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Research Article

How Does Capital Account Liberalization Affect Systemic Financial Risks? Evidence from China

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Capital account liberalization typically results in higher volumes of capital inflows and outflows for a country, yet abnormal cross-border capital flows may lead to overall financial risk accumulation, in turn causing tremendous damages to the economy. Using a time-varying parameter structural vector autoregression model with stochastic volatility (SV-TVP-SVAR), we identify time-varying effects of capital account liberalization on four types of systemic financial risks in China. Empirical results demonstrate that capital account liberalization, in the short run, can effectively curb the accumulation of macroeconomic and sudden stop risks. On the other hand, capital account liberalization may heighten credit crunch and asset bubble risks to varying degrees. We also find that some important capital account liberalization measures are double-edged: reform policies are likely to increase macroeconomic risk when optimizing the financing structure and reducing credit crunch risk.

1. Introduction

With the current significant downward pressure on the world economy, capital account liberalization is an important measure taken by countries to seek international cooperation and ease domestic financing pressures [1]. However, how to reap the benefits of international financial integration without taking huge systemic risks remains a key challenge for many countries, especially for emerging markets. As the world's largest developing country, China has been taking a gradual approach to capital account liberalization. Therefore, this paper examines how capital account liberalization affects different types of systemic financial risks in developing countries, using China as an example.

Since the proposal of convertible capital account in 1982, China has introduced a series of policies and measures to promote openness. For example, China established the system of qualified foreign institutional investors (QFII) in 2002 and then combined the QFII system with the system of RMB qualified foreign institutional investors (RQFII) in 2019. In the process of capital account liberalization reforms in the past 30 years, China has gradually improved its subsidiary accounts and relaxed controls on market access, thus greatly facilitating cross-border capital transactions, improving liquidity, and providing strong support for the country's economic development [2]. However, it is well known that capital account liberalization is a double-edged sword. It will lead to disorderly flows of domestic and foreign capital; it will have an impact on the financial system and related industries and cause the accumulation of risks when increasing the efficiency of domestic resource allocation and promoting economic development [3, 4]. Due to the vulnerability and correlation within finance, the prevention and control of systemic financial risks is now also an important task for all countries in their financial efforts. Capital account liberalization will bring about large cross-border capital inflows and outflows. Speculative currencies may have a huge impact on the securities markets and related industries in all countries, and it may have a series of

consequences that harm social and economic development if there is a financial crisis in any sector or industry [5].

Systemic financial risks are risks that occur in one economic or financial sector that, due to their correlation with the economy, spread to other economic sectors and cause a "domino effect." They further lead to the occurrence of risks in the financial system as a whole [6]. Driven by factors such as information asymmetry and investor irrationality, risk contagion in capital markets will gradually accelerate, which will have serious negative effects on the entire economy and society [7]. Therefore, it becomes increasingly important to identify areas that may constitute systemic financial risks. In this paper, based on the dynamic observation of the SV-TVP-SVAR model, we analyze the specific impacts of China's capital account liberalization on systemic financial risks. It is informative for China and other developing countries to steadily promote capital account liberalization and prevent systemic financial risks.

Based on the "transmission channels of capital account liberalization to the financial system" and the actual situation of China's economic development, we identify four types of systemic financial risks and establish measurement indexes: macroeconomic risk, credit crunch risk, sudden stop risk, and asset bubble risk. Macroeconomic risk refers to the volatile impact of capital liberalization on the domestic economy. Credit crunch risk refers to the insufficient supply of credit facilities in the financial system. Sudden stop risk refers to the impact of foreign capital entry on the financial system due to liberalization. And asset bubble risk refers to the risk arising from the accumulation of asset bubbles as a result of large capital flows to the stock and real estate markets, raising leverage and accumulating asset bubbles. By studying the impact of capital account liberalization on risks, we get the main conclusions: capital account liberalization has a relatively strong dampening effect on the accumulation of macroeconomic risk and sudden stop risk in the short run. Moreover, credit crunch risk and asset bubble risk accumulate during the liberalization process. We construct a scientific system of indexes to measure capital account liberalization and systemic financial risks and identify time-varying effects of capital account liberalization on the risks as comprehensive as possible.

This study may have contributions in the following aspects: first, we take an innovative research perspective to explore the impact of capital account liberalization on risks in certain areas. Based on the contagiousness of systemic financial risks and the development of the real economies, we construct a scientific system of systemic financial risk measurement indexes and conduct a comprehensive analysis of the impact of openness on the four types of systemic financial risks. Second, we adopt an innovative research method. In most cases, existing studies measure the effects of capital account liberalization based on qualitative analysis or by selecting empirical models containing fixed parameters and coefficients, while failing to capture the impacts of time-varying factors. Therefore, in this study, we choose the SV-TVP-SVAR model to construct a dynamic empirical analysis framework and measure the short- and long-term effects of capital account liberalization on risks as well as the lagged effects. Moreover, we also document a comprehensive analysis of the specific impacts arising from several reforms of capital account liberalization.

The remainder of the study is structured as follows. Section 2 discusses the current studies on capital account liberalization and systemic financial risks and provides the foundation of this paper's research. Section 3 presents the transmission mechanism. Section 4 presents the econometric models. Section 5 constructs the index system. Section 6 analyzes the empirical results. The final section concludes and discusses the policy implication.

2. Literature Review

2.1. Connotations and Measurement of Systemic Financial Risks. How to measure systemic financial risks scientifically? Basically, an outbreak of financial crisis is a result of accumulation of systemic financial risks [8]. Domestic and overseas scholars have carried out research studies from multiple perspectives to explore the connotations and measurement of systemic financial risks. The earliest study pointed out that systemic financial risks were inter-bank risks which were transmitted to the entire financial system through various channels [9]. This definition is not adequate due to restrictions on the economic environment at that time. An official document jointly issued by the International Monetary Fund (IMF), Financial Stability Board (FSB), and Bank for International Settlements (BIS) in 2011 explained that systemic financial risk is "a risk of disruption to financial services that is (i) caused by an impairment of all or parts of the financial system and (ii) has the potential to have serious negative consequences for the real economy." Financial systemic risk is any existential threat to the general stability of the financial system [10]. From the perspective of fluctuation range, in addition, systemic financial risks cover a wide range of influence: they not only influence the internal part of financial system but also cause weakness of macroeconomy and reduce social welfare because of overflow effect [11, 12].

Since the financial crisis in 2008, scholars and state agencies have paid increasing attention to the research studies of measurement of systemic financial risks and international organizations and central banks of various countries have developed all kinds of measurement and monitoring systems, such as IMF's Early Warning Exercise (EWE) and European Central Bank's Composite Indicator of Systemic Stress (CISS). As China's financial system displays the characteristic of transition to new-type economy, at present, scholars' studies are mostly based on micro perspectives and focused on the bank system [13, 14]. Although research studies from the micro perspective can explore and analyze specific operating mechanism of systemic risks in financial markets, they fail to integrally measure economic operational situations and capabilities to withstand impact of external risks. Therefore, based on operation characteristics of China's financial system and major influence of systemic financial risks, we divide systemic financial risks into macroeconomic risk, credit crunch risk, sudden stop risk, and asset bubble risk and construct a system of

measurement indexes to make overall measurement of China's systemic financial risks, which is beneficial to filling in gaps in measurement mechanism of systemic financial risks in China and provides relevant references for other countries in formulating policies of risk prevention and assessment.

2.2. Conduction of Capital Account Liberalization with Systemic Financial Risks

2.2.1. Conduction of Capital Account Liberalization with Macroeconomic Risk. Maintaining macroeconomic stability is an important goal of capital account liberalization, but abnormal international capital flows and vulnerability of financial system easily result in macroeconomic instability [15]. Capital account liberalization mainly affects macroeconomy through direct and indirect channels [16]. Based on neoclassical economics, direct channel indicates that capital inflow will raise investment efficiency, lower investment cost, and disperse macro investment risks [17]. At the same time, however, large-scale cross-border capital flows present the characteristics of procyclicality and fluctuation [18], which causes such hazards as instability in macroeconomy and financial system of the countries of capital account liberalization [19]. Indirect channel lays emphasis on overflow effect of capital account liberalization [20]. Advanced technologies and management experience are introduced in the course of capital account liberalization, which is conducive to improving production technologies of inflow countries and enhancing macroeconomic order and stability [21]. This is more obvious in developing countries [22]. Driven by the idea of benefit maximization, companies in countries of capital account liberalization will give priority to the international markets whose finance is operating more efficiently. This leads to exhaustion of domestic capital flows and causes negative influence on domestic macroeconomic stability [23].

2.2.2. Conduction of Capital Account Liberalization with Credit Crunch Risk. Constant acceleration of capital account liberalization will lead to a large amount of money flows from bank system intermediary to economic system, accumulating possibility of outbreak of potential risks [24]. First of all, capital account liberalization will generate enormous demands for monetary capital and further push up asset prices [25]. Second, block in credit crunch process will also give rise to liquidity risk [26]. For example, tight monetary policies implemented in subprime crisis restrict market transactions. At the same time, they further exacerbate shortage of currency flows, causing a vicious circle in market financing environment. Ultimately, scholars found that influence of capital account liberalization on credit crunch risk displays a U-shape distribution [27]. This implies that credit crunch risk possesses hiddenness and that the possibility of outbreak of credit crunch crisis will become higher along with further capital account liberalization. In the long run, however, capital account liberalization that is regulated by prudent and flexible monetary policies may be favorable to alleviating currency flows and stabilizing asset prices [28].

2.2.3. Conduction of Capital Account Liberalization with Sudden Stop Risk. Regarding sudden stop risk, capital account liberalization primarily exerts positive or negative impacts on real exchange rate, foreign direct investment (FDI), and income distribution through cross-border capital flows. In respect of change in real exchange rate, abnormalities of net trade inflow in current account will reduce balance of exchange rate while flexible and prudent policies of exchange rate can effectively avoid risks [29]. With respect to influence on FDI, the major concern is asset price and financial stability level of countries of capital account liberalization [30]. Potential risks are more noticeable in developing countries whose financial system is not complete enough. Difference of income distribution between investors and investees during the open process is a key factor influencing investment confidence and sustainability [31]. By constructing the Chinn–Ito index to effectively partition the range of capital account liberalization, researchers found that open policies would further aggravate imbalance of income distribution in countries which were weaker in withstanding financial risks. As a result, developing countries that have fragile basis for openness need to attach importance to the mutual coordination between exchange rate and capital account liberalization policies so as to resist sudden stop impact resulting from capital account liberalization.

2.2.4. Conduction of Capital Account Liberalization with Asset Bubble Risk. Capital account liberalization accelerates international capital flows. Investors' optimistic expectations rapidly expand credit loans, which constantly lifts industry leverage ratio. Market changes cause leverage rupture and further trigger asset bubble risk [32]. Asset bubbles are apt to amass in two sectors: stock market and real estate industry. Capital account liberalization attracts foreign investment and provides stock market with imbalanced short-position or long-position capital, causing countercyclical aggregate volatility and credit spread movements [33]. Besides, capital account liberalization brings about fluctuation in exchange rate and cross-border capital flows. In addition to the vulnerability of China's real estate financial market, fluctuation in real estate prices becomes even more significant and leverage ratio turns higher [34]. Asset bubble accumulation is a long-term and unavoidable issue. Having the source of openness under surveillance and keeping key fields under supervision should be important measures for China to prevent asset bubble risk at the next phase.

In summary, capital account liberalization can incur systemic financial risks through different risk perspectives and prevent risks by improving capital supervision and enhancing resilience of financial system. Discussion on risk perspectives by scholars at home and abroad lays a sound theoretical basis for this study. However, few scholars have developed a complete evaluation system concerning the

nature and influence of systemic financial risks, leading to difficulties in in-depth exploration of specific evolution of risks. Scholars are still doubtful about negative influence of hidden asset bubble accumulation, market speculation, and other capital account liberalization-caused consequences. Studies are not very common, which is not beneficial to improving capital supervision or conducting targeted prevention and control of risks. Besides, most empirical research studies are based on impacts model of invariant parameters while neglecting nonlinear time-varying relationship and structural mutation characteristics. Compared with previous studies, we have two improvement in this study: (1) based on research outcomes at home and abroad and combining China's national conditions, we construct an evaluation system of systemic financial risks and identify four types risks of systemic financial risks for the convenience of exploration; (2) we use the SV-TVP-SVAR model to completely figure out capital account liberalization's time-varying characteristics towards systemic financial risks and we also select key time points during the course of China's capital account liberalization for special analysis, providing decision-making basis for China and the rest of the world to guard against systemic financial risks during the course of openness.

3. Mechanism Analysis

As is previously stated, capital account liberalization's conduction channels with macroeconomic risk, credit crunch risk, sudden stop risk, and asset bubble risk mainly include FDI and indirect investment of bank credit loan. It directly affects systemic financial risks by influencing foreign exchange market and domestic financial system. The analysis framework is shown as follows (see Figure 1).

We can construct a mean-variance model of international capital investment to make a concrete explanation of the influence of international capital on micro operating mechanism of financial risks [35]. Let us assume that international investors are similarly profit-seeking and are homogeneous investors. They distribute and invest normalized capital in m countries and the expected returns on investment of m investees obey the normal distribution of variance $= \sigma_0^2$ and mean $= \rho$. In Country A, which is an element of set m, its capital account liberalization grows in pace with returns on capital investment. Investors will amend the original investment portfolio when the threshold value of returns on investment reaches r. Let $r - \rho = \varepsilon \neq 0$, σ_A be standard deviation of returns of Country A, β be aggregate investment shares other than those of Country A, and Z be expected total rate of returns of investment portfolio; we have the following formulas:

$$E(Z) = \rho + (1-\beta)\varepsilon,$$
$$\mathrm{Var}(Z) = \frac{(\beta\sigma_0)^2}{(m-1) + (1-\beta)^2\sigma_A^2}. \tag{1}$$

The choice of investment proportion accords with the hypothesis of maximum risk-to-return ratio k ($k > 0$ and k is a constant) since investors follow the idea of benefit maximization. Hence:

$$\mathrm{MaxEU}(Z) = [\rho + (1-\beta)\varepsilon] - \frac{k}{2}\left[\frac{\beta^2\sigma_0^2}{(m-1) + (1-\beta)^2\sigma_A^2}\right]. \tag{2}$$

By first order condition, let $y = \sigma_0^2/(n-1)$, and above formula is turned into

$$\frac{\partial(1-\beta)}{\partial\varepsilon} = \left[k\left(y + \sigma_A^2\right)\right]^{-1},$$
$$\frac{\partial(1-\beta)}{\partial\sigma_A^2} = -\frac{(y + \varepsilon/k)}{\left(y + \sigma_A^2\right)^2}. \tag{3}$$

According to computational formula of elasticity, elasticity spread and risk elasticity of international capital investment shares are denoted as

$$\text{elasticity speed: } E_\varepsilon = \frac{1}{1 + (k/\varepsilon)y};$$
$$\text{risk elasticity } E_\sigma = \frac{1}{1 + y/\sigma_A^2}. \tag{4}$$

This theoretical model shows that international capital investors' investment shares are $1/m$ when capital account liberalization of Country A is not deepened. However, return difference ε and $1/m$ increase in the same pace and they are relatively sensitive to risks when capital account liberalization of Country A is constantly enhanced. In the end, rise in investment risk σ_A^2 decreases $1/m$, causing higher level of sensitivity to risks. As a consequence, international market will have remarkably higher expectation for and sensitivity to the rate of returns on capital investment along with improvement of a country's capital account liberalization and rapid capital inflow and outflow will bring about asset bubble risk and credit crunch risk to the country. Theories have summarized and proven that capital account liberalization may affect systemic financial risks through various channels, but further empirical analyses are required to figure out the ways and levels of influence.

4. Model Building

Some scholars have studied specific effects of capital account liberalization on one country's economy and finance, mostly based on the analysis of fixed parameter models. Therefore, by constructing an empirical model of the SV-TVP-SVAR, in which coefficients, disturbance variance, and coupling factor vary along with the time, we are able to take into full consideration the time-varying effects and nonlinear effects under lag factors and dynamically depict impacts of capital account liberalization. The primary need is to simplify the original SVAR model, and we get the following formula:

$$Ay_t = \Gamma_1 y_{t-1} + \cdots + \Gamma_p y_{t-p} + u_t. \tag{5}$$

In formula (5), y_t refers to $n \times 1$ dimensional column vector composed of n endogenous variables. p is lag order and t is quarter and $t = p+1, \ldots, n$. A is a triangular matrix

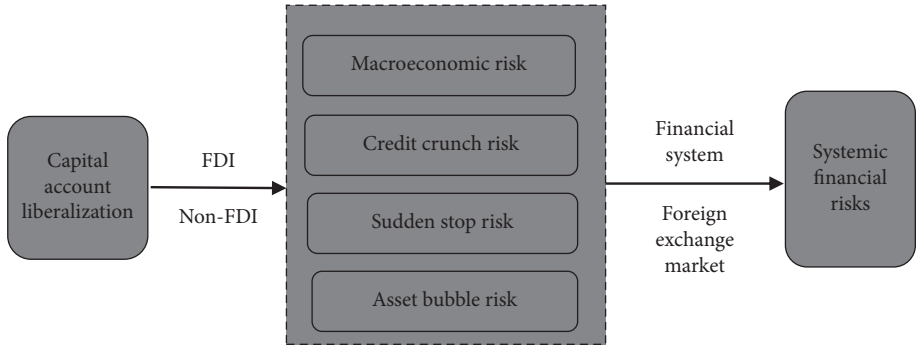

Figure 1: Framework of capital account liberalization influence on systemic financial risks.

under $n \times 1$ dimensions. Γ_p is $n \times n$ dimensional matrix consisting of lagged coefficients. u_t is $n \times 1$ dimensional random disturbance term and $u_t \sim N(0, \Sigma^2)$. Let us assume that $I_i = A^{-1}\Gamma_i$, $i = 1, \ldots, p$, e_t is $n \times 1$ dimensional random disturbance term, and $e_t \sim N(0, I_n)$. However, parameters of SVAR are fixed and they need to be turned into time-varying parameters [36]. Hence, the standard formula of time-varying parameter vector autoregression (TVP-VAR) is

$$y_t = X_t\beta_t + A_t^{-1}\Sigma_t e_t, \quad t = p+1, \ldots, n. \tag{6}$$

In formula (6), we assume that parameters are instantaneously or permanently variable, namely, the SV-TVP-SVAR. This model possesses the characteristic of stochastic volatility. The matrix of volatility is $h_t = (h_{1t}, h_{2t}, \ldots, h_{kt})$, which satisfies the condition $h_{jt} = \log \delta^2{}_{jt}$, $j = 1, \ldots, k$. Vector matrix is composed of triangular A_t element association under $a_t = (a_{21}, a_{31}, a_{32}, \ldots, a_{k,k-1})$. We assume that solve-for parameter obeys the walk process, i.e.,

$$\beta_{t+1} = \beta_t + u_{\beta t}, a_{t+1} = a_t + u_{at}, h_{t+1} = h_t + u_{ht},$$
$$\begin{bmatrix} e_t \\ u_{\beta t} \\ u_{at} \\ u_{ht} \end{bmatrix} \sim N\left(0, \begin{bmatrix} I & 0 & 0 & 0 \\ 0 & \Sigma_\beta & 0 & 0 \\ 0 & 0 & \Sigma_a & 0 \\ 0 & 0 & 0 & \Sigma_h \end{bmatrix}\right), \tag{7}$$

satisfying $\beta_{t+1} \sim N(\mu_{\beta_0}, \Sigma_{\beta_0}), a_{t+1} \sim N(\mu_{a_0}, \Sigma_{a_0}), h_{t+1} \sim N(\mu_{h_0}, \Sigma_{h_0})$.

In formula (6), I, Σ_β, Σ_a, and Σ_h, respectively, represent the covariance matrix of e_t, $u_{\beta t}$, u_{at}, and u_{ht}. In order to deal with estimation deviation of the model, Markov Chain Monte Carlo (MCMC) developed by Nakajima [37] is applied to the estimation of parameter posteriori distribution. Let $\mu_{\beta_0} = \mu_{a_0} = \mu_{h_0}$, $\Sigma_{\beta_0} = \Sigma_{a_0} = \Sigma_{h_0} = 10I$, and i elements in covariance diagonal satisfy

$$\Sigma_{\beta_0}\Sigma_i^{-2} \sim \text{Gamma}(4, 0.02), (\Sigma_a)_i^{-2} \sim \text{Gamma}(4, 0.02), (\Sigma_h)_i^{-2} \sim \text{Gamma}(4, 0.02). \tag{8}$$

Hence, we calculate the Impulse Response Function (IRF) of endogenous variables.

5. Selection of Variables

In this study, we select capital account liberalization and China's systemic financial risks indictor pool, including four elements: macroeconomic risk, credit crunch risk, sudden stop risk, and asset bubble risk, as variables. To highlight pertinence and comprehensiveness of this study, we focus on the analysis of capital account liberalization effects on the four risks. Considering data availability and operational condition of China's financial market, the time span of selected variables is from the first quarter of 2004 to the fourth quarter of 2019, covering key periods of China's capital account liberalization and critical time nodes of economic fluctuation. In the meantime, the selection of quarter data is based on two concerns: (1) because of great time lags in China's currency and fiscal policies [38], monthly and annual data will lose degree of freedom in the SV-TVP-SVAR with information criterion of over 12-period lags, leading to estimation deviation; (2) the selected data are on a quarterly basis, which are most frequently released by authorities. As a result, data conversion, if any, will cause deviation in effectiveness of empirical results. Specific variables are shown in the following.

5.1. Capital Account Liberalization. Measurement of capital account liberalization includes legitimate openness and de facto openness. However, the latter can better present short-term continuous variations of capital account. Therefore, we select de facto openness as the index of evaluation system. According to the research outcomes of Aizenman et al. [39], capital account liberalization is the ratio between total capital flows and GDP, and financial account openness is the specific index of capital account liberalization. Consequently, we take financial direct investment account (DI), securities investment account (SI), financial derivative instrument account (FI), and other investment accounts (OI) into full consideration. Then, we have

$$\mathrm{CAO} = \frac{\mathrm{DI} + \mathrm{SI} + \mathrm{FI} + \mathrm{OI}}{\mathrm{GDP}}. \tag{9}$$

5.2. Systemic Financial Risk Index Set. On the basis of the transmission channel of "capital account liberalization to financial system" and combing with actual situations of China's economic development, we identify four types of systemic financial risks: macroeconomic risk, credit crunch risk, sudden stop risk, and asset bubble risk. Macroeconomic risk concerns the fluctuation effects of capital liberalization on domestic economy. Credit crunch risk refers to the insufficient supply of credit facilities among the financial system. Sudden stop risk is the impact of foreign capital access on financial system due to openness. And asset bubble risk is the risk arising from accumulation of asset bubble because a large amount of capital flows to stock market and real estate market and lifts leverage ratio (see Table 1).

After constructing the index set, we need to standardize the indexes of the four risks. And then principal component analysis is adopted to carry out analysis of dimension reduction. Finally, risk indexes are concluded. Data are sourced from IMF database, Wind database, and official website of China People's Bank and China's National Bureau of Statistics.

5.3. Stationary Test. In order to verify the stationarity of experimental data, we select Augmented Dickey–Fuller (ADF) test, DF-GLS test, and Phillips and Perron (PP) test for unit root test. As is indicated in Table 2, the significance levels of both capital account liberalization and credit crunch risk (CCR) are stationary sequences while those of macroeconomic risk (MER), sudden stop risk (SSR), and asset bubble risk (ABR) are all nonstationary sequences. Nonstationary sequences are processed by the first difference, and it is found that those with the significance level of 1% are stationary sequences. Hence, another empirical modeling is made.

6. Empirical Analysis

6.1. Analysis of Parameter Estimation. We use Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) and select Lag 1 in the model and apply previous MCMC parameter setting to conduct 20,000 information simulations to obtain outcomes of posterior parameter estimation. According to Figure 2, the autocorrelation coefficients in the first line drop rapidly, indicating that the characteristic of autocorrelation during the simulation process can be effectively removed through 20,000 iterations. In the second line, the convergence pathway of parameters presents a typical "white noise" path, implying that parameters operate at a relatively stable level in accordance with posterior mean. Table 3 shows that all Geweke statistical magnitudes are higher than 0.01 and the original hypothesis of convergence posterior stationary distribution cannot be rejected. Additionally, the ineffective factor values of parameters are all lower than 100 in 20,000 simulations, suggesting that parameter sampling outcomes are steady and reliable.

6.2. Analysis of Pulse Response with Different Lags. According to the validity of sampling results, we get the outcomes of equal-interval impulse response of different lags. Considering the time-effectiveness of capital account liberalization, we select 2-period, 4-period, and 6-period lags and analyze capital account liberalization's short-term, medium-term, and long-term impulse response to macroeconomic risk, credit crunch risk, sudden stop risk, and asset bubble risk.

From Figure 3(a), we can see that the time-varying trend of capital account liberalization's influence on macroeconomic risk generally displays the characteristic of negative fluctuation. This indicates that capital account liberalization on the whole restrains the accumulation of macroeconomic risk in China, but the inhibitory effects are different. Based on the response trajectory of macroeconomic risk, the inhibitory effects fall into three levels which are distributed in different time frames: (1) the inhibitory effect of capital account liberalization was relatively weak at the early stage of openness from 2005 to 2010 and such effect was significantly fluctuant; (2) the inhibitory effect was constantly enhanced from 2011 to 2014; and (3) such effect has been weaker since 2015 and the macro economy has tended to be stable after a period of growing risks. Above results indicate that, in the early stage of capital account liberalization, China was able to avoid as many macro-operation risks as possible by introducing advanced technologies, improving investment efficiency, and other means. However, the country's anti-risk capability was insufficient to withstand such negative influences as international financial crisis because of weak financial system, petty advantages in market competitiveness, and other factors. Subsequently, the Chinese government released "Administrative Measures for the Pilot RMB Settlement of Outward Direct Investment" and introduced other relevant policies, aiming to make the openness broader and profounder. Through these efforts, both threshold and quality of international capital inflow were remarkably improved and the negative effects resulting from openness were significantly reduced. At present, China's economy enters a period of new normal and capital bonus continuously decreases, which may change international capital flow directions. As capital inflow is reduced and domestic risk management is improved, inhibitory effects of openness on risks gradually tend to be steady. From the perspective of lags, different lags roughly demonstrate the same variation direction. But the inhibitory effects of openness on risks may be the most stable in the short run and the response curve displays slight fluctuations. More lags lead to more unstable inhibitory effects. Therefore, the Chinese government should attach greater importance to the evaluation of long-term effects on macroeconomic environment when formulating open policies.

Figure 3(b) denotes the impulse response after credit crunch risk imposes one-unit standard impact on capital account liberalization. Overall, the response trajectory of credit crunch risk basically fluctuates in the positive range

Table 1: Basic systemic financial risk index set.

	Index	Significance	Possible relationship
Macroeconomic risk	GDP growth rate	Measuring a country's overall economic conditions	Change in the reverse direction
	Budget deficit growth rate	Judging the orientation and intensity of fiscal policies	Change in the same direction
	CPI growth rate	An important index reflecting currency inflation	Change in the reverse direction
	Industrial added value growth rate	Reflecting the value of industrial production for macroeconomy	Change in the reverse direction
	Fixed asset investment growth rate	Re-production of fixed assets	Change in the reverse direction
Credit crunch risk	Quasi-currency growth rate	Latent currency directly affects currency circulation	Change in the reverse direction
	One-year fixed-term deposit interest rate	Reflecting the long-term financial supply and demand between banks and depositors	Change in the same direction
	One-year benchmark interest rate for loans	Measuring the relationship of benefit distribution between companies and banks	Change in the same direction
	Loan growth rate	Positively correlated with bad debts	Change in the same direction
	Inter-bank offered rate	Short-term supply and demand of internal funds in financial market	Change in the same direction
	M2 growth rate	Reflecting changes in purchasing power	Change in the reverse direction
Sudden stop risk	FDI growth rate	One of main forms of capital internationalization	Change in the reverse direction
	Growth rate of amount of import	An important index measuring trade activeness	Change in the reverse direction
	Real effective exchange rate index	Reflecting the international value of domestic currency	Change in the same direction
	Growth rate of foreign exchange reserves	A crucial measure for resisting external risks	Change in the reverse direction
	Growth rate of amount of export	An important index measuring trade activeness	Change in the reverse direction
	International balance of payment	Shares of capital flows in international trade	Change in the same direction
Asset bubble risk	Rate of returns of SSE Composite Index	Ratio of returns on investment in stock market	Change in the same direction
	SSE average P/E ratio	Ratio between market value per share and earnings	Change in the same direction
	Rate of returns of SZSE Component Index	Ratio of returns on investment	Change in the same direction
	SZSE average P/E ratio	Ratio between market value per share and earnings	Change in the same direction
	Growth rate of real estate investment	Reflecting the trends of real estate investment	Change in the reverse direction
	Growth rate of house price	Reflecting price level in real estate industry	Change in the same direction

Table 2: Outcomes of unit root test.

	ADF test	DF-GLS test	PP test	Outcomes
CAO	-4.671^{***}	-4.609^{***}	-5.309^{***}	Stationary
MER	-1.647	-3.208^{**}	-1.481	Nonstationary
ΔMER	-3.518^{***}	-3.191^{***}	-4.894^{***}	Stationary
CFR	-3.305^{**}	-3.468^{***}	-2.872^{**}	Stationary
EMR	-1.763	-3.788^{*}	-1.736	Nonstationary
ΔEMR	-4.479^{***}	-4.030^{***}	-7.383^{***}	Stationary
ABR	-2.161	-2.170	-3.179^{**}	Nonstationary
ΔABR	-6.097^{***}	-5.780^{***}	-8.589^{***}	Stationary

Δ means the first difference; *, **, and ***, respectively, signify the significance levels of 10%, 5%, and 1%.

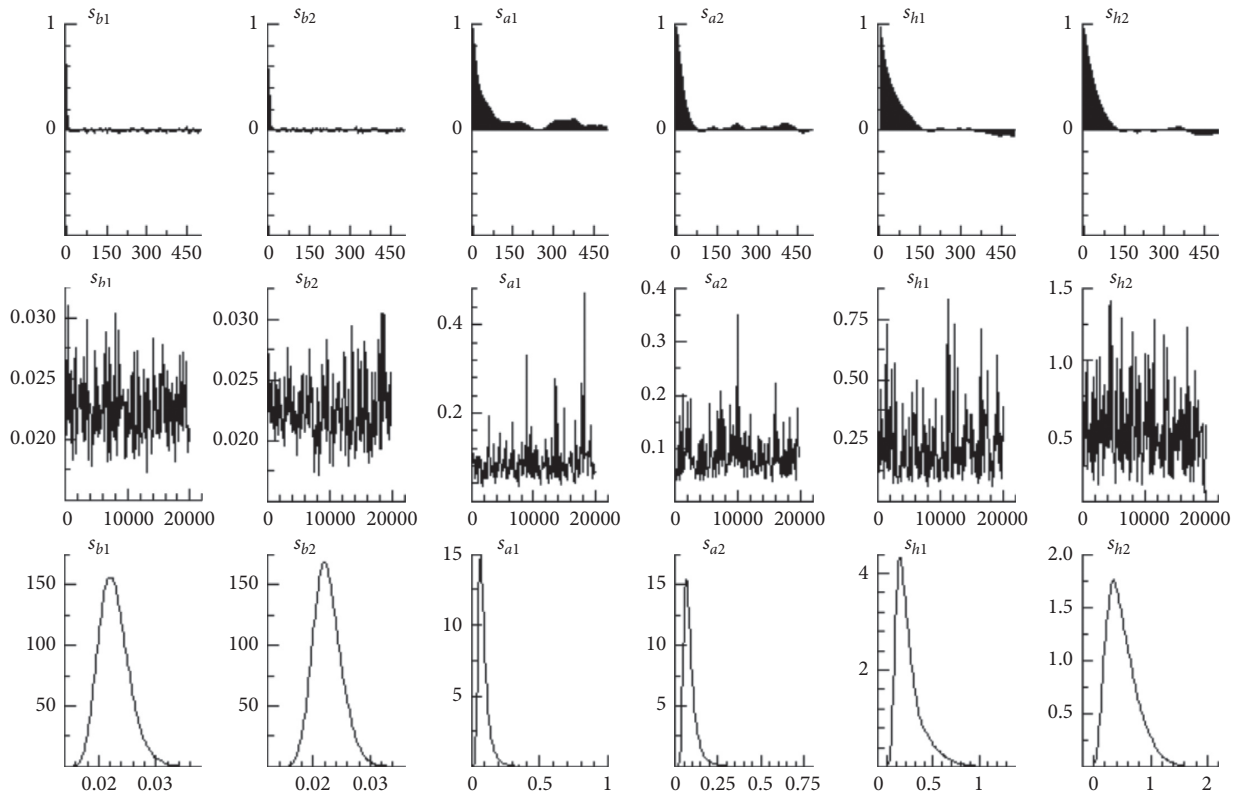

Figure 2: The SV-TVP-SVAR sampling outcomes.

Table 3: Parameter estimation results.

Parameter	Mean	Stdev	95%LU	Geweke	Inef
$(\sum_{\beta})_1$	0.0228	0.0026	(0.0183, 0.0287)	0.883	4.04
$(\sum_{\beta})_2$	0.0225	0.0025	(0.0182, 0.0279)	0.165	4.64
$(\sum_{a})_1$	0.0909	0.0522	(0.0429, 0.2116)	0.100	72.46
$(\sum_{a})_2$	0.0880	0.0498	(0.0419, 0.2050)	0.256	49.97
$(\sum_{h})_1$	0.2368	0.1499	(0.0718, 0.6394)	0.760	90.84
$(\sum_{h})_2$	0.5041	0.2622	(0.1330, 1.1232)	0.588	76.64

and it has always been fluctuating at a high level in recent years. This suggests that China's capital account liberalization on the contrary accumulates credit crunch risk and the country is currently facing greater pressure on credit crunch risk. Possible reason lies in that profound capital account liberalization will inevitably generate a large number of financial demands and further raise asset prices. Under the global economic downward pressure, many countries adopt tight monetary policies to take currency flows under control, which will further widen China's current capital gap and amass liquidity risks. According to Keynes's "liquidity trap," the central bank promotes medium-term lending facility (MLF) and lowers required deposit reserve ratio and takes other measures to stimulate supply of currency. At the same time, it is also cautious of increase of investment currency caused by decline of interest rate, placing itself in a dilemma in respect of risk control. Based on different lags, currency flows have relatively significant short-term response to openness, but they have relatively low negative influence on medium- and long-term response. This is because international capital, affected by the idea of benefit maximization, will respond rapidly in a short term and lead to "fast inflow and outflow" of currency and generate risks. However, China remains insistent on flexible monetary policies and macro-prudential policies and adopts targeted policies and takes timely remedy to cope with liquidity crisis. In the long run, the Chinese economy will not operate with high risks. Due to liquidity shortage resulting from the subprime crisis in 2008, the Chinese government implemented the "RMB 4 Trillion Investment Plan," which effectively stabilized long-term economic and financial growth. Hence, openness will always expose China to credit crunch risk. The next important task is to keep negative influence at a steady and controllable range and, based on existing policies, improve the open policies featuring strict access and the flexible and moderate monetary policies.

Figure 3(c) presents the influence of capital account liberalization on sudden stop risk. The impulse is negative fluctuation and displays a "U-shape" motion trail. This shows that openness generally restrains sudden stop risk in China and the inhibitory effect displays the trend of "weak-strong-weak" and the effect becomes the strongest before and after 2015. Possible reason is that at the early stage of China's capital account liberalization, the country's domestic economy and industries demand urgent development and international capital inflow can improve domestic resource allocation and lessen developing countries' financing pressure. Combining the effective regulation and control effects of floating exchange rate system on asset prices, capital account liberalization is able to deliver win-win

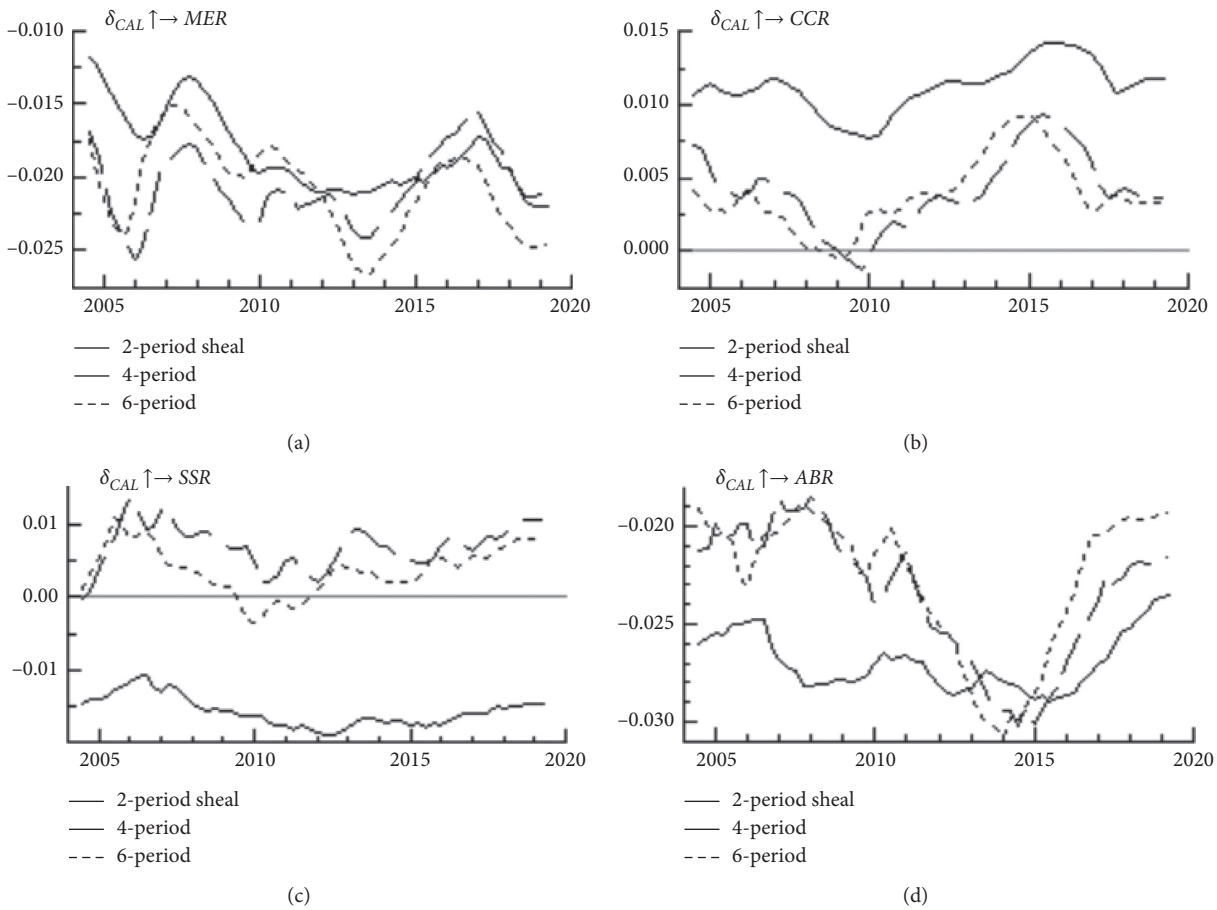

Figure 3: Effects of impulse of different lags.

results. Before and after 2015, in particular, China implemented the managed floating exchange rate system that was based on supply and demand and referred to basket of currencies. This effectively dispersed the influence of single currency on fluctuation of exchange rate and reduced risks. At the same time, however, the fragile financial system and international capital speculation present instability of risks. According to "Lucas Critique" theory in new classical macroeconomics, in policy fluctuations, the impacts of economists on future income expectations should be taken into consideration. Capital rupture or backflow may occur, which on the contrary heightens risks. Regarding distribution of lags, capital account liberalization has relatively steady short-term inhibitory effect on sudden stop risk, but the significance level of its medium- and long-term effects are relatively weak. It is probably because policy reform restrains and reduces sudden stop risk in the short run, but China's economic environment and financial system are developing and improving. This easily intensifies international capital panic effects and is disadvantageous to long-term development. In consequence, openness restrains sudden stop risk, but, affected by chase of profit and speculation of capital, the inhibitory effect will be weakened. Only by steadily promoting the improvement of capital account liberalization system and reform of exchange rate system can risks be effectively dispersed. At the same time, improving domestic economic and financial risk management system is the key to advancing capital account liberalization's long-term effects of serving the economic and social development.

Figure 3(d) represents the trajectory of asset bubble risk's response to the impacts of capital account liberalization. It can be seen from the diagram that response curves of different lags are greatly different from each other. In the short term, significant negative influence emerges, implying that capital account liberalization stabilizes asset bubble risk in the short run. However, medium- and long-term trends are relatively uniform and both are positive fluctuations, suggesting that capital account openness on the contrary accumulates asset bubble risk in the medium and long term. There may be two possible reasons: first, a large amount of rapid international capital inflow into the stock market and real estate industry where domestic leverage ratio is relatively high will boost short-term prosperity of economic industries. In the face of sufficient capital inflow, moreover, investors become optimistic about market expectations and the generated asset bubbles will not burst in the short term. Second, with the constant accumulation of asset bubbles and rise of financial leverage ratio, investors will quickly withdraw capital when the market is fluctuant or industrial crisis arises, resulting in capital chain rupture and asset bubble crisis. This is consistent with the theoretical outcomes stated previously. The curves also show that, currently, openness has rising medium- and long-term negative effects on ABR,

which is largely related to decline in China's interest rate. Decline in interest rate can narrow term spread and improve financing restriction, but excessive domestic and overseas current capital will further elevate leverage level and lead to outbreak of asset bubble crisis. Therefore, there are some important measures to cope with accumulation of asset bubbles, such as putting the fields where asset bubbles are apt to amass under stricter financial supervision and formulating monetary policies that coordinate capital account openness.

In summary, based on above analysis of equal-interval impulse response of different lags, we learn that capital account liberalization has certain inhibitory effects on macroeconomic risk and sudden stop risk and the inhibitory effects are subject to the impacts of exogenous crisis and influence of fluctuations in domestic policies, with certain fluctuations. On the contrary, however, capital account openness intensifies the accumulation of credit crunch risk and asset bubble risk. In the short run, capital account liberalization exerts inhibitory effect on asset bubble risk. Due to false prosperity caused by hiddenness of bubbles, however, it still increases asset bubble risk in the long run and leads to outbreak of systemic financial crisis. China has constantly improved its capital account liberalization policies and monetary policies. As a result, China becomes more internationally compatible and is able to promote its domestic economic development. However, this poses hidden risks in some areas. Therefore, the fundamental objective of this section is to copy experience from successful risk reduction and improve the field where there is insufficient risk restraint in China's capital account liberalization process.

6.3. Analysis of Impulse Response at Different Time Points. It can be seen from above empirical analysis that impulse response of different lags can better explain capital account liberalization's time-varying effects on systemic financial risks. As China's capital account liberalization has experienced several important reforms, will immediate significant changes take place in the transmission channels of liberalization? The answer not only reflects the market's expected changes in policies but also presents the real effects of policies to the maximum extent and is of referential significance to targeted implementation of policies. As a result, we select three time points, including the third quarter of 2009, the fourth quarter of 2011, and the fourth quarter of 2015, to dynamically identify capital account liberalization's transmission mechanism on systemic financial risks at different periods. These three time points are selected because they represent major reform measures for China's capital account liberalization: on July 1, 2009, the central bank and other departments officially implemented "Measures for the Administration of Pilot RMB Settlement in Cross-Border Trade." According to the document, the central bank may exercise control over the aggregate of RMB settlement of cross-border trade transactions in line with the need of risk prevention and control, which is an important breakthrough in standardizing capital market order. In December 2011, the RQFII system was implemented, which was a crucial measure for building an offshore RMB market under the backdrop of control of foreign exchange. In November 2015, RMB was eligible for joining Special Drawing Rights (SDR) currency basket, symbolizing a milestone in the process of RMB internationalization.

By observing above diagrams, we can see that the impacts directions of capital account liberalization present significant fluctuations after 2-period lags, indicating that the influence of capital account liberalization possesses obvious time-lag effects. This is consistent with the conclusion on selection of capital account liberalization lags. Figure 4(a) represents capital account liberalization's effects on macroeconomic risk at different time points. The effects of policies on risks are all negative, suggesting that all selected capital account liberalization reform measures can restrain macroeconomic risk, but the inhibitory effects have significant differences. After 2-period lags, control over the aggregate of RMB settlement of cross-border trade transactions in 2009 significantly weakens the inhibitory effects on macroeconomic risk and the inhibitory effects become weaker along with rise of lags. This demonstrates that this measure not only facilitates settlements for cross-national corporations but also increases hidden macroeconomic risk. The implementation of RQFII system in 2011 and RMB's accession to SDR currency basket in 2015 continually intensify the inhibitory effects on macroeconomic risk. Long-term implementation of RQFII system exerts better inhibitory effects. This implies that promoting the construction of offshore RMB market effectively disperses domestic economic operating risk. It is a key measure for boosting openness and reducing risks at the same time. As an effective means to avoid risk of exchange rate, RMB's accession to SDR currency basket lessens international risk impacts arising from RMB free convertibility. It plays an important role in macroeconomic stability.

Figure 4(b) presents the effects of capital account openness on credit crunch risk at different time points. Basically, impulse response moves in the same direction at all time points. Within 2-period lags, the effects are positive, but they rapidly fall after rise, showing that it causes significant shock on capital flows in the currency market at the early stage of policy introduction. It may lead to rapid inflow and outflow of a large amount of capital in the short term and tighten risks. Afterwards, the panic market tends to be stable. The marginal effects of policies gradually emerge and the negative influence on money flows also wanes little by little. Compared with other policies, the implementation of the RQFII system in December 2011 generates more negative long-term influence. This is likely because foreign investors, benefiting from the RQFII system, have greater flexibility in investment and they are able to rapidly exit market in the case of unfavorable capital market environment, causing greater credit crunch risk.

Figure 4(c) illustrates the effects of different capital account openness reform measures on sudden stop risk. In general, all impulse response curves at different time points fluctuate at the negative direction, signifying that China's capital account liberalization reform is able to standardize capital market order and avoid risks. Specifically, the RQFII system, which is designated for domestic bond market, can better improve the structure of capital market and stabilize the market in the long term by improving capital access. Reform measures present

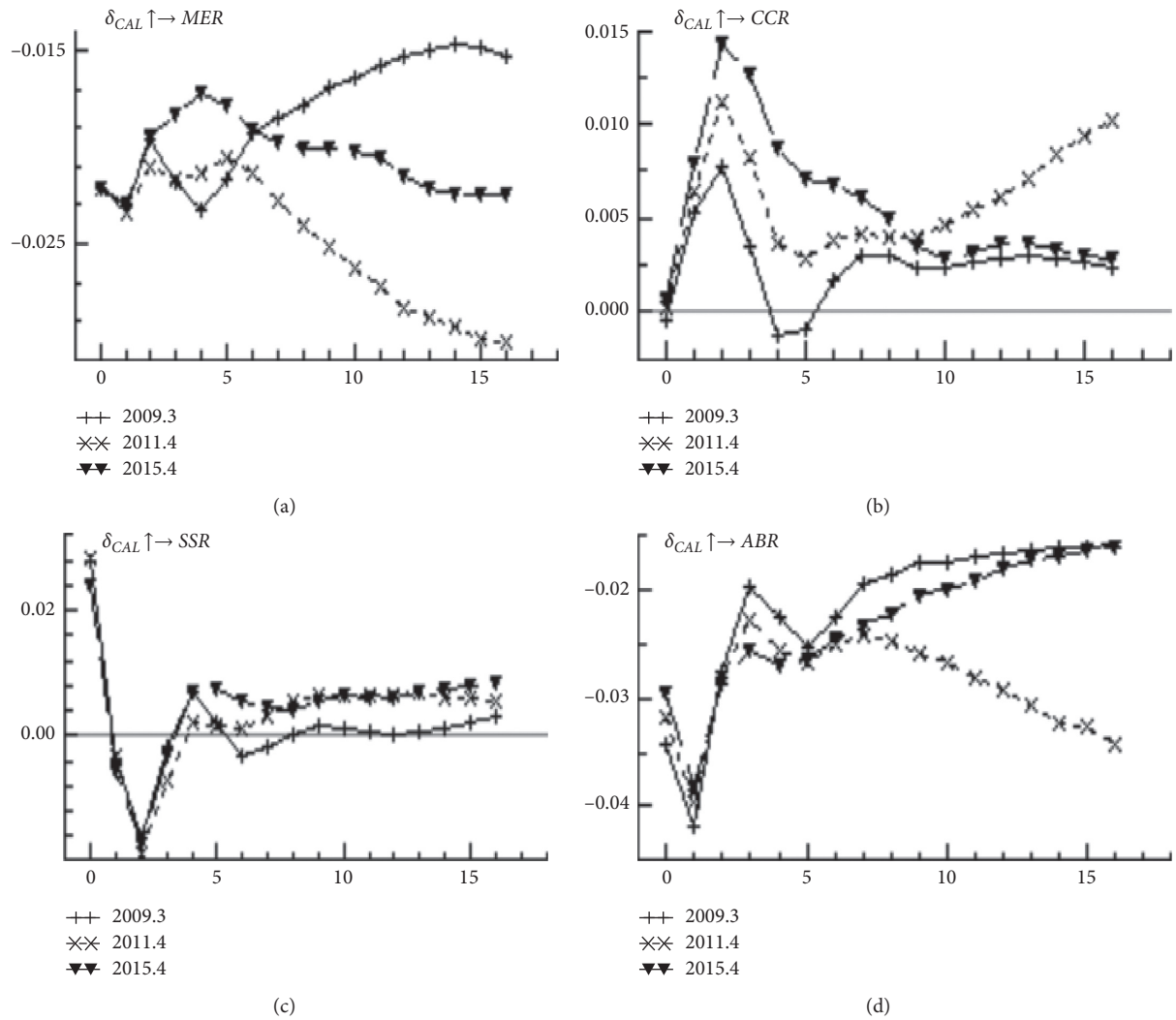

Figure 4: Impulse effects at different time points.

risks with obvious fluctuations, meaning that current sudden stop is relatively sensitive to the response mechanism of capital account liberalization and attention should be paid to improve capital supervision and safeguard measures of sudden stop.

Figure 4(d) indicates the impulse impacts of capital account openness on asset bubble risk at different time points. Impulse responses at different periods basically have the same trend, but the positive influence at 2-period lags rapidly turns negative and then slowly tends to be zero. Possible reason is that China's capital account liberalization reform measures also lay emphasis on the review of capital flow direction and raise the threshold of capital access when attracting domestic and overseas capital investment. This reduces opportunities of capital inflows to industries with high leverage ratio for speculative financing. For example, "Measures for the Administration of Pilot RMB Settlement in Cross-Border Trade" issued in 2009 clearly points out that not only domestic and overseas investors should meet relevant qualifications for import and export trade but also domestic settlement banks and agent banks need to be fully aware of customers' purposes of transactions and nature of transactions so as to avoid malignant financing. However, open measures may still cause accumulation of asset bubbles. China People's Bank should give priority to risk supervision of the process after introduction of foreign capital when improving policies.

Analysis of impulse response at different time points has effectively supplemented the analysis results as is mentioned above. Research shows that different reform measures have significantly different marginal effects. Therefore, risk control over such links as access rules and process management should be carried out in line with differences of policy effects and importance should be attached to sustainability of policy making.

7. Conclusion

This paper examines how capital account liberalization affects different types of systemic financial risks in developing countries, using China as an example.We identify four types of systemic financial risks in China: macroeconomic risk, credit crunch risk, sudden stop risk, and asset bubble risk. Based on the SV-TVP-SVAR model, we dynamically identify time-

varying impacts of capital account liberalization on these four types of risks from the first quarter of 2004 to the fourth quarter of 2019.

Firstly, we find that the pace of China's capital account liberalization is significantly different from the accumulation of systemic financial risks. China's financial opening-up has made steady progressin recent years, while at the same time, most systemic financial risks sharply increased. Secondly, capital account liberalization has distinctive time-varying effects on different types of systemic financial risks. It has strong dampening effects on the accumulation of macroeconomic and sudden stop risks in the short term. However, in the medium to long term, these effects are significantly weakened. Moreover, credit crunch and asset bubble risks have accumulated during the financial opening-up, mainly because of the liquidity gap and capital speculation.Thirdly, major capital account liberalization measures are double-edged. The control of total RMB settlement of cross-border trade transactions reduces credit crunch risk caused by blocked investment channelsbut exacerbates the macroeconomic impacts. Moreover, with the construction of offshore RMB market, the overseas trading floor has weakened the impacts of the financial opening-up on the domestic macroeconomic and sudden stop risks, but there is a lack of control over the currency flows.

We suggest that financial regulators should improve the management of cross-border capital flows and prevent the accumulation of specific systemic financial risks related to financial opening-up.Since capital account liberalization has significant time-varying effects on different types of systemic financial risks, we also suggest that capital inflows should be under long-term supervision, with a focus on industries with high leverage ratios.

Data Availability

The data used to support the findings of this study are available upon request from the corresponding author.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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