories. As for bank lending, it is calculated using the following formula:

$$BL(t) = L(t) - L(t-1) + RP(t), \tag{15}$$

where $L(t)$ represents outstanding loans for the t period.

Based on the VAR model, we conducted impulse response analysis to examine different transmission channels outlined in the theoretical analysis section. This was achieved by introducing typical shocks to the corresponding economic variables in the channels and observing the responses of the respective variables. The results are presented in Figure 4(A–C).

Our observations are consistent with the theoretical analysis. First, there is a negative response of disposable income to the repayment shock. Second, bank lending flow exhibits a sustained negative response to the monetary shock (variation in the federal funds rate) over a longer time horizon. Third, bank deposits respond positively to the credit creation shock (variation of outstanding loans). Furthermore, in response to a shock from disposable income, total bank lending, and deposits, total consumption and investment in the economy all show a positive response, which are accordance with the effects predicted by the theoretical model. Finally, GDP exhibits a positive response to the shock from total consumption and investment. The findings as illustrated in Figure 4(D–G) provide some explanations for the channel mechanisms analyzed in this study.

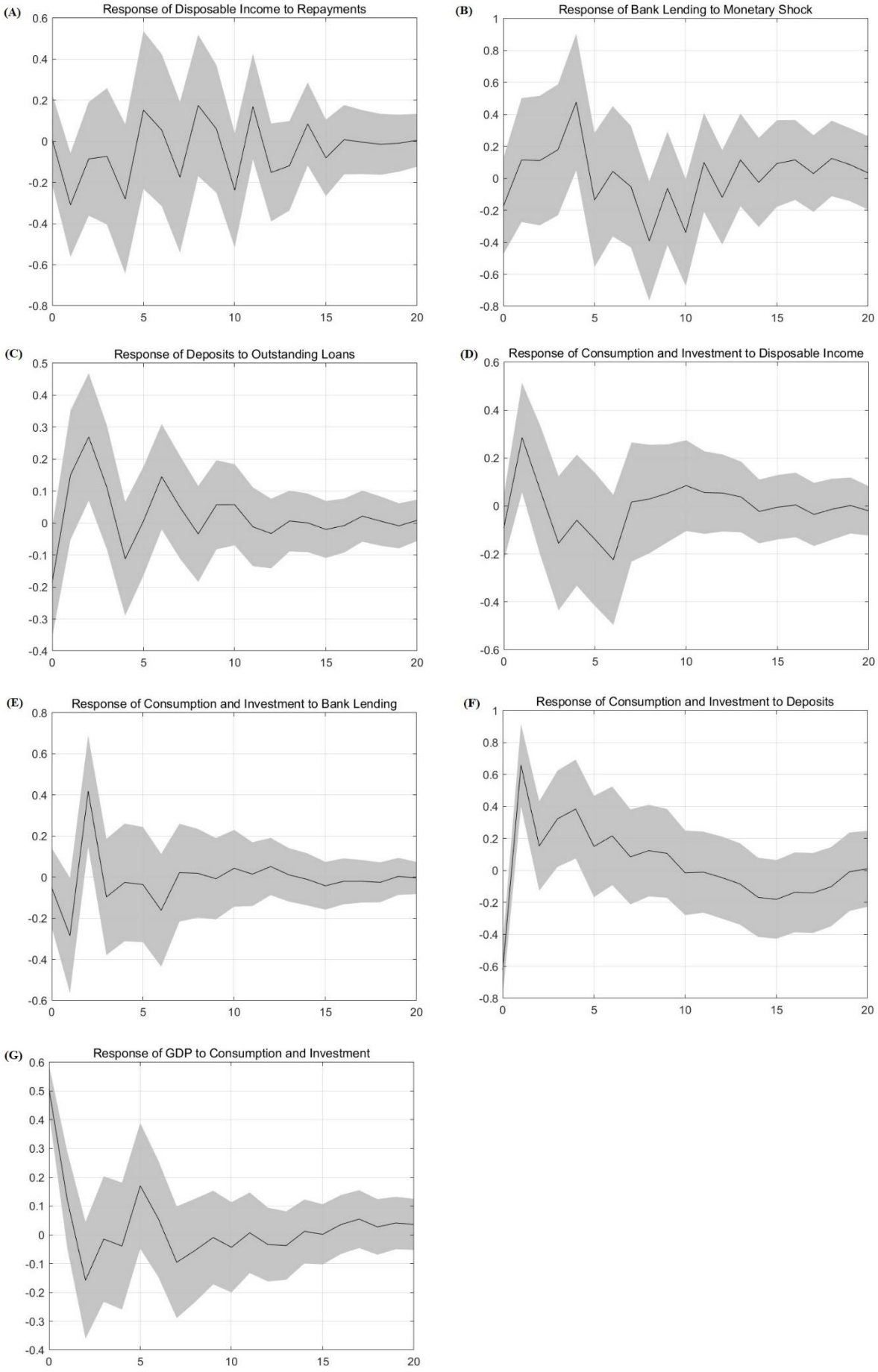
(A)
Response of Disposable Income to Repayments
(B)
Response of Bank Lending to Monetary Shock
(C)
Response of Deposits to Outstanding Loans
(D)
Response of Consumption and Investment to Disposable Income
(E)
Response of Consumption and Investment to Bank Lending
(F)
Response of Consumption and Investment to Deposits
(G)
Response of GDP to Consumption and Investment

Figure 4. The results of the impulse response analysis. Note: The shaded regions represent the 95% confidence intervals. Figure 4(A) illustrates the response of the rate of change in disposable income to a repayment shock. In Figure 4(B), the depicted response is the rate of change in bank lending flow to a monetary shock. Figure 4(C) demonstrates the rate of change in bank deposits in response to a shock of loans. Figures 4(D), 4(E), and 4(F) portray the responses of the rate of change in total consumption and investment to a shock in disposable income, bank lending, and deposits, respectively. Finally, Figure 4(G) illustrates the response of GDP to a shock in total consumption and investment.

6. Discussion

After the outbreak of the 2008 financial crisis, in an effort to stimulate economic recovery, interest rates have reached the zero lower bound in some developed countries, prompting the central banks to adopt unconventional monetary policies such as quantitative easing. The 2020 pandemic crisis further compelled the central banks to implement rescue-oriented policies. Despite these policies reaching unprecedented quantities, their actual effectiveness is unsatisfactory. Therefore, the pressing issue at hand revolves around implementing more targeted monetary policies to ensure their effectiveness and stimulate economic recovery.

Evaluating the effectiveness of monetary policy can be understood as whether and to what extent a monetary policy can follow the expected transmission mechanism by influencing intermediate goals stably and achieving the final goal of stimulating aggregate demand. Building upon a comprehensive foundation of research on monetary transmission channels, this paper constructs a unified model of credit economy with a focus on bank decisions and loanable funds market from the perspective of credit creation. Diverging from previous viewpoints that treat different channels as operating independently, this paper emphasizes the interconnectedness of various channels within the credit system. This approach is conducive to a more realistic reflection of the transmission mechanism of monetary policy, thereby facilitating better adaptability to diverse economic conditions and enabling adjustments in monetary policy.

To emphasize the excellence of such a framework of the credit economy for analyzing the effectiveness of monetary policy, we argue that all the monetary transmission channels are knitted with each other. Taking bank lending as an example, it is a crucial hub of monetary transmission. Bank lending is the quantity resulted from the loanable funds market, whose supply is governed by bank decisions and regulations, and thus a monetary shock would transmit to it via many distinct channels. Bank lending contributes directly to aggregate demand, while adding up money and loans. Therefore, when market-driven bank lending changes, it could pass either directly through consumption and/or investment, or indirectly through stocks of money and loans, thereby influencing aggregate demand.

For the traditional analysis of monetary transmission, the primary channel influencing aggregate demand is the bank lending channel. This channel emphasizes the impact of monetary shocks on bank deposit levels, subsequently affecting the volume of bank loans. Thus, the direct and effective method to stimulate bank lending is by increasing the amount of bank deposits. Consequently, banks may implement measures, such as adjusting interest rates, to attract additional deposits. However, the traditional methods for enhancing bank lending by increasing bank deposits involve three major misconceptions. Firstly, there is a mistake in understanding the role of banks in the macroeconomic system; banks are credit creators rather than financial intermediaries, and both

deposits and loans are simultaneously created through credit creation. Secondly, there is a conceptual confusion of stock and flow variables. In traditional analysis, an increase in bank loans is often misunderstood as bank lending, which serves as a flow variable and is jointly determined by the supply and demand in the loanable funds market. However, a change in bank loans is the compound of credit creation and deletion by banks, while the flow of bank lending is only the addend. Actually, the subtrahend is repayments to loans, which is arbitrarily discarded in the calculation of the change in outstanding loans. Finally, according to our model of the credit economy, the size of bank lending is governed by multiple factors, including bank regulations, banks' profits, and the demand of firms for loanable funds. Therefore, solely stimulating bank lending through the method of increasing bank deposits is impractical. To boost the level of bank lending, monetary policymakers must first address the credit capacity under multiple bank regulations, focusing on the decision-making process of banks to supply loanable funds. In a scenario where the demand for loanable funds remains unchanged, it is only through monetary shocks that alter factors influencing bank decision-making, such as changes in the structure of banks' balance sheets. In fact, the transmission of a monetary shock to bank lending is an intricate process, many channels come into play, such as the bank capital channel, the bank risk-taking channel, and the bank's balance sheet channel. The effectiveness of a monetary policy depends on which is the dominating channel and what is the true impact of the monetary shock on the balance sheet structure.

Based on the preceding analyses, we can ascertain that the operation of monetary policy is a complex process. This complexity is evident not only in the involvement of multiple entities and modules within the credit economy system but also in the interconnected and mutually influential nature of different monetary channels. These characteristics introduce a considerable level of uncertainty into the effectiveness of monetary policy. As mentioned above, bank lending, serving as an intermediary variable in the impact of a monetary policy, is influenced by various factors throughout the operation of the credit economy system, including bank regulations. The central bank influences bank lending levels through multiple monetary transmission channels. Therefore, if any factor or link fails to transmit as intended during the process of monetary transmission, uncertainties arise, reducing the effectiveness of monetary policy. For instance, if a monetary policy shock fails to alter the credit base corresponding to the strictest constraint within multiple regulations, the size of credit capacity would remain unchanged, impeding the transmission process. When the anticipated changes in bank lending do not materialize, the causes are complex and hard to identify. In such a scenario, to enhance the effectiveness of monetary policy, it becomes imperative to integrate the credit integration model with an analysis of new monetary transmission channels. Since the analysis of these new channels is derived from the interplay between different modules and the interactions among various monetary policy channels, these innovative channels aid in promptly tracing the origins of issues impairing the effectiveness of monetary policy. This, in turn, allows for a more efficient problem-solving approach, reducing uncertainties during the transmission process and enhancing the overall effectiveness of monetary policy.

To sum up, the proposed model of the credit economy and the reevaluation of monetary transmission channels in this paper provide a theoretical foundation for policymakers. This aids in comprehensively considering the operational processes of the entire credit system and implementing monetary policies more targeted to stimulate economic recovery and achieve the goal of high economic growth.

7. Conclusions

The shift from interest rate channels to quantitative channels of monetary operations calls for a revisit to monetary transmissions. Although various transmission channels of monetary policy have been proposed, there is no theoretical model to integrate those channels. This paper aims to knit all channels together by proposing a unified framework of credit systems.

We take the view of credit creation, arguing that bank lending creates both loans and deposits simultaneously. Therefore, the transmission process relies on how the implementation of monetary policy impacts the credit creation decisions of commercial banks. Taking this as a core, we divide the entire pass-through process of monetary policy into five components: the federal funds market, bank regulations and decisions, the loanable funds market, dynamics of credit creation, and aggregate demand decomposition. The federal funds market is responsible for the implementation of monetary policy. The monetary operations first act on the volume of reserves and then the banks' decisions on the structure of balance sheets. The influence of various banking regulations lies in shaping the credit capacity, thereby placing constraints on banks credit creation. The magnitude of credit creation significantly impacts the supply of loanable funds in the market, with market demand together to determine bank lending, which consists of a crucial component of aggregate demand. The outcomes of credit creation (deposits and loans) contribute to aggregate demand through their respective monetary flows.

In the part of bank regulation, we focus on the requirements of Basel III accord. The results show that each regulatory requirement has a corresponding constraint on banks' credit creation, and when multiple regulations are imposed simultaneously, credit capacity depends on the tightest constraint and will directly affect banks' decision-making. All banks aim to maximize profit based on their balance sheet condition, subject to all regulatory constraints, and by doing so determine the supply of loanable funds. Based on this point, we find that some transmission channels related to banks' balance sheet, such as the bank balance sheet channel, the bank capital channel, and the risk-taking channel, each having an alternative way to banks' supply of loanable funds via credit capacity. Regarding the function of the loanable funds market, we argue that the supply of and demand for loanable funds jointly determine the level of bank lending and the interest rate. Since the overall effect of this market on aggregate demand has been taken into account with the channel of bank lending, the interest rates no longer directly affect aggregate demand. Therefore, we reject the interest rate channel as a direct channel on aggregate demand. Instead, we argue that interest rates affect aggregate demand firstly through the wealth effect, and then the narrow velocity of money circulation. Of course, it may also have other indirect effects, such as on the supply of loanable funds through bank decisions, or on bank capital through bank profits.

In the last part, based on the alternative way of decomposing aggregate demand, we identified all direct channels on aggregate demand and proposed the following four channels: the money channel, the narrow money circulation channel, the new bank lending channel, and the repayment channel. The first channel emphasizes the stock of money created by banks; however, the amount of money affects aggregate demand with the narrow velocity of money together, which is the second channel. The third is named as the new bank lending channel that has a direct effect on aggregated demand. The last one reflects the contribution of debt in terms of repayments. Thus, this channel can be further divided into the private debt and debt circulation channels. The former emphasizes the impact of the volume of loans generated by banks' credit creation, while the latter refers to the contribution of the rate of debt turnover.

We also conducted a brief empirical analysis based on the FRED and FDIC databases. Due to the unavailability of credit capacity data, our empirical analysis focused on examining how monetary policy directly influences aggregate demand. Utilizing the VAR impulse response model, we considered the impacts of some key variables, including bank lending, repayments, and deposits, on GDP. These results align with the theoretical predictions presented in Section 4, providing further confirmation of the effectiveness of our proposed monetary transmission channels.

The reformulated transmission channels of monetary policy are based on a better understanding of how the credit system governs aggregate demand, which takes credit creation of banks as a core, thus showing that bank decisions are crucial in the monetary transmission process. Finally, we believe this work provides theoretical guidance for understanding the effect of a policy and making effective policies.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

Conflict of interest

All authors declare no conflicts of interest in this paper.

References

Ahrend R, Goujard A (2015) Global banking, global crises? The role of the bank balance-sheet channel. for the transmission of financial crises. *Eur Econ Rev* 80: 253–279. https://doi.org/10.1016/j.euroecorev.2015.10.003

BCBS (2013) The liquidity coverage ratio and liquidity risk monitoring tools. *Banks for International Settlements*.

Berger AN, Bouwman CHS (2013) How does capital affect bank performance during financial crises?. *J Financ Econ* 109: 146–176. https://doi.org/10.1016/j.jfineco.2013.02.008

Bernanke BS (1983) Irreversilibity, uncertainty, and cyclical investment. *Q J Econ* 98: 85–106. https://doi.org/10.2307/1885568

Bernanke BS, Blinder AS (1988) Credit, money and aggregate demand. *Am Econ Rev* 78: 435–439. https://doi.org/10.3386/w2534

Bernanke BS, Gertler M (1995) Inside the black box the credit channel of monetary policy transmission. *J Econ Perspect* 9: 27–48. https://doi.org/10.3386/w5146

Bernardo G, Campiglio E (2013) A simple model of income, aggregate demand and the process of credit creation by private banks. *Empirica* 41: 381–405. https://doi.org/10.1007/s10663-013-9239-6

Blinder AS, Stiglitz JE (1983) Money, credit constraints, and economic activity. *NBER Working Paper, No.1084.* https://doi.org/10.3386/w1084

Boivin J, Governor D, Lane T, et al. (2010) Should monetary policy be used to counteract financial imbalances. *Bank Can Rev* 23–36.

Brunner K, Meltzer AH (1972) Money, debt, and economic activity. *J Polit Econ* 80: 951–977. https://doi.org/10.1086/259945

Calem P, Rob R (1999) The Impact of Capital-Based Regulation on Bank Risk-Taking. *J Financial Intermediation* 8: 317–352. https://doi.org/10.1006/jfin.1999.0276

Chami R, Cosimano TF (2010) Monetary policy with a touch of Basel. *J Econ Bus* 62: 161–175. https://doi.org/10.1016/j.jeconbus.2009.12.001

Chen NK (2001) Bank net worth, asset prices and economic activity. *J Monet Econ* 48: 415–436. https://doi.org/10.1016/S0304-3932(01)00076-9

Dermine J (2013) Bank Regulations after the Global Financial Crisis: Good Intentions and Unintended. Evil. *Eur Financial Manag* 19: 658–674. https://doi.org/10.1111/j.1468-036X.2013.12017.x

Disyatat P (2011) The bank lending channel revisited. *J Money Credit Bank* 43: 711–734. https://doi.org/10.1111/j.1538-4616.2011.00394.x

Eggertsson GB, Krugman P (2012) Debt, Deleveraging, and the Liquidity Trap: A Fisher-Minsky-Koo. Approach. *Q J Econ* 127: 1469–1513. https://doi.org/10.1093/qje/qjs023

Fisher I (1933) The Debt-Deflation Theory of Great Depressions. *Econometrica* 1: 337–357. https://doi.org/10.2307/1907327

Friedman A (1982) *Foundations of modern analysis*. New York: Dover Publications.

Gambacorta L, Mistrulli PE (2004) Does bank capital affect lending behavior? *J Financial Intermediation* 13: 436–457. https://doi.org/10.1016/j.jfi.2004.06.001

Gertler M, Kiyotaki N (2010) Financial intermediation and credit policy in business cycle analysis, In: Friedman, B.M., Woodford M., *Handbook of monetary economics*, 3: 547–599. https://doi.org/10.1016/B978-0-444-53238-1.00011-9

Gertler M, Kiyotaki N (2015) Banking, Liquidity, and Bank Runs in an Infinite Horizon Economy. *Am Econ Rev* 105: 2011–2043. https://doi.org/10.1257/aer.20130665

Gertler M, Karadi P (2011) A model of unconventional monetary policy. *J Monet Econ* 58: 17–34. https://doi.org/10.1016/j.jmoneco.2010.10.004

Goodhart CAE (2010) Money, Credit and Bank Behaviour: Need for a New Approach. *Natl Inst Econ Rev* 214: F73–F82. https://doi.org/10.1177/0027950110389774

Goyal A, Parab P (2021) Effectiveness of Expectations Channel of Monetary Policy Transmission: Evidence from India. *Mumbai: Indira Gandhi Institute of Development Research, Working Paper No. 11*.

Gunji H, Yuan Y (2010) Bank profitability and the bank lending channel: Evidence from China. *J Asian Econ* 21: 129–141. https://doi.org/10.1016/j.asieco.2009.12.001

Gurley JG, Shaw ES (1955) Financial Aspects of Economic Development. *Ame Econ Rev* 45: 515–538.

Gurley JG, Shaw ES (1960) *Money in a Theory of Finance*, Chicago: The Brookings Institution.

Honda Y (2004) Bank capital regulations and the transmission mechanism. *J Policy Model* 26: 675–688. https://doi.org/10.1016/j.jpolmod.2004.01.006

Jakab Z, Kumhof M (2015) Banks are not intermediaries of loanable of funds-and why this matters. *Bank of England Working Paper No.529.*

Jakab Z, Kumhof M (2019) Banks are not intermediaries of loanable funds — facts theory and evidence. *Bank of England Working Paper No. 761.*

Jiménez G, Ongena S, Peydró JL, et al. (2012) Credit Supply and Monetary Policy: Identifying. the Bank Balance-Sheet Channel with Loan Applications. *Am Econ Rev* 102: 2301–2326. https://doi.org/10.1257/aer.102.5.2301

Jodrà Ò, Schularick M, Taylor AM (2013) When credit bites back. *J Money Credit Bank* 45: 3–28. https://doi.org/10.1111/jmcb.12069

Kapan T, Minoiu C (2018) Balance sheet strength and bank lending: Evidence from the global financial. crisis. *J Bank Financ* 92: 35–50. https://doi.org/10.1016/j.jbankfin.2018.04.011

Kashyap AK, Stein JC (1994) Monetary Policy and Bank Lending, The University of Chicago Press. https://doi.org/10.3386/w4317

Kashyap AK, Stein JC (1997) The role of banks in monetary policy: A survey with implications for the European monetary union. *Economic Perspectives-Federal Reserve Bank of Chicago* 21: 2–18.

Keen S (2016) Modeling Financial Instability, In: Malliaris, A.G., Shaw, L., Shefrin, H., *The Global Financial Crisis and Its Aftermath: Hidden Factors in the Meltdown*, Oxford: Oxford University Press, 67–103. https://doi.org/10.1093/acprof:oso/9780199386222.003.0004

Koo RC (2011) *The Holy Grail Of Macroeconomics: Lessons From Japan's Great Recession*, Singapore: John Wiley & Sons (Asia) Pte. Ltd..

Kopecky KJ, VanHoose D (2004) A model of the monetary sector with and without binding capital. requirements. *J Bank Financ* 28: 633–646. https://doi.org/10.1016/s0378-4266(03)00038-4

Krug S, Lengnick M, Wohltmann HW (2015) The impact of Basel III on financial (in)stability: an. agent-based credit network approach. *Quant Finance* 15: 1917–1932. https://doi.org/10.1080/14697688.2014.999701

Kumhof M, Wang X (2021) Banks, money, and the zero lower bound on deposit rates. *J Econ Dyn Control* 132: 104208. https://doi.org/10.1016/j.jedc.2021.104208

Le Heron E, Mouakil T (2008) A Post-Keynesian Stock-Flow Consistent Model for Dynamic Analysis of Monetary Policy Shock on Banking Behaviour. *Metroeconomica* 59: 405–440. https://doi.org/10.1111/j.1467-999X.2008.00313.x

Li B, Xiong W, Chen L, et al. (2017) The impact of the liquidity coverage ratio on money creation: A stock-flow based dynamic approach. *Econ Model* 67: 193–202. https://doi.org/10.1016/j.econmod.2016.12.016

Macleod HD (1866) *The Theory and Practice of Banking*, London: Longmans.

McLeay M, Radia A, Thomas R (2014a) Money Creation in the Modern Economy. *Bank of England Quarterly Bulletin, Q1.*

McLeay M, Radia A, Thomas R (2014b) Money in the modern economy: an introduction. *Bank of England. Quarterly Bulletin.*

Meh C, Moran K (2004) Bank Capital, Agency Costs, and Monetary Policy. *Bank of Canada Working. Paper 2004-6.*

Mian A, Sufi A (2011) House Prices, Home Equity–Based Borrowing, and the US Household Leverage. Crisis. *Am Econ Rev* 101: 2132–2156. https://doi.org/10.1257/aer.101.5.2132

Mian AR, Sufi A (2012) What explains high unemployment? The aggregate demand channel. *NBER Working Paper, No.17830* https://doi.org/10.3386/w17830

Mian AR, Straub L, Sufi A (2020) The saving glut of the rich. *NBER Working Paper, No. 26941.* https://doi.org/10.3386/w26941

Minsky HP (1982) The Financial-Instability Hypothesis: Capitalist Processes and the Behavior of the Economy. *Hyman P. Minsky Archive.* 282.

Orzechowski PE (2019) The bank capital channel and bank profits. *Rev Financial Econ* 37: 372–388. https://doi.org/10.1002/rfe.1054

Palley TI (1997) Endogenous money and the business cycle. *J Econ* 65: 133–149. https://doi.org/10.1007/BF01226931

Panagopoulos Y (2010) Basel II and the money supply process: some empirical evidence from the. Greek banking system. *Appl Econ Lett* 17: 973–976. https://doi.org/10.1080/13504850802599482

Peek J, Rosengren ES (2013) The role of banks in the transmission of monetary policy. *Public Policy. Discussion Papers No. 13-5.* https://doi.org/http://hdl.handle.net/10419/99119

Rajan RG (2006) Has Finance Made the World Riskier. *Eur Financial Manag* 12: 499–533. https://doi.org/10.1111/j.1468-036X.2006.00330.x

Rasche RH, Johannes JM (2012) *Controlling the Growth of Monetary Aggregates*, Springer Science & Business Media. https://doi.org/10.1007/978-94-009-3275-3

Rogoff K (2010) Three Challenges Facing Modern Macroeconomics. *American Economic Association, Ten Years and Beyond: Economists Answer NSF's Call for Long-Term Research Agendas.* https://doi.org/10.2139/ssrn.1889366

Romer CD, Romer DH, Goldfeld SM, et al. (1990) New evidence on the monetary. transmission mechanism. *Brookings Pap Econ Act* 1: 149–213.

Schumpeter JA (1912) *The Theory of Economic Development*, Cambridge, MA: Harvard University Press.

Stiglitz JE (2018) Where modern macroeconomics went wrong. *Oxford Rev Econ Policy* 34: 70–106. https://doi.org/10.1093/oxrep/grx040

Swanson ET (2023) The federal funds market, pre-and post-2008. InResearch Handbook of Financial: 220-236. UK: Edward Elgar Publishing.

Tanaka M (2002) How Do Bank Capital and Capital Adequacy Regulation Affect the Monetary. Transmission Mechanism? *CESIFO Working Paper No. 799.*

Taylor JB (1993) Discretion versus policy rules in practice. *Carnegie-Rochester conference series on public policy* 39: 195–214. https://doi.org/10.1016/0167-2231(93)90009-L

Tobin J, Brainard WC (1963) Financial Intermediaries and the Effectiveness of Monetary Controls. *Am Econ Rev* 53: 383–400.

Tobin J (1964) Commercial banks as creators of "money". Yale: Cowles Foundation for Research in Economics.

Werner RA (2014) How do banks create money, and why can other firms not do the same? An explanation for the coexistence of lending and deposit-taking. *Int Rev Financial Anal* 36: 71–77. https://doi.org/10.1016/j.irfa.2014.10.013

Werner RA (2016) A lost century in economics: Three theories of banking and the conclusive evidence. *Int Rev Financial Anal* 46: 361–379. https://doi.org/10.1016/j.irfa.2015.08.014

Wicksell K (1898) Geldzins und Güterpreise: Eine Untersuchung über die den Tauschwert des Geldes bestimmenden Ursachen (Jena: Gustav Fischer), translated as Interest and Prices: A Study of the Causes Regulating the Value of Money (London: Macmillan, 1936).

Wicksell K (1907) Krisernas gäta, Statsøkonomisk Tidskrift, 21 (3), 255–84, translated as The Enigma of Business Cycles, International Economic Papers, 3 (1953), 58–74.

Woodford M (2010) Financial Intermediation and Macroeconomic Analysis. *J Econ Perspect* 24: 21–44. https://doi.org/10.1257/jep.24.4.21

Xing X, Wang M, Wang Y, et al. (2020) Credit creation under multiple banking regulations: The. impact of balance sheet diversity on money supply. *Econ Model* 91: 720–735. https://doi.org/10.1016/j.econmod.2019.09.030

Xing X, Xiong W, Guo J, et al. (2021) The role of debt in aggregate demand. *Finance Res Lett* 39: 101653. https://doi.org/10.1016/j.frl.2020.101653

Xiong W, Li B, Wang Y, et al. (2020) The versatility of money multiplier under Basel III. regulations. *Finance Res Lett* 32: https://doi.org/10.1016/j.frl.2019.04.024

Xiong W, Fu H, Wang Y (2017) Money creation and circulation in a credit economy. *Physica A* 465: 425–437. https://doi.org/10.1016/j.physa.2016.08.023

Xiong W, Wang Y (2018) The impact of Basel III on money creation: a synthetic theoretical analysis. *Economics* 12. https://doi.org/10.5018/economics-ejournal.ja.2018-41

Xiong W, Wang Y (2022) A reformulation of the bank lending channel under multiple prudential. regulations. *Econ Model* 114: 105916. https://doi.org/10.1016/j.econmod.2022.105916

AIMS Press