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The Synergy and Dynamic Interaction between Financial Opening-Up and Renminbi Internationalization

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ABSTRACT

The internationalization of the RMB and China's financial opening represent a continuous process of co-evolution. This process is propelled by a mutually reinforcing cycle where institutional supply, market demand, and network effects interact dynamically. The bidirectional synergistic evolution of the two has unleashed significant institutional dividends, yet its deepening process still faces multiple structural constraints. The synergistic advancement of financial opening-up and RMB internationalization necessitates a holistic framework—one that strategically balances risk containment with growth momentum to ensure these processes are mutually reinforcing. This study examines the synergistic pathways and interactive dynamics between financial opening and RMB internationalization. The objective of this paper is to elucidate the intricate relationship between these processes and their strategic implications, thereby formulating a theoretical and policy-oriented framework to support high-level financial opening and enhance the international standing of the RMB.

1. Introduction

The steps of global financial integration of a country are usually quantified in terms of financial openness and internationalization of currency. It is significant in terms of reconstructing the financial landscape in the country, and it has a direct impact on the placement and power of the country in the international economic system. The issues of trade frictions have serious implications on the financial opening-up and Renminbi (RMB) internationalization of China. China's international trade and financial markets are closely connected with many countries worldwide. China's financial openness is a determining factor of the RMB's global position in that there is a mutually reinforcing relationship. The financial openness of China and the position of RMB in the international arena are

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closely interacting, and it is a mutually supporting relationship. Conversely, further RMB internationalization also subjects financial openness to greater demands [1].

The gradual intensification of global financial integration in the modern globalized economy has radically transformed the national economic systems and the overall structure of global economic governance. The extent and intensity of financial openness and the level of domestic-currency internationalization largely determine a country's position in the world financial system. Monetary transparency increases international-capital opportunities, improves financial-resource-allocation efficiency, and expands a nation's inclusion in the global economy, raising its institutional impact and discursive strength in the international economy. At the same time, currency internationalization directly affects such vital areas as international trade settlement, international financing, and the composition of global reserves, and is therefore a significant indicator of a state's overall economic power and international financial integration. It is in this changing context that China's financial opening and RMB internationalization have become major issues of scholarly and policy interest. The Chinese economy is now firmly embedded in international value chains and global financial systems, and its expanding trade, investment and financial ties expose it to increasingly complex external constraints and competitive pressures. At the same time, rising uncertainty in the international trade environment−such as frequent trade friction−poses a major challenge to China's decades-old outward-oriented development path. With major-power rivalry intensifying and global production and financial networks being restructured, China faces growing uncertainty over financial security, strategic decisions on further liberalization, and how much international space the RMB can be granted.

At this fateful point, the correlation between financial openness and RMB internationalization in China is a dynamic, mutually-reinforcing interaction [2]. On the one hand, the level of financial openness reflects the institutional base and business condition of the further development of the RMB's functions as a currency for cross-border settlement, investment, financing and reserve diversification. Conversely, the increasing internationalization of the RMB−especially in trade transactions, offshore financial markets and global reserves−creates new institutional-fit pressures, regulatory-modernization needs and market-oriented-reform imperatives in the Chinese financial system. This two-way process is in effect speeding up reform in fields like capital-account management, the financial-regulatory structure, and the international interoperability of financial market infrastructures [3]. Consequently, China must strike a delicate balance between the benefits of deeper financial integration and the systemic risks of further opening. Foreign investors held Chinese bonds and shares worth 6.51 trillion yuan at the end of 20231, 5.34 times the end-2015 level. The RMB's share of global payments rose to 3.75 percent in 2024[2], up from 0.3 percent in 2010, making the RMB the fourth most active currency in global payments. Such massive change has spurred the modernization of the cross-border RMB payment system. As of 2024, the Cross-border Interbank Payment System (CIPS) recorded a transaction volume of more than CNY 60 billion[3]. This vigorous operation is expected to be supported by a long-term growth in demand for RMB-denominated assets. It mandates that China work harder to improve financial transparency, advance

1 Data source: People's Bank of China official website.http://www.pbc.gov.cn/diaochatongjisi/resource/cms/2024/02/2024022115171218645.pdf
2 Data source: Official Website of the Central People's Government of the People's Republic of China.https://www.gov.cn/yaowen/liebiao/202502/content_7005133.htm
3 Data source: People's Bank of China official website. http://www.pbc.gov.cn/huobizhengceersi/214481/3871621/5472873/index.html

financial-market reforms, and enhance the international competitiveness of its financial system, so as to meet the growing demand for efficient allocation of international capital.

As shown in Figure 1, the RMB internationalization curve for 2010–2024 displays a two-stage trend, shifting from moderate to accelerated expansion. The Standard Chartered Renminbi Glocalization Index also stayed flat at around 1,600 between late 2010 and 2016, and the RMB's share of world payments did not exceed 2 percent, indicating a policy-driven period of foundational accumulation. All indicators then began to rise, with a steep climb starting after 2020: by 2024 the glocalization index exceeded 5,600 and the RMB's share of global payments reached roughly 4 percent. The sharp clustering of these signs around 2020 marks a clear inflection, shifting RMB internationalization from quantitative accumulation to qualitative development.

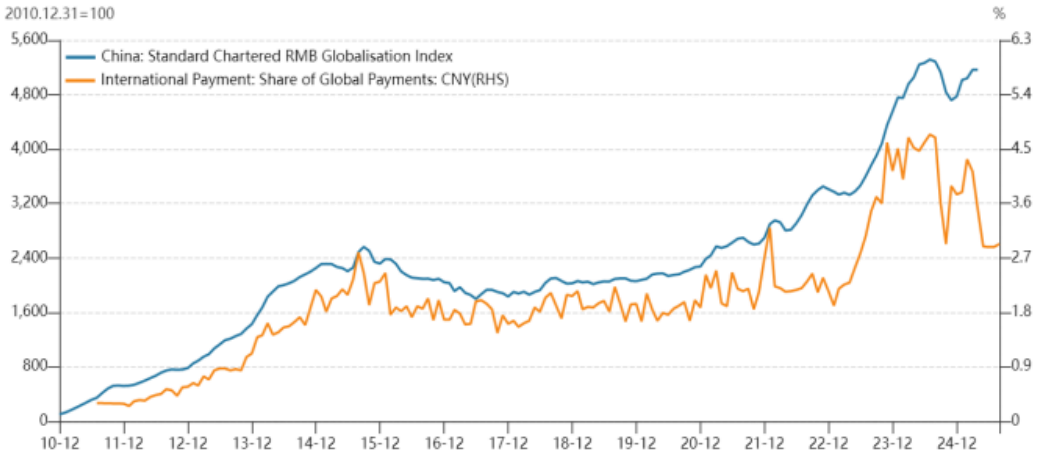

Fig. 1. RMB Globalisation Index (left axis) vs. Share of Global Payments (right axis)
Source: Standard Chartered Bank and SWIFT

The paper aims to investigate systematically the dynamic interaction between financial openness and RMB internationalization, focusing on their time-varying nature and mutual influence mechanism. In particular, it examines how financial openness affects RMB internationalization and, conversely, how further RMB internationalization affects financial opening policies, thereby uncovering the bidirectional relationship and its evolution over time. Theoretically, the paper clarifies how emerging economies balance external financial openness with domestic financial sovereignty and highlights the structural and time-varying dynamics of this interaction. In practice, the financial openness-RMB internationalization interaction shapes China's strategic position in the global value chain and the international monetary system, and it affects cross-border financial-resource allocation, financial market stability and the overall competitiveness of the national financial system. The detailed study of this time-varying interaction mechanism provides theoretical guidance and policy insights for optimizing the path of financial opening, advancing financial-market reforms and enhancing the international resilience of China's financial system.

Whereas the current literature has examined the determinants of financial opening and RMB internationalization as separate variables, few studies have integrated the two into a single analytic model. Specifically, the literature offers no systematic account of how financial opening and RMB internationalization co-evolve, how their interplay shapes the Chinese financial system and its external monetary effects, or what constraints or frictions impede their coordinated advancement. Against this research gap, the paper focuses on the co-evolutionary relationship and dynamic interactions between financial opening and RMB internationalization. It also examines how the two

support or condition each other, identifies the main bottlenecks and institutional limits that hinder their synchronized advance, and proposes strategies to foster their synergistic progress. The research process of this paper is organized as shown in Figure 2.

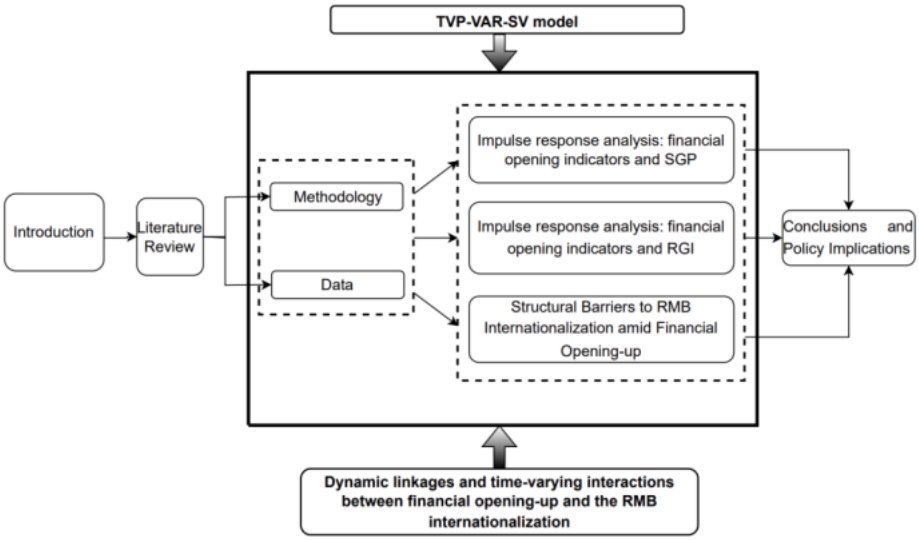

Fig. 2. Flowchart of research design and methodology

2. Literature Review

The academic community has yet to reach consensus on the correlation between a country's financial openness and its currency internationalization. According to some scholars, currency internationalization presupposes a higher degree of financial openness, as currency competitiveness must enable international transactions that meet investors' demand for diversification [4]. Monetary openness will push a currency out of the nation and into global circulation [5]. The reason is that financial openness ensures free cross-border flow of domestic capital, giving international investors more diversified investment and settlement options [6,7]. Capital can be allocated on a wider scale in an open financial system, and domestic financial institutions and market participants can conduct cross-border and international financial transactions [8]. This not only raises the domestic currency's share in international transactions but also boosts its liquidity and credibility among international investors [9,10]. Simultaneously, financial openness attracts foreign capital and international investment standards, enhancing the domestic financial market framework and institutions and aligning monetary policy and financial regulation with international norms [11]. Conversely, a group of scholars remain skeptical of this linear facilitating effect, arguing that financial openness promotes currency internationalization only under a string of preconditions. Financial openness can tip the economy into either dominant or low-level equilibria, because its effects on the real economy are highly complex [12]. The reason is that financial openness has complex, non-uniform and non-unidirectional effects on the real economy; free capital mobility can heighten market volatility, alter investment and consumption patterns, and exert multidimensional impacts on economic and financial stability [13]. Financial openness can foster a dominant equilibrium that promotes currency internationalization only when institutional underpinnings are sound, financial regulation is strong, and the macroeconomic environment is stable [14]. Yet without adequate institutional structures or with weak economic fundamentals, overly rapid or blind liberalization can trap the economy in a low-level equilibrium of market instability, capital flight and diminished currency use [15,16]. This uncertainty implies that the effect of financial openness on currency internationalization is

conditional; only under appropriate economic, institutional and regulatory conditions can its positive facilitating role be fully realized [17]. Furthermore, international capital flows pose significant risks to macroeconomic stability. There is also a positive correlation, under open conditions, between higher levels of financial development, a relatively low risk of debt default, net inflows of foreign long-term capital and economic smoothness; when the country's debt-compliance rate reaches a certain level, a higher savings rate also significantly reduces the magnitude of macroeconomic volatility [18]. The pathways and consequences of cross-border capital flows during liberalization are complex. In general, if a country lacks sound preconditions, blind opening of financial markets is detrimental to currency internationalization. A growing body of research highlights the increasing importance of economic fundamentals: if a country deepens financial openness amid a macroeconomic downturn, it can trigger instability in financial institutions and the system instead of promoting currency internationalization [19]. It has also been found that the relationship between financial openness and currency internationalization follows an inverted-U shape: the two are positively correlated at first, but the correlation gradually weakens and eventually turns negative [20-22].

The scale and direction of cross-border capital flows undoubtedly play a central role in advancing financial openness and promoting currency internationalization. Compared with domestic flows, cross-border capital flows are significantly more complex because of the multiple intermediaries involved, diverse market infrastructures and changing regulatory frameworks [23]. Challenges to cross-border capital include differences in data and format standards, lack of system interoperability, limited synchronization of working hours between payment systems, extensive correspondent-bank networks, currency-exchange complexity, and stringent compliance checks among banks in various jurisdictions [24]. These impediments raise costs and slow cross-border capital flows, especially in emerging and developing economies where end-users face higher fees. Studies of China's Cross-border Interbank Payment System (CIPS) have usually examined it through the lens of international security and politics [25]. Even without full capital-account liberalization, a robust international payment system can strengthen a country's external position and foster gradual currency internationalization [26].

RMB internationalization exposes financial risks through impacts on the balance of payments, changes in macroeconomic policy frameworks and strains on the domestic financial system; scholars assess these systemic risks in terms of China's macroeconomic performance, the autonomy of its monetary and fiscal policies, and conditions in both international and domestic financial markets. [27]. When internationalizing the RMB, it is vital to identify and measure financial risks in time to prevent further aggravating the vulnerability of the Chinese financial system [28]. Others have focused on the incremental construction of onshore and offshore investment channels and on financial vehicles that insulate domestic markets from the risks of large-scale cross-border capital flow volatility [29]. The People's Bank of China's currency swap agreements and offshore clearing banks supply external markets with RMB liquidity, offsetting the cross-border capital flow constraints created by the still-limited capital-account liberalization [30-33].

Existing studies have extensively examined the relationship between financial openness and currency internationalization. On the one hand, some scholars argue that financial openness enhances the cross-border circulation and competitiveness of a country's currency, provides international investors with diversified options and promotes the development and refinement of domestic financial market institutions, thereby facilitating currency internationalization. Other researchers, conversely, focus on the idea that the influence of financial openness on currency internationalization is highly complex and conditional, depending on the economic base, institutional

quality and regulatory systems. Excessive or indiscriminate liberalization could cause financial instability, capital flight and limited currency use, and the relationship could follow an inverted-U shape over time. Additionally, cross-border capital flows are complex, costly and inefficient; the RMB internationalization process is exposed to systemic financial risk and also creates problems for macroeconomic-policy coordination. Although these studies highlight various mechanisms and possible dangers behind financial openness and RMB internationalization, they mostly fail to provide a systematic examination of the interaction processes and synergistic outcomes between the two. This paper attempts to fill that research gap and explore possible sources of synergy in the relationship between financial openness and RMB internationalization. Analyzing these intricate relations and strategic choices provides a theoretical basis and policy framework for high-level financial opening in China and for encouraging RMB internationalization.

3. Methodology and Data

Financial opening promotes RMB internationalization by redefining network externalities and institutional complementarities. According to the theory of self-reinforcing mechanisms, the initial acquisition of international status by the RMB must break through the critical threshold of network effects, significantly enhancing currency externality by reducing cross-border asset-holding costs and improving asset allocation efficiency. This occurs through three main dimensions: the convertibility enhancement mechanism, the liquidity creation mechanism and the risk hedging mechanism.

The convertibility enhancement mechanism has a direct positive effect on the availability of RMB asset markets. According to the currency anchor theory, it is a virtuous cycle, as the investments in China are made by holding the RMB assets, which gives the Chinese expanded economic growth that gives investors further confidence in the RMB. The restructuring of the QFII/RQFII quota management system and other factors have reduced the cost of search and switching costs to cross-border investors which is a decisive point in the market depth model of currency internationalization. The liquidity creation scheme functions based on the derivatives markets development and exchange rate hedging instruments that reduce the risks of currency mismatch of non-residents holding RMB assets and raise the willingness to allocate it long-term. The risk hedging mechanism also makes sure that the opening process has institutional synergies with domestic financial reforms, which forms an end-to-end institutional structure of market access, transaction settlement and risk management which will adapt to the international financial standards.

The convertibility-enhancement mechanism directly enlarges RMB asset supply. Currency-anchor theory implies a virtuous circle: foreign holdings of RMB assets stimulate Chinese growth, which in turn reinforces confidence in the RMB. Reforms such as the removal of QFII/RQFII quotas cut search and switching costs for cross-border investors, the tipping point in the market-depth model of currency internationalization. The liquidity-creation scheme rests on derivatives market development and exchange rate hedging instruments that reduce currency mismatch risk for non-resident RMB holders and raise their willingness to hold the currency long-term. The risk-hedging mechanism aligns the opening process with domestic financial reforms, creating an end-to-end institutional chain – market access, transaction settlement and risk management – that meets international financial standards.

This institutional innovation is exemplified by the continuous upgrading of the RMB Cross-Border Interbank Payment System (CIPS). As a core liquidity hub linking onshore and offshore markets, CIPS raises the efficiency and stability of RMB internationalization. By adopting the ISO 20022 message standard it converts technical-standard advantages into currency-network power, while faster clearing strengthens China's institutional bargaining position. This symbiosis of institutional change

and market liberalization embodies China's strategy for reconciling the inherent tension between financial openness and the threat of financial instability.

The effect of financial opening on the RMB's international currency position stems from the dynamic matching of institutional supply and market demand in the construction of international monetary power. The three tier demand theory of reserve currency holds that a sovereign currency must offer asset safety, market liquidity and institutional stability to qualify as a reserve asset; financial openness systematically generates these three attributes, thereby expanding the stock of RMB safe assets. The liquidity premium lowers frictional costs and triggers a self-lubricating loop: an increase in reserve demand, the resultant capital inflows and self-reinforcing market deepening.

According to the regime quality threshold hypothesis, reserve currency status requires policy framework transparency and financial market regulation to meet international standards [34]. China has enhanced institutional credibility through a dual-track opening strategy. At the macro level, it has improved the market maker system in the bond market and established a Central Counterparty (CCP) clearing system for bond transactions, complying with IMF guidelines for the Management of Reserve Assets regarding settlement security. At the micro level, China has adopted International Financial Reporting Standards (IFRS) and aligned with international credit rating practices to lower information verification costs for foreign institutions. These institutional changes have gradually endowed RMB assets with safe asset attributes.

Based on currency-use externality theory, the wide use of RMB in regional trade settlement generates precautionary reserve demand from emerging-market central banks through the valuation-settlement-reserve chain. A noticeable asymmetric trend in the RMB's rise as a reserve currency: emerging-market central banks account for 73 % of accumulation, exceeding that of advanced economies and signalling a radical shift in the center‑periphery structure of the global monetary system. The proactive vigor of the monetary functions and the development of the financial system are reflected in upgrading financial-market infrastructure to meet foreign investors' demands. This underscores the radical effects RMB internationalization has on financial-system reform: it must address liquidity constraints from shallow markets, interoperability gaps between Chinese and international standards, and weak regulatory predictability. In China, the bond-market custody balance grew from about 48.8 trillion yuan to 154 trillion yuan between 2015 and 2023, yet foreign holdings remained below 3%. This scale growth amid structural imbalance reflects an asymmetric development of institutional supply and market demand, analyzable through three theoretical levels: network externalities threshold-breaking mechanism, technological progression and the spiral evolution path of institutional synergy [35]. This section uses an empirical model to examine the dynamic, time-varying interactions between financial opening-up and RMB internationalization, explaining their complex interdependencies and strategic implications.

3.1 Methodology

This paper uses a Time-Varying Parameter Vector Autoregressive Stochastic Volatility (TVP-VAR-SV) framework to examine the time-dependent and dynamic interrelations between financial openness and internationalization of RMB. The TVP-VAR framework of Primiceri and Nakajima includes time-varying parameters within a VAR structure [36,37]. One main benefit of the approach over traditional fixed-parameter models is that it captures changing relationships between economic variables. We can evaluate the reciprocal impact of financial openness and RMB internationalization and see how these impacts evolve, providing a platform for deeper examination of their relationship. We begin with a standard structural VAR model:

$$Ay_t = F_1 y_{t-1} + \cdots + F_s y_{t-s} + u_t \tag{1}$$

Here, y_t is a $k \times 1$ vector of observed variables, $t = s+1, \ldots, n$, and s denotes the lag order. The matrices $A, F_1, \ldots, F_s$ are $k \times k$ coefficient matrices, and u_t is a $k \times 1$ vector of structural shocks with $u_t \sim N(0, \Sigma\Sigma))$, where

$$\Sigma = \begin{pmatrix} \sigma_1 & 0 & \ldots & 0 \\ 0 & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \sigma_k \end{pmatrix} \tag{2}$$

Assuming a recursive identification scheme, A is a lower triangular matrix:

$$A = \begin{pmatrix} 1 & 0 & \ldots & 0 \\ a_{21} & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ a_{k1} & \ldots & a_{k,k-1} & 1 \end{pmatrix} \tag{3}$$

Rewriting equation (1) yields the reduced form VAR:

$$y_t = B_1 Y_{t-1} + \cdots + B_x y_{t-s} + A^{-1} \sum \epsilon_t, \quad \epsilon_t \sim N(0, I_k) \tag{4}$$

where $B_i = A^{-1}F, \ \ i = 1, \ldots, s$. By stacking the rows of B_i into a $k^2 s \times 1$ vector and defining $X_t = I_k \otimes (y_{t-1}', \ldots, y_{t-s}')$, where $\otimes$ is the Kronecker product, the model becomes:

$$y_t = X_t \beta + A^{-1} \sum \epsilon_t \tag{5}$$

To capture the dynamic characteristics of variable interactions, equation (5) is extended into the TVP-VAR-SV model, which allows the parameters to vary over time as follows:

$$y_t = X_t \beta_t + A_t^{-1} \sum_t \epsilon_t, \quad t = s+1, \ldots, n \tag{6}$$

Here, $t = s+1, \ldots, n$, and β_t, A_t, and Σ_t are all time-varying. The lower triangular elements of A_t are parameterized and expressed as $a_t = (a_{21}, a_{31}, a_{32}, a_{41}, \ldots, a_{k-k-1})'$ and $h_t = (h_{1,t}, \ldots, h_{kt})'_{j,t} = \log \sigma_{jt}^2$, for $j = 1, \ldots, k, t = s+1, \ldots, n$. The time-varying parameters are assumed to follow a random walk with the initial conditions satisfying $\beta_{s+1} \sim N(\mu_{\beta_0}, \Sigma_{\rho_0}), \ \ a_{s+1} \sim N(\mu_{a_0}, \Sigma_{a_0}), \ \ h_{s+1} \sim N(\mu_{h_0}, \Sigma_{h_0})$.

$$\begin{pmatrix} \varepsilon_t \\ \mu_{\beta t} \\ \mu_{\alpha t} \\ \mu_{ht} \end{pmatrix} \sim N\left(0, \begin{pmatrix} I & 0 & 0 & 0 \\ 0 & \Sigma_\beta & 0 & 0 \\ 0 & 0 & \Sigma_\alpha & 0 \\ 0 & 0 & 0 & \Sigma_h \end{pmatrix}\right) \tag{7}$$

The TVP-VAR-SV model is highly nonlinear, and maximum-likelihood estimation entails a heavy computational burden: the likelihood must be evaluated for every parameter vector through repeated filtering over the sample until convergence is achieved.

3.2 Data

Using relatively high-frequency data, the indicator system is built on the concept of financial openness while accounting for China's distinctive economic context. A comprehensive indicator system for financial openness should cover three core dimensions: capital flows (showing the degree of freedom of foreign capital flows), economic market participation (reflecting the degree of openness to foreign capital), and the exchange rate regime (reflecting the authorities' views on exchange rate management). Table 1 presents the constituent indicators of the system.

Table 1
Selection of Financial Variables for Measuring Financial Openness

Variables Classification	Name of Variables	Abbreviations	Economic Significance	Directional Attributes
Capital flows category (CF)	New Foreign Currency-denominated Loans	NFCL	Indicates the ease of access to external financing for enterprises	+
	Foreign Direct Investment	FDI	Measures the level of openness in the real economy	+
	Overseas Deposits for Financial Institutions	ODFI	Reflects outward investment by financial institutions	+
	Foreign Loans by Financial Institutions	FLFI	Captures external lending activities of financial institutions	+
Financial market participation category (FM)	Stock Held by Overseas Entities	SHOE	Represents the openness of the stock market	+
	Bonds Held by Overseas Entities	BHOE	Indicates the openness of the bond market	+
	Loans Held by Overseas Entities	LHOE	Reflects the openness of the credit market	+
	Deposits Held by Overseas Entities	DHOE	Measures the openness of the banking sector	+
Exchange rate and foreign exchange market category (EX)	Balance of Overseas Receipts and Payments by Domestic Banks for Clients	BORP	Tracks the flow and direction of cross-border capital	+
	Renminbi Real Effective Exchange Rate Index	REER	Reflects the real purchasing power of the RMB	+
	Foreign Exchang Reserves	FXR	Indicates the stability of the foreign exchange market	+
	FX Market Turnover	FXMT	Reflects the activity level of the foreign exchange market	+

To improve numerical stability and estimation efficiency, all indicators are normalized to a common scale. This study uses the entropy method to quantify the three core dimensions of China's financial openness. Unlike subjective weighting, the entropy method relies only on the data's

inherent variability, avoiding expert-judgment bias; it assigns weights by the information each indicator contains, giving an objective measure of relative importance

Given that the original data vary in units, scales, and directional attributes (i.e., some indicators are positive while others are negative), only positively oriented indicators are used to measure the degree of financial openness in our system. Prior to analysis, all indicators are normalized using the min-max scaling formula:

$$Y_{ij} = \frac{X_{ij} - \min(X_j)}{\max(X_j) - \min(X_j)} \tag{8}$$

Here, $\mathrm{X_{ij}}$ denotes the raw value of the j indicator for the i sample, while $\min(\mathrm{X_j})$ and $\max(\mathrm{X_j})$represent the minimum and maximum values of indicatorj respectively. Next, the entropy value$\mathrm{E_j}$is computed to assess the dispersion degree of each indicator, which reflects its informational content:

$$p_{ij} = \frac{Y_{ij}}{\sum_{i=1}^{m} Y_{ij}} \tag{9}$$

Where m is the total number of samples, and $\mathrm{p_{ij}}$ represents the proportion of the i-th sample in the j-th indicator, satisfying $\sum \mathrm{p_{ij}} = 1$.

$$E_j = -k \sum_{i=1}^{m} p_{ij} \ln(p_{ij}), \qquad k = \frac{1}{\ln(m)} \ (k > 0) \tag{10}$$

The entropy value $E_j$ranges between 0 and 1. When all samples exhibit identical values for a given indicator—that is, when $p_{ij} = \frac{1}{m}$, the entropy reaches its maximum ($E_j = 1$), indicating that the indicator provides minimal information. The weight w_j is determined by the divergence coefficient $d_j = 1 - E_j$, where a largerd_j, implies greater importance of the indicator. After normalizing the divergence coefficients, the final weights are obtained as:

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \tag{11}$$

These weights satisfy $\sum_{\mathrm{j=1}}^{\mathrm{n}} \mathrm{w_j} = 1$, where n is the number of indicators. Finally, a comprehensive score is calculated to evaluate the overall performance of each sample based on the weighted indicators.

$$S_i = \sum_{j=1}^{n} w_j \cdot Y_{ij} \tag{12}$$

In the context of variable selection for RMB internationalization, the monthly updated RMB Global Market Share in International Payments (SGP) reported by SWIFT represents the proportion of RMB utilized as an international payment and settlement currency on a global scale, thereby serving as an indicator of the degree of RMB internationalization. To explore the intricate interactions between financial openness and RMB internationalization from various perspectives, we also employ the Standard Chartered RMB Globalisation Index (RGI) to assess the extent of RMB internationalization. Both SGP and RGI indicators are normalized using the MAX_MIN method.

Table 2
Summary statistics for all variables

Indicators	Variables	Mean	Std.Dev.	Min	Max	Skewness	Kurtosis	ADF tests	PP tests
Financial opening indicators	CF_S	0.497	0.208	0.125	0.891	-0.169	-1.155	-6.933***	-8.623***
	FM_S	0.464	0.272	0.034	0.832	-0.043	-1.661	-3.350**	-4.651**
	EX_S	0.394	0.105	0.205	0.729	1.201	1.58	-3.446***	-5.235***
RMB internationalization indicators	SGP	0.282	0.258	0.000	1.000	1.552	1.264	-13.833***	-9.631***
	RGI	0.288	0.301	0.000	1.000	1.236	0.14	-3.597*	-2.168*

Note: Asterisks indicate statistical signiffcance at the 1% (***), 5% (**) or 10% (*) levels, respectively.

The indicator system uses monthly data from January 2015 to June 2025. Table 2 reports descriptive statistics for the three groups of financial-opening indicators and the standardized RMB-internationalization indicators; after first-differencing, all variables are stationary.

4. Analysis of two-way interactions

This is based on the previously cited researcher Nakajima, where the Markov Chain Monte Carlo (MCMC) algorithm is used to sample with 10,000 iterations [37]. The resultant model gives the time varying impulse response and response lag structure of the core observed variables. The shocks effects which are our primary concern are the shocks between the financial opening indicators and the RMB internationalization indicators.

4.1 Impulse response analysis: Financial opening indicators and SGP

Figure 3 shows the impulse response of SGP to financial-opening indicators, exhibiting strong time-dependence and term-structure variation. Overall, financial openness boosts RMB market share, and a higher RMB payment share in turn prompts further openness, producing a virtuous cycle between the two. The capital-flow dimension (CF_S) shows the strongest SGP response in the short term (4 periods), climbing from 2015 to a 2022 peak near 0.5—well above the medium-term (8 periods, peak 0.351) and long-term (12 periods, peak 0.121) values—indicating that capital-flow liberalization exerts the quickest, most powerful push to RMB internationalization. The financial-market-participation dimension (FM_S) also produces its largest short- and medium-term impacts (both 0.142) but fades to near zero thereafter, revealing that foreign holdings of onshore financial assets boost the RMB only temporarily. By contrast, the exchange rate and foreign exchange market dimension (EX_S) displays a distinct term structure: its medium- and long-term responses (peaks of 0.251 and 0.242) markedly exceed the flat short-term reading (0.041–0.053), confirming pronounced lag and cumulative effects.

As illustrated in Figure 4, which depicts the impulse response of SGP to financial opening indicators , the impact of SGP on CF_S exhibits the strongest long-term response (peak 0.175), well above the medium-term and short-term responses. This indicates that the promotion of capital flow liberalization through RMB internationalization possesses a pronounced long-term cumulative effect, revealing a durable feedback loop: RMB internationalization → higher capital flows → deeper financial opening. Its impact on FM_S peaks at 0.085 in the medium term, indicating that stronger overseas confidence in RMB assets encourages foreign holdings of onshore financial instruments over that horizon. The impact on EX_S is more complex: the response is most volatile, with an overall peak of 0.095; the short-term path stays positive and stable (0.022–0.065), while the medium-term reading frequently turns negative, underscoring the nonlinear, time-varying way RMB internationalization influences exchange-rate and FX-market openness.

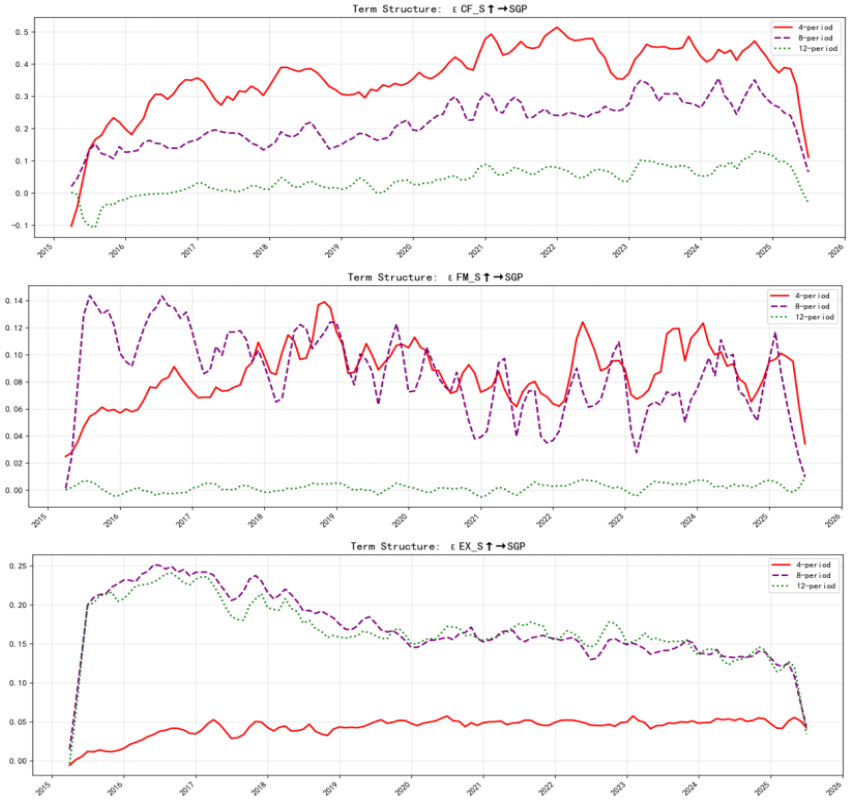

Fig. 3. The Impulse Response of SGP to Financial Opening Indicators

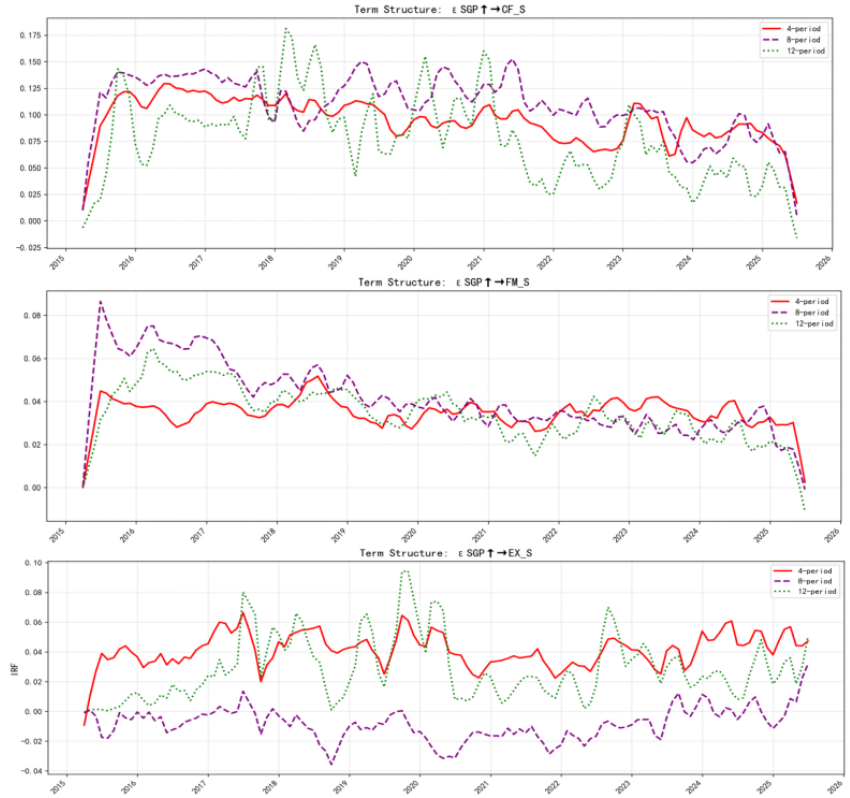

Fig. 4. The Impulse Response of Financial Opening Indicators to SGP

This two-way relationship reflects the dynamic adaptation of expanding international monetary functions to the supply capacity of the domestic financial system. On the one hand, currency internationalization requires the RMB to serve as a medium of exchange, a unit of account and store of value, all of which presuppose deep, liquid and open domestic markets; the persistent positive response of RMB internationalization to financial opening shows that overseas investors' demand is forcing an upgrade of market infrastructure—internationalization driving reform. On the other hand, deeper financial opening supplies the institutions and the market depth needed for RMB internationalization, creating the transmission chain of "institutional supply → market demand → currency internationalization". The time-varying response intensities reveal a shifting balance between opening and stability: muted early-stage reactions reflect policy compartmentalization when opening is narrow, while stronger late-stage reactions mirror the multiplying complexity of transmission channels once opening widens. Growing domestic and international financial interconnections amplify policy-shock transmission and raise sensitivity, indicating that reforms are gaining traction. Although all impulse responses stay positive, their highly unstable magnitudes underscore that the interaction between financial opening and RMB internationalization is dynamic and intricate, with instability rooted in shifting policy settings, evolving market expectations, institutional integration and external shocks.

4.2 Impulse response analysis: financial opening indicators and RGI

Figure 5 shows the shock-response association among the financial opening indicators as well as Standard Chartered Renminbi Global Index (RGI). RGI also has a more moderate response to financial opening shocks than the SGP, and the response patterns exhibit distinct patterns due to differences in the underlying concepts of the indicators. On the effects of financial opening on RGI, CF_S shows a distinct term structure: the short-term response is positive yet flat, ranging from 0.003 to 0.008, indicating that capital-flow opening exerts only a small positive influence on RGI in the short run. Those of the medium- and long-term responses, however, are negative, ranging from -0.010 to -0.020 and -0.005 to -0.015 respectively. This implies a term structure variation of the effects of liberalization of capital flows on RGI, which is a short-term positive effect and medium-to-long-term negative effects. The effect of FM_S on the RGI has more time dependent characteristics: The responses to FM_S were negative in all the time horizons, the medium-term effect was the most negative with a mean value of -0.075 and as high as -0.101, which suggested that openness to participation in financial markets subjects the RGI to a negative shock in the short term. However, by 2025, responses across all maturities abruptly turned positive, with 4-period and 12-period responses responses reaching 0.025 and 0.050 respectively, indicating the emergence of long-term institutional dividends from financial market participation opening. The impact of EX_S on the RGI is predominantly positive but exhibits significant volatility. The peak values for the medium-term and long-term responses reach 0.091 and 0.116, respectively, indicating that the promotional effect of exchange rate and foreign exchange market liberalization on the RGI is more pronounced in the medium to long term. However, the impulse response abruptly turned negative (-0.041) by the end of 2025, suggesting a potential inflection point in the long term impact of exchange rate and foreign exchange market liberalization on the RGI.

As shown in Figure 6, the impulse response of SGP to CF_S is negative at every horizon. The short-term response is the least negative, fluctuating between -0.051 and -0.152. The medium-term response ranges from -0.251 to -0.753. The long-term impulse response is the most negative and exhibits the highest volatility, peaking at -1.755. It means that the rise of the RGI puts a considerable negative effect on the openness of capital flow, and this effect is the strongest in the long term. The

result carries a clear economic consequence: higher RGI can trigger capital-outflow pressures, as domestic firms seek overseas opportunities or policymakers tighten capital-account controls to curb foreign-exposure risks.

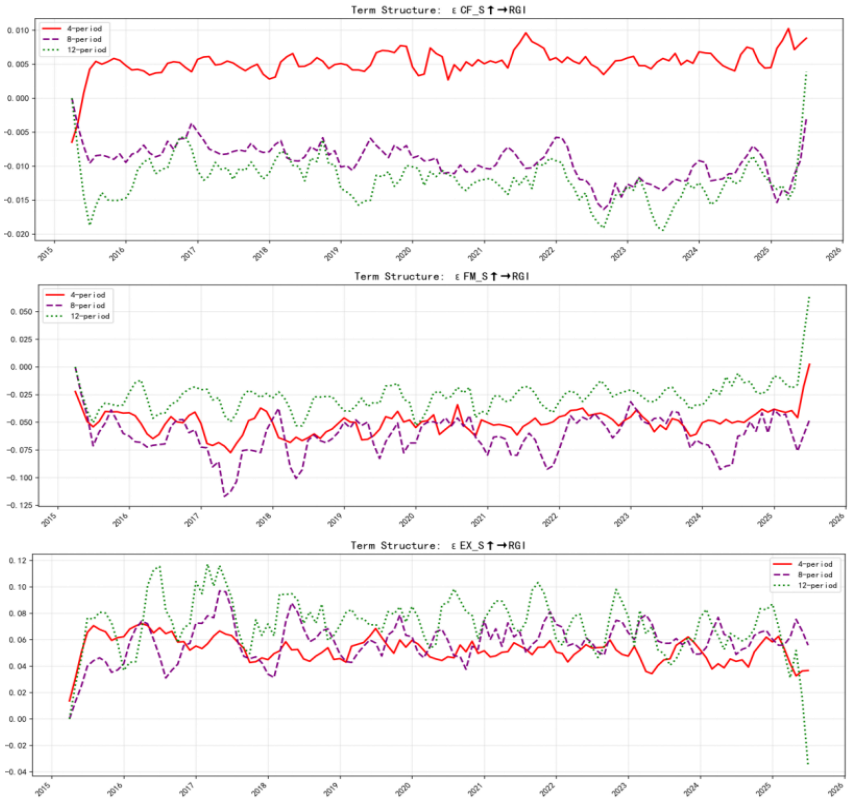

Fig. 5. The Impulse Response of RGI to Financial Opening Indicators

The result of this is a decrease in the capital flow openness, which represents a complicated trade-off between the internationalization of RMB and the liberalization of the capital account. RGI had significant effects on FM_S term structure,the short- and medium-term responses are mostly positive, the strongest response is in the medium term, peaking at 0.06. It means that a rise in RGI has the potential to encourage the inflow of foreign institutions and individuals to hold more domestic financial assets in both the short and medium term. The impulse response is weakest and mostly negative, implying that RGI has little or even adverse long-term influence on financial-market participation openness. The influence of RGI on EX_S shows a trend where the short-term effect is more negative, while the long-term effect is more positive, with maximum values of 0.06 and 0.09 respectively. This implies that the effect of improvement of RGI on the openness of exchange rate and foreign exchange market has a high lag effect.

The divergent responses of RGI and SGP to financial-opening shocks stem from their distinct transmission mechanisms and conceptual frameworks. SGP, measuring the RMB's share of global payments, captures a high-frequency flow and is immediately sensitive to market liquidity, transaction costs and exchange-rate swings; it directly mirrors actual currency use in cross-border trade and finance. As a direct competitor to the USD and EUR in the international-payments market, SGP responds fastest and strongest in the short run. Conversely, RGI—Standard Chartered's composite index of RMB internationalization—embeds deeper, slower-moving structures such as

financial development, regulation and institutional quality, so its reaction to opening shocks is more muted and delayed, blending short-term adjustment costs with long-term institutional dividends.

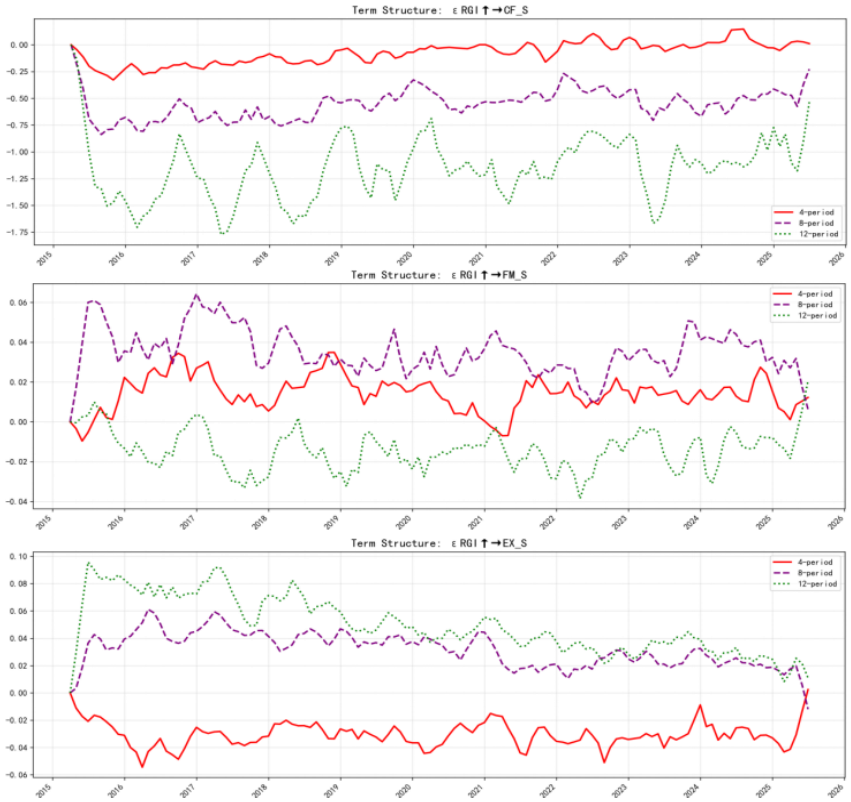

Fig. 6. The Impulse Response of Financial Opening Indicators to RGI

4.3 Robustness Check

Robustness checks are essential for verifying the reliability and stability of research conclusions under different model specifications and estimation methods. To further examine the robustness of the baseline results, this study employs a VAR model to re-estimate the dynamic impact of financial opening on both SGP and RGI across different time periods, thereby assessing whether substantive changes occur in the conclusions under alternative model settings. The results are presented in Figures 7 and 8. While the two figures reveal different patterns of dynamic responses, they collectively demonstrate that financial opening indicators and RMB internationalization indicators exhibit mutual promotion effects overall. Specifically, for RGI, the mutual positive impulse effects between RGI and financial opening indicators are more pronounced, with the overall trend indicating that the two group-by variables exhibit a relatively strong positive correlation in most periods, despite some negative relationships or fluctuations appearing in a few time intervals. A comprehensive analysis reveals that the dynamic response paths derived from the VAR model are highly consistent with the estimation results of the TVP-VAR-SV model in terms of both direction and evolutionary characteristics, indicating that the fundamental features of the impact of financial opening on SGP and RGI remain relatively stable across different time periods. Overall, these findings confirm the robustness of the conclusions derived from the TVP-VAR-SV model, further supporting the reliability of the baseline results.

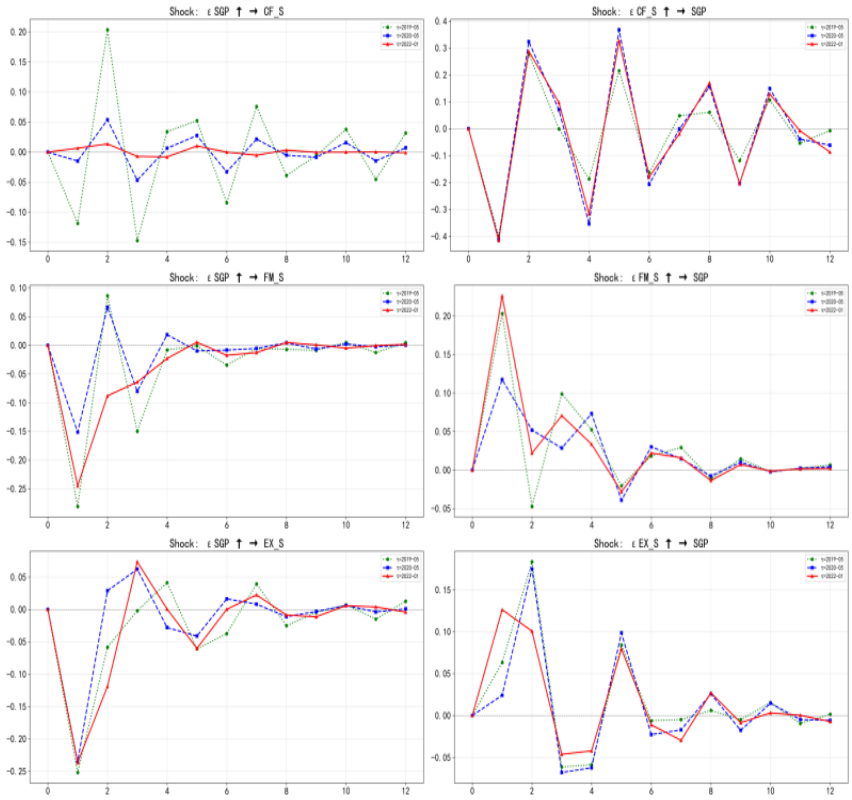

Fig. 7. VAR-Based Impulse Responses between Financial Opening Indicators and SGP

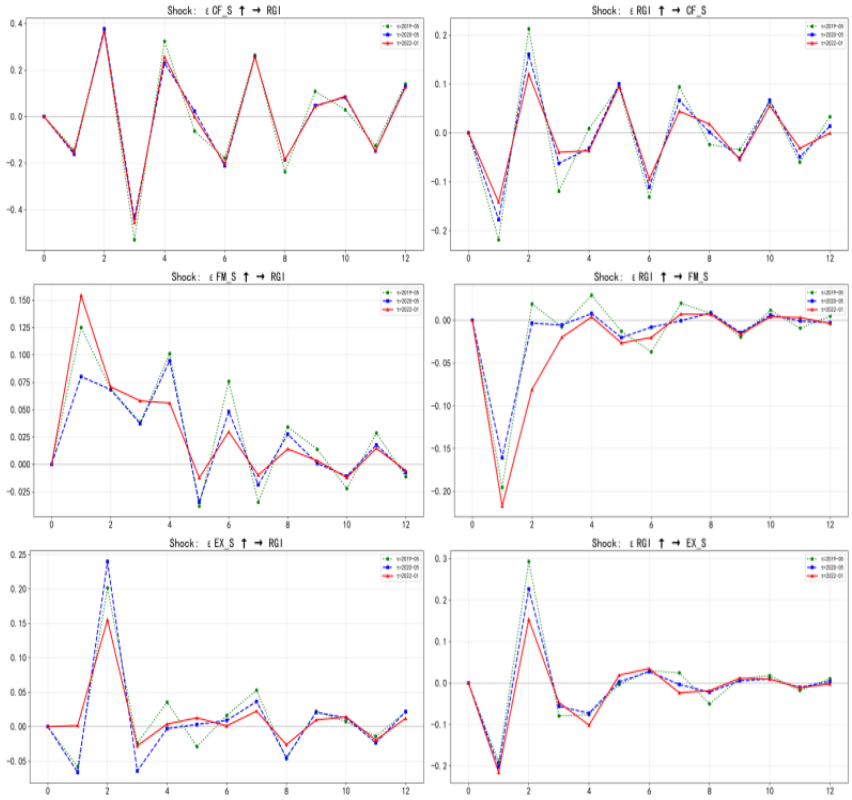

Fig. 8. VAR-Based Impulse Responses between Financial Opening Indicators and RGI

4.4 Structural Barriers to RMB Internationalization amid Financial Opening-up

As shown in the empirical evidence in Section 4.2, financial opening and RMB internationalization are mutually reinforcing, yet the volatility of the response magnitudes is evidence that this virtuous circle is limited by external institutional rigidities. This section systematically examines barriers to RMB internationalization by dividing them into four dimensions: structural, institutional, political and technical. We describe structural barriers as entrenched characteristics of the international monetary system which introduce path dependence and network externalities. We describe structural barriers as entrenched features of the international monetary system that create path dependence and network externalities. Political impediments include geopolitical tensions and power imbalances in global monetary governance. Technical barriers cover infrastructure constraints and standardization gaps that reduce transaction efficiency.

The structural barriers are in the form of the high inertia of the current international monetary system, which limits the functional growth of the RMB. The externalities in networks, i.e., the more users a currency has, the more useful it becomes, are a self-reinforcing process that is more likely to benefit incumbent currencies. An example is the SWIFT system, in which technological lock-in effects create network effects which increases switching costs to use other payment systems. On the institutional level, US dollar is the predominant global trade finance with about 85 percent of the transactions relying on the letter of credit system. In 2020, the RMB demonstrated that it is still susceptible to network externalities, to the extent that a global U.S.-dollar liquidity crunch triggered heavy safe-haven demand, which eroded the RMB share of global payments by 0.7 percentage points despite years of improvement. The power‑settlement‑financing closed loop is a more resistant structural barrier. The US dollar dominates over 90 percent of forward contracting in as much as less than 5 percent of commodities, such as oil and iron ore are denominated in RMB. This results in a self-referencing cycle in which the pricing power solidifies the financing power, and solidifies settlement power, actually entraps RMB internationalization in what we refer to as a low-level equilibrium trap. The three mutually reinforcing constraints that limit the RMB to higher functional levels constitute this trap: (1) limited pricing power: because commodity markets are still dollar-denominated, the RMB cannot become a preferred form of invoicing; (2) weak financing power: because the commodity markets are still dollar-denominated, the ability to develop RMB-denominated financial instruments is limited, and the RMB cannot become a well-liked form of storing value; and (3) insufficient settlement power: since the commodity markets are still dollar-denominated. To avoid this trap, breakthroughs in all three dimensions are necessary because progress in any of the three dimensions is not enough to break the network externalities of the incumbent system.

The obstruction created by institutions takes the form of organizational disintegration between offshore and onshore markets which dilute RMB internationalization synergies. The two-track interest rates and exchange rates system allows arbitrage, and an even deeper contradiction is regulatory asymmetry: the offshore market is governed by common law and managed by negative-lists, whereas the onshore market is governed by the approval-based system. Such an asymmetry creates drastic institutional contradictions in the treatment, disclosure requirements, and default disposal procedures of financial products across borders. Regulatory inconsistency is a major hindrance since it increases transaction costs and lacks confidence in the foreign investor. The lack of international monetary power in the institutions also limits upgrading of the statutory functions of RMB. In the IMF, there is a significant difference between the 6.4% voting rights that China has and the 2.69% of world reserves that the RMB represents. Such an institutional weight gap was also clear in the 2020 crisis response, as the utilization rates of RMB-denominated swap lines were below

5% relative to a 78% utilization of the US dollar facilities. This lack of soft power has compelled the internationalization of RMB to be based on bilateral agreements and has given the new development model of point breakthroughs instead of systematic restructuring.

Geopolitical tensions and power asymmetries in international monetary governance are the causes of political barriers. The current global financial system is a manifestation of the geopolitical system that came into place after the World War II, and the superiority of the US dollar was strengthened through security agreements and economic interdependencies. The emerging economic power of China has not been equally matched with the corresponding financial power, which leaves a gap between economic weight and institutional representation. This loophole limits the capacity of the RMB to be used as a reserve currency because, in almost every case, geopolitics prevails over economic influences when reserve allocation is made.

Technical barriers refer to the constraints of the infrastructure that limits efficiency and interoperability of transactions. Even though China has created the CIPS and has been involved in the Multiple Central Bank Digital Currency Bridge (mBridge) project, there are still issues in integration. The division of the home and international payment systems brings about such frictions that they lower the competitiveness of the RMB compared with other established networks. The cross-border transactions are also complicated by the problem of standardization, especially the format of messages and the process of settlement.

These limitations are caught up in a dynamic interrelationship in a system‑market‑power model in which the structural, institutional, political, and technical barriers are strengthened. This combination works as an emergent effect that magnifies the efficiency of personal limitations and creates a clearer direction for the breakthrough. As an example, a lack of financial market maturity and exchange rate flexibility undermine the effectiveness of the macroprudential instruments. The higher the capital outflow pressure, the shallower the market is able to self-adjust supply and demand by adjusting price, and thus regulating agencies have to intensify administrative intervention, and the more they will stifle the development of depth in the market. The other illustration is the reinforcement of network externalities, path dependence, and coordination of policy friction. SWIFT's technological hegemony concentrates the pricing power of the dollar, and the decentralization of the offshore and onshore markets weakens the competitiveness of the RMB, which creates a self-referential cycle of the center‑periphery system.

The three-pronged strategy recommended to overcome the low-level equilibrium trap to facilitate RMB internationalization is (1) technical standard breakthrough, such as the enhanced integration of CIPS and mBridge and the establishment of RMB-denominated trade chains in the RCEP framework; (2) reorganization of the regional network, which involves the development of alternative payment networks, thereby decreasing reliance on existing infrastructure; and (3) institutional effect, which involves intensifying the awareness and execution of RMB-related systems within the IMF governance framework. Financial opening should be complemented by further domestic reforms, such as more flexibility in exchange rates and more effective exploitation of macroprudential tools. A set of solutions is required to make the market more resilient: enhancing the liquidity of bond markets with incentives of the tiered market-maker, developing a more adaptive mechanism of central parity with a wider range of fluctuations, and deploying AI-based systems to track cross-border capital flows. The best synergy in regard to financial opening and RMB internationalization is possible only with the help of institutional innovation that disrupts the low-level equilibrium of constraints.

5. Conclusions and Policy Implications

This study employs a TVP-VAR-SV model to examine the dynamic relationship between financial opening and RMB internationalization. Our analysis reveals a complex, bidirectional relationship characterized by time-varying responses and term structure differences, rather than a straightforward linear association. The empirical evidence demonstrates that financial opening and RMB internationalization reinforce each other through a dynamic feedback mechanism involving institutional supply, market demand, and network effects. However, the unstable response magnitudes indicate that this virtuous cycle remains constrained by external institutional rigidities. This study makes several distinctive contributions to the literature on currency internationalization and financial opening. Using a time-varying parameter framework, we provide a comprehensive empirical analysis of the bidirectional relationship between financial opening and RMB internationalization, revealing nuanced term structure differences that previous studies have overlooked. As we have shown, the relationship is heterogeneous in terms of various dimensions of financial opening (capital flows, financial market participation and exchange rate regimes) and various metrics of internationalization (market share and comprehensive indices). We analytically classify the obstacles to RMB internationalization under four different dimensions including structural, institutional, political and technical, which provides a theoretical understanding that explains why gradual advances in currency internationalization may not be enough to break network externalities of the existing system. We have found that the uneven nature of the process of RMB reserve accumulation, with emerging-market central banks contributing 73% of the growth, indicates deep changes in the center‐periphery framework of the global monetary system.

Although two-way synergy between financial opening and RMB internationalization has motivated the emergence of numerous institutional dividends, numerous structural constraints typify the process of deepening. Instead of introducing a timeline, we suggest an integrated strategy that tackles a number of barriers at the same time, as they are all interdependent. The pricing power‐financing power‐settlement power closed loop can be rectified by removing structural barriers and focusing on all three dimensions simultaneously; the establishment of RMB-based trade chains within the Regional Comprehensive Economic Partnership (RCEP) framework facilitates the settlement of commodity trade using the RMB. By enhancing the integration of CIPS and mBridge to form alternative payment networks that minimize reliance on SWIFT infrastructure, we achieve a better fit with settlement power. Financing power is tackled through the creation of RMB-based financial products, such as interest rate options and inflation-based bonds, increasing the amount of assets that can be invested. All these measures attempt to counter network externalities and path dependence in support of incumbent currencies. The institutional fragmentation between offshore and onshore markets needs to be harmonized through institutional coordination in order to deal with institutional impediments. Moving toward using International Financial Reporting Standards (IFRS) and conforming to international credit rating practices directly addresses the information asymmetry that erodes investor confidence among international investors. The settlement security issue is handled by implementing a Central Counterparty (CCP) clearing system for bond transactions. The liquidity scale paradox is solved by creating a tiered market maker system in the bond market where liquidity requirements and compensations are in place to motivate depth of the market. These institutional changes decrease transaction costs and regulatory friction which hinder cross-border financial integration. This gap in governance between the economic weight and the institutional representation in China means that there is a need to strategically engage international monetary governance in an effort to deal with the political barriers of the country. The RMB-related systems

gaining momentum in the IMF governance structures will fill the soft power gap. The creation of regional safe assets by means of the BRICS New Development Bank (NDB) and the Chiang Mai Initiative Multilateralization (CMIM) offers alternatives to dollar-based infrastructure by changing the geo-economic collaboration into the monetary network effect. These actions mitigate geopolitical restraints that arise from institutional counterbalance to the status quo of power. Technical barriers are caused by the need for infrastructure enhancement within the country and the global inclusion. The interoperability problems are resolved through the continuous development of CIPS, and the connection with ISO20022 message standards. The emergence of distributed ledger technology in tracking the processes of quota approvals in the QFII also addresses the issue of transparency and efficiency. These technical advances minimize transaction costs in terms of frictions that inhibit transaction efficiency and restrict the competitiveness of the RMB with respect to established networks. In our analysis, we find the relationship between financial opening and RMB internationalization operates through a system-market-power framework, with constraints interacting in dynamism and establishing power between them. This realization implies that policy interventions have to be harmonized on several levels as opposed to being carried out in solitude. The secret to successful synergy is having an active balance between progressive reforms and risk management. This necessitates a multidimensional coordination mechanism, which brings together institutional optimization, market stability, network restructuring in the region, and global governance synergy.

The liquidity scale paradox demands severe structural reforms of the domestic financial market. A tiered market-maker in the bond market with integrated liquidity requirements and compensation provisions, promotes market depth. Risk-hedging capacity is increased by the proliferation of derivatives markets such as interest rate options and inflation-linked bonds. Long-term capital is attracted by the extension of connectivity facilities to technology and innovation firms such as cross-border Depositary Receipts (DRs) pilot programs. All these are aimed at dealing with the asymmetry between institutional supply and market demand growth. The macroprudential framework needs to shift towards dynamic adjustment that is forward-looking in contrast to the current status of managing macroprudential thresholds without altering the course. This transition is made possible through the development of an intelligent system to monitor cross-border capital flows, as well as a linkage system linking the market pressure indices and the instrument response matrices. This work has a number of limitations that can guide further research studies. The introduction of a double-liquidity risk cushion is resilient to abnormal capital flows due to distorted price signals. Although the TVP-VAR-SV model can capture time-dependent relationships, it might not capture regime shifts or structural breaks. Instead of continuous variation in policy environments, future research may use regime-switching models to capture discrete variation in policy environments. The four-dimensional classification of barriers, as exhaustive as it is, might not be sufficient to grasp all the details of the limitations RMB internationalization is experiencing. Further studies could systematically investigate the relative significance of various obstacles and their effects on each other. The emphasis on the experience of China, although quite informative, may limit the generalization to other emerging economies. Comparative research in various countries would help us better understand the overall principles of internationalization of currency. The process of internationalizing RMB is complicated and should be coordinated in several dimensions. We find that financial opening and RMB internationalization can be mutually reinforcing but this virtuous circle is limited by structural, institutional, political, and technical impediments. The low level equilibrium trap can only be broken if breakthroughs are made on the dimensions of pricing power, financing power, and settlement power simultaneously. The above policy recommendations will offer guidelines for dealing with these

barriers, but they will be fruitless unless they are implemented carefully, monitored and adjusted to new realities in the market and the international dynamics. The way forward must be to maintain a dynamic balance between opening and stability, between coming to grips with the world and being actively engaged with it, between gradual development and systemic change.

Author Contributions

Conceptualization, K.Z. and W.L.; investigation, Z.Z.; data curation, X.G.; writing—original draft preparation, K.Z.; writing—review and editing, K.Z. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

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Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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