Routledge
Taylor & Francis Group

Economic Research-Ekonomska Istraživanja

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rero20

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To cite this article: Qianqian Guo & Zhifang Su (2023) Capital account liberalisation and systemic financial risk: evidence from 24 countries, Economic Research-Ekonomska Istraživanja, 36:1, 845-863, DOI: 10.1080/1331677X.2022.2080741

To link to this article: https://doi.org/10.1080/1331677X.2022.2080741

Published online: 31 May 2022.

ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA
2023, VOL. 36, NO. 1, 845–863
https://doi.org/10.1080/1331677X.2022.2080741

Capital account liberalisation and systemic financial risk: evidence from 24 countries

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ABSTRACT

Capital account liberalisation can give rise to uncertainty in capital flows, which may lead to an accumulation of financial risks. This study measures the systemic financial risk indices using the coefficient of variation method with data of 24 countries from 2003 to 2019 and the impact of capital account liberalisation on systemic financial risks using the panel threshold model. Evidence shows that systemic financial risk indices vary heterogeneously across countries. The systemic financial risk indices of high-income countries are lower than those of middle- and low-income countries. Second, capital account liberalisation has an asymmetric effect on systemic financial risk with a double threshold. Low-intensity and high-intensity capital account liberalisation increases systemic financial risk. However, medium-intensity capital account liberalisation is effective in reducing systemic financial risk. Third, the heterogeneity results suggest that capital account liberalisation is conducive to reducing the financial risk of high- and middle-income countries and has the opposite effect on low-income countries. Therefore, this study recommends that countries adjust the intensity of capital account liberalisation according to their national conditions. It is necessary to establish a regulatory system for cross-border capital flows and maximise the benefits of liberalisation while safeguarding financial market stability.

ARTICLE HISTORY
Received 6 January 2022
Accepted 16 May 2022

KEYWORDS
Capital account liberalisation; systemic financial risk; asymmetric effect; threshold model

JEL CODES
F32; G01; G15

1. Introduction

Countries have increased their openness with the development and deepening of economic globalisation and trade liberalisation (Korinek, 2018; Zheng et al., 2021). Capital account liberalisation improves countries' financial levels. Under the condition of liberalisation, the 'alignment effect' among different countries will bring about improvement in system quality, promoting the process of capital account liberalisation. The historical experience of developed countries shows that capital account liberalisation is the way to prosperity, and it is an important element in a country's governance level (Van Cauwenberge et al., 2019). However, capital account

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liberalisation is a two-way flow between countries. The improvement in international capital mobility will inevitably impact the national financial system of a country, causing internal and external instability, which threatens its financial security (Furceri & Mourougane, 2012; Zheng et al., 2021). However, under global economic integration, a level of capital account liberalisation that matches the process of financial liberalisation is an inevitable requirement for economic development (Morelli & Vioto, 2020; Peng & Yu, 2019; Song & Li, 2021).

Since entering the new economic normal, the international economic situation has become increasingly complex and countries are facing huge challenges to their financial security (Dastkhan, 2021). The modern financial industry has a powerful function of resource allocation (Mukherjee et al., 2021). The risks in the financial industry itself are transmitted to various industries through the capital chain, which threatens the overall security of countries (Morelli & Vioto, 2020; Mukherjee et al., 2021; Van Cauwenberge et al., 2019; Zhou et al., 2021). In this context, it is of great practical significance to study the following issues: What is the impact of capital account liberalisation on systemic risks? How can these problems be addressed to maintain a country's financial security and stability?

Based on previous studies, this paper broadens the research scope of capital account liberalisation and provides a theoretical basis as well as policy recommendations for countries to make better use of international capital and ensure financial security in the process of financial liberalisation. This study constructs systemic financial risk indicators for financial markets across countries from 2003 to 2019 to examine the impact of the degree of capital account liberalisation on systemic financial risks.

First, in terms of theoretical implications, many scholars argue that capital account liberalisation has positive or negative effects on systemic financial risks (Umutlu et al., 2020; Liu et al., 2021; Zheng et al., 2021). Thus, most of the current literature is not uniformly conclusive regarding the impact of capital account liberalisation on systemic financial risks. This study tests the relationship between the two using a nonlinear model and finds that capital account liberalisation produces a 'double-edged sword effect' on systemic financial risks.

Second, in contrast to previous studies, most have examined the impact of capital flows in a country on the financial market (Umutlu et al., 2020; Van Cauwenberge et al., 2019; Kösedağlı & Önder, 2021). However, few studies have examined the impact of capital account liberalisation on systemic risk in countries with different levels of economic development from the perspective of income differentiation. To study the heterogeneity of capital account liberalisation on systemic risk among different income countries, 24 countries were classified into high-income, middle-income, and lower-income countries based on their income disparity. We also classify capital account liberalisation into low-, medium-, and high-intensity zones, providing an empirical reference for countries with different incomes to adjust the degree of capital account liberalisation.

Finally, in terms of methodological contributions, the financial stress indices constructed in previous literatures do not reflect the extent to which the macroeconomic system monitors the financial markets and does not provide a complete picture of its

performance. Therefore, this study uses the coefficient of variation method to construct a systemic risk evaluation index (Monin, 2019; Ozcelebi, 2020; Song & Li, 2021). Systematic financial risks are divided into macroeconomic security operations, monetary security, financial operation security, financial institution security, and stock market security subsystems to measure the systemic financial risk of each country, which can comprehensively reflect the contribution of each subsystem to financial risks. What's more, this paper uses a threshold model to measure the threshold values of capital account liberalisation. And it classifies capital account liberalisation into the low-intensity zone, the medium-intensity zone and the high-intensity zone.

The remainder of this paper is organised as follows. Section 2 provides a literature review and hypotheses. Section 3 introduces the study's data and methodology. Section 4 presents the results of the empirical study. Section 5 concludes the paper and discusses possible policy implications.

2. Theoretical analysis and literature review

2.1. Literature review

At present, research on capital account liberalisation and systemic financial risk focuses on the following aspects. First, the connotation of systemic financial risk is determined by the nature of finance that is the circulation of value, which is mainly reflected in the ability of countries to cope with external shocks (Kuek et al., 2020; Liu et al., 2021; Song & Li, 2021; Zheng et al., 2021). The measurement standards of systemic financial risk include the operation of financial institutions, maintenance of social and financial order, and national political security (Jackson & Pernoud, 2021; Kou et al., 2019). Many new risk characteristics and behavioural manifestations have emerged in the sphere of finance, and the relationship between risks is intricate (Zeb & Rashid, 2019). Therefore, the concept of financial risk can be defined from the perspective of financial security characteristics, with reference to a government's negative list model (Wang & Li, 2021). Thus, it can be seen that scholars have not yet reached a consensus on the concept of the financial risk index. After reviewing the relevant literature, this study defines the systemic financial risk index as follows: The financial risk index refers to the state of financial market operation when economic agents are affected by external environmental factors. It is an early warning indicator that can predict financial crises and provide dynamic regulation of financial markets.

Secondly, scholars have constructed financial risk indicators from the dimensions of micro financial institutions, financial markets, and macroeconomic operations (Kuek et al., 2020; Ozcelebi, 2020; Kösedağlı & Önder, 2021). The financial risk early warning monitoring system can be divided into subsystems, such as macroeconomic, banking, stock market, insurance, debt, and monetary security (Ishrakieh et al., 2020; Nguyen & Su, 2021; Umutlu et al., 2020). In terms of systemic financial risk measurement methods, there are currently neural network methods, principal component analysis methods, machine learning methods, mixed-frequency hierarchical dynamic factor models, and linear weighted comprehensive evaluation models. (Dastkhan, 2021; Jemović & Marinković, 2021; Kuek et al., 2020). However, current measurement methods in the literature mainly focus on financial security monitoring. Few factors

can reflect systemic financial risk, which results in an imperfect systemic financial risk indicator system. More so, few studies have examined the factors and mechanisms of the impact of capital account liberalisation on systemic risk.

Regarding studies on the relationship between capital account liberalisation and systemic financial risks, some scholars believe that capital account flows are conducive to the stable operation of the financial systems of countries (Erten et al., 2021; Lai et al., 2020; Liu et al., 2021; Mukherjee et al., 2021). Scholars have found that capital account liberalisation is not the culprit of financial crisis, but the negative signals sent by capital controls to financial markets that have led to market 'panic' (Glick et al., 2006). The 'panic' caused the financial crisis. This 'panic' essentially stems from countries' fundamental economic weaknesses, such as low institutional quality, low openness, low level of financial development, and insufficient international liquidity (Glick et al., 2006; Lai et al., 2020). Studies have shown that capital account liberalisation can trigger capital inflows, which have a positive impact on financial depth and competition (Bush, 2019). The liberalisation of government intervention in banks and other financial institutions has a positive impact on the stability of the financial sector (Mukherjee et al., 2021; Umutlu et al., 2020). At the same time, trade liberalisation plays a role in improving the efficiency of the financial sector. Therefore, capital account liberalisation does not destabilise the financial sector and facilitates the development of financial markets (Furceri & Mourougane, 2012; Peng & Yu, 2019).

However, some scholars argue that the increased liquidity of capital account liberalisation promotes capital flight. This, in turn, has a negative impact on the safety of financial institutions, capital market safety, macroeconomic safety, and external financial safety, leading to an increase in systemic financial risk (Ali & Iness, 2020; Chen et al., 2020; Furceri & Loungani, 2018; Zheng et al., 2021). The reason is that capital account liberalisation may increase abnormal international capital flows, capital flight, capital surge, capital stop and capital withdrawal (Chen et al., 2020; Hamdaoui et al., 2022). International capital flows can generate systemic risks and destabilise financial institutions and markets. This affects the transmission effect of macro-regulations and negatively impacts national financial security (Chen et al., 2020; Hamdaoui et al., 2022).

A review of the literature reveals the following shortcomings of existing studies. First, current measurement indicators for the level of capital account liberalisation are not perfect. Second, there is no definite conclusion on whether capital account liberalisation amplifies systemic risk in studies. Moreover, research on the heterogeneity of systemic financial risk in countries with different income levels is lacking. Third, the available studies do not discuss the impact of capital account liberalisation in different intensity bands in a disaggregated manner.

2.2. Theoretical analysis

Theoretical studies have argued at the macro and micro levels that capital account liberalisation can reduce systemic financial risks (Chen et al., 2020; Li & Liang, 2021; Zheng et al., 2021; Zheng et al., 2021). First, according to the financial integration theory (De Nicolò & Juvenal, 2014; Hoffmann et al., 2020), capital account

liberalisation provides investors with diversified investment and financing options, which is conducive to reducing investment costs and improving the efficiency of capital use. Simultaneously, capital account liberalisation broadens investment and financing channels for high-risk projects, which is helpful in diversifying investment risks.

Second, according to 'competition-stability theory' (Boyd & De Nicoló, 2005), capital account liberalisation promotes healthy competition among financial institutions. Increased competition among financial institutions encourages lower lending rates, eliminating inefficient financial institutions, and alleviating information asymmetry, thus promoting the continuous deepening of the financial market and ensuring the stable operation of the financial system.

Third, based on corporate governance theory (La Porta et al., 1998), capital account liberalisation can reduce the cost of capital for enterprises, alleviate their financing difficulties, expand their financing levels, and improve their capital allocation efficiency. This improves corporate governance, safeguards the efficient use of financial capital, and contributes to the positive development of the financial system.

At the micro level, capital account liberalisation brings more capital to financial institutions and firms, which promotes healthy competition among institutions. This encourages financial institutions and firms to reform their financial systems. The stability of the financial system is maintained by strengthening regulatory capacity and improving the quality of regulations. At the macro level, capital account liberalisation promotes the flow of capital from surplus countries to deficit countries through diversified investment and financing channels, which achieves the optimal use of financial resources. The inflow of international capital can alleviate the imbalance between domestic capital supply and demand, improving the quantity and quality of investments, and weakens exchange rate fluctuations. In addition, the advanced technology and management experience of developed countries will be transmitted to backward countries through the free flow of capital, assisting these countries in carrying out financial reforms. Therefore, capital account liberalisation can increase the level of capital reserves in a country's financial system and improve its ability to withstand shocks and absorb risks. Based on this analysis, we propose the following hypothesis.

> Hypothesis I: Capital account liberalisation is conducive to reducing systemic financial risks for countries.

Furthermore, studies show that capital account liberalisation has a negative impact on systemic financial risks. First, based on three-generation currency crisis theory (Corsetti et al., 1999), excessive capital account opening leads to a currency crisis. On the one hand, when there is a large inflow of cross-border capital into a country, financial markets significantly increase the demand for local currency, which increases pressure on the foreign exchange market for appreciation. On the other hand, a massive inflow of capital increases the prices of domestic financial assets and consumer goods. The level of domestic inflation also increases, making the country vulnerable to the risk of asset price bubbles.

Second, according to the 'competition-fragility theory' (Jiménez et al., 2013), capital account liberalisation has created competition among financial institutions.

Table 1. Variable description.

Variable name	Variable symbol	Variable definition
Systemic financial risk index	FR	Measured by the coefficient of variation method
Capital account liberalisation	open	KAOPEN Index
Global governance index	lnWGI	Gross national product per capita
Gross capital formation/GDP	lncap	total capital formation/GDP
Human capital	lnhum	Human capital development index
National income per capita	lngi	GNI/Total population
Level of urbanisation development	lnr	Urban population/total population
R&D expenditure costs	lnR&D	R&D expenditure/GDP
International crime rate	lnmou	International murder crime rate
Unemployment rate	lnlab	Unemployed population/total population

Source: Author's own elaboration.

Competition among financial institutions can weaken market power, reduce profitability, and induce institutions into risky investments. As a result, it reduces the stability of financial institutions and increases the probability of a country experiencing a financial crisis.

Third, capital account liberalisation leads to a large inflow or outflow of capital in the financial market in the short term, which aggravates the volatility of the securities market. Under the 'herding effect', when international investors detect positive information, they swarm the financial markets of these countries. When there is a pessimistic message in the financial markets, funds are withdrawn in the short term, leading to a simultaneous collapse in these countries. The high volatility of stock markets increases systemic financial risk which could lead to a global financial crisis.

Capital account liberalisation has an uncertain impact on capital flow (Bacchetta, 1992). On the one hand, when there is a higher intensity of capital account liberalisation, the profit-seeking nature of capital can lead to large inflows of international 'hot money' in the short run. Investment frenzy in capital-inflowing countries will probably increase asset price volatility and affect the money supply. Ultimately, this affects the level of inflation. On the other hand, if the intensity of capital account liberalisation is not controlled, it may induce capital flow risks. Whether it is the formation of a market bubble due to capital inflows or a 'panic flight' of capital due to pessimistic market expectations, it could lead to turmoil in financial markets. Therefore, excessive capital inflows and panic capital flights affect the stability of domestic financial systems. This could distort a country's economic and financial structure, and even lead to financial crises. Based on this analysis, we propose the following hypothesis.

Hypothesis II: Inappropriate capital account liberalisation will increase systemic financial risks for countries.

3. Data and methods

3.1. Sample and data description

3.1.1. Sample selection

This study selected data from 24 countries from 2003 to 2019. The research data are obtained from the World Bank, China Economic and Social Database, EPS data platform, and the Chinn-Ito Index (KAOPEN) data website.

3.1.2. Variable description

As shown in Table 1, the explained variable is the systemic financial risk index used to measure the level of systemic financial risk. The core explanatory variable in this study is the degree of capital account liberalisation of the KAOPEN index[1], which can reflect the degree of capital account openness of a country. Various factors affecting systemic financial risk have been proposed in the literature (Jemović & Marinković, 2021; Li & Liang, 2021). Therefore, the following factors were selected as control variables: the global governance index, proportion of total capital formation in GDP, human capital, national income per capita, urban population as a share of total population, R&D expenditure costs, international crime rate, and unemployment rate.

3.2. Model setting

According to the previous analyses, capital account liberalisation has a positive effect on maintaining the functioning of a country's financial system (Erten et al., 2021; Lai et al., 2020; Liu et al., 2021; Mukherjee et al., 2021). However, due to the two-way flow of international capital, potential risks impact a country's financial system. Factors such as capital flight and financial crime also weaken capital accumulation, which makes a country vulnerable to financial crises (Ali & Iness, 2020; Chen et al., 2020; Furceri & Loungani, 2018; Zheng et al., 2021). Thus, the impact of capital liberalisation on systemic financial risks varies across countries with different levels of economic development. This implies a possible double-edged sword effect between systemic financial risk and capital account liberalisation.

Therefore, this study was conducted as follows: First, the coefficient of variation method is used to measure the systemic financial risk indices for countries. Second, a nonlinear relationship between capital account liberalisation and systemic financial risks is tested using a nonlinear model, drawing on the approach of Lv et al. (2021). Third, there may be thresholds for capital account liberalisation if there is a double-edged sword effect. The threshold values for capital account liberalisation were measured using the threshold model. Countries were classified into different intensity zones of capital account liberalisation based on threshold values and the effect of capital account liberalisation on systemic financial risk was tested.

First, we construct a nonlinear model that includes both primary and secondary provisions for capital account liberalisation. The formula is as follows:

$$\ln FR_{it} = \alpha_0 + \alpha_1 \ln open_{it} + \alpha_2 \ln open_{it}^2 + \alpha_n \times controls_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

The systemic financial risk index is the explained variable FR_{it}, and capital account liberalisation ($open_{it}$)is the core explanatory variable. The global governance index, gross capital formation, degree of human capital, national income per capita, urbanised population, R&D, international crime rate, and unemployment rate were added as control variables ($controls_{it}$). i is the region, t is the year, α_i is the corresponding estimated coefficient value of the variable, μ_i is the individual effect of the region, and ε_{it} is the random effect.

Second, this study draws on Hansen (1999) to construct the following panel threshold model. The single-threshold model for capital account liberalisation is as follows:

$$\ln FR_{it} = \alpha_0 + \alpha_1 \ln open_{it} \times I(\ln open_{it} \le \gamma_1) + \alpha_2 \ln open_{it} \times I(\ln open_{it} > \gamma_1) + \alpha_n \times controls_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

Here, I is the indicative function; $open_{it}$ is the threshold variable; and γ_i is the threshold value.

A double threshold may exist for capital account liberalisation. Thus, the double threshold model for capital account liberalisation is as follows:

$$\ln FR_{it} = \alpha_0 + \alpha_1 \ln open_{it} \times I(\ln open_{it} \le \gamma_1) + \alpha_2 \ln open_{it} \times I(\gamma_1 < \ln open_{it} \le \gamma_2) + \alpha_3 \ln open_{it} \times I(\ln open_{it} > \gamma_2) + \alpha_n \times controls_{it} + \mu_i + \varepsilon_{it} \quad (3)$$

3.3. Construction of a systemic financial risk index

3.3.1. Indicator system of the systemic financial risk index

In Table 2, following Jemović and Marinković (2021), we constructed a composite index of systemic financial risks to measure the early warning of systemic financial risks in countries. The systemic financial risk index is divided into five dimensions, including 21 indicators.

3.3.2. Methodology for measuring systemic financial risk indices

First, we standardised each of the 21 indicators under the five dimensions as follows:

$$X_{jit}^{+} = \frac{x_{jit} - m_{jt}}{M_{jt} - m_{jt}}, j = 1, 2, \ldots, 21$$
$$X_{jit}^{-} = \frac{M_{jt} - x_{jit}}{M_{jt} - m_{jt}}, j = 1, 2, \ldots, 21 \quad (4)$$

where i, j, and t are countries, indicators, and years, respectively; $j = 1, 2, \ldots, 21$, $i = 1, 2, \ldots, 24$, and $t = 2003, \ldots, 2019$. x_{jit} denotes the value of indicator j in country i over year t; X_{jit}^{+} $\left(X_{jit}^{-}\right)$ denotes indicator j with a positive (negative) effect; M_{jt} and m_{jt} denote the maximum and minimum of indicator j across countries over year t. Then, we assign X_{jit}^{+} $\left(X_{jit}^{-}\right)$ to X_{jit}, for $j = 1, 2, \ldots, 21$.

Second, the coefficient of variation was used to calculate the weights of the indicators (Table 2). Specifically, the 21 indicators were weighted using the following scheme.

$$\omega_{jt} = V_{jt} / \sum_{j} V_{jt}, V_{jt} = \sigma_{jt} / \overline{X}_{jt} \quad (5)$$

where ω_{jt} is the weight of the indicator j in year t; $\overline{X}_{jt}$ and σ_{jt} are, respectively, the mean and standard deviation of indicator j over countries $(X_{jit},\ i = 1, 2, \ldots, 24)$, and V_{jt} represents the coefficient of variation of the indicator.

Third, the composite index of the 21 indicators measuring systemic financial risk in country i is calculated as:

Table 2. Construction of system of the systemic financial risk index.

Subsystem name	Indicator name	Indicator weights	Nature of indicator
Macroeconomic security operation subsystem (S1)	GDP growth rate (G1)	0.0658	Positive (+)
	Inflation rate (G2)	0.0773	Positive (+)
	Real interest rate (G3)	0.0947	Positive (+)
	Growth rate of fixed asset investment (G4)	0.0489	Positive (+)
Currency security subsystem (S2)	M2/GDP (G5)	0.0534	Positive (+)
	Foreign exchange reserves (G6)	0.0331	Positive (+)
	Exchange rate volatility (G7)	0.0258	Positive (+)
Financial operation subsystem (S3)	Government revenue (G8)	0.0620	Positive (+)
	Government expenditure (G9)	0.0635	Negative (-)
	Surplus or deficit in current prices/GDP (G10)	0.0458	Positive (+)
	Total government debt/GDP (G11)	0.0225	Positive (+)
	Net government borrowing/GDP (G12)	0.0502	Negative (-)
	Current account/GDP (G13)	0.0336	Positive (+)
Financial institution subsystem (S4)	Total domestic credit/GDP (G14)	0.0519	Positive (+)
	Bank capital to assets ratio (G15)	0.0455	Positive (+)
	Non-performing loan ratio (G16)	0.0360	Positive (+)
	Insurance and financial services (G17)	0.0322	Positive (+)
	Insurance and financial services (G18)	0.0423	Positive (+)
Stock market subsystem (S5)	Total stock transactions (G19)	0.0354	Positive (+)
	Total market capitalisation of listed companies (G20)	0.0335	Positive (+)
	Stock turnover rate (G21)	0.0466	Positive (+)

Source: World Bank, China Economic and Social Database, EPS data platform and author's calculations.

$$FR_{it} = 1 - \sqrt{\frac{\sum_j (1 - X_{jit})^2 \omega_{jt}^2}{\sum_j \omega_{jt}^2}} \tag{6}$$

The index ranged between 0 and 1. A higher FR_{it} implies a higher level of systemic financial risk in a country.

3.3.3. Measurement of the systemic financial risk level in each country

As shown in Table 3, the average systemic financial risk index in high-income countries is approximately 0.35, while the average financial risk index in middle-income and low-income countries is 0.41 and 0.47, respectively. In addition, the average systemic risk indices for high-income countries range from 0.22 to 0.58. The average systemic financial risk indices for middle-income and low-income countries are in the range of 0.25–0.74 and 0.30–0.65, respectively. This suggests that the systemic financial risk indices in high-income countries are generally lower than those in middle- and low-income countries. It is worth noting that among the high-income countries, Russia and Australia have significantly higher systemic financial risks than the others. Brazil and India have the highest systemic financial risk among middle- and low-income countries. In particular, Brazil was at high-risk, with a national financial risk index of around 0.74 in 2016. Additionally, the financial risk index across countries from 2014 to 2019 shows a decreasing trend. And the average financial risk index of countries in the world is roughly 0.38.

4. Analysis of empirical results

4.1. Descriptive statistics

The descriptive statistics of variables are shown in Table 4. The variable with the largest standard deviation is the international crime rate, with a standard deviation of

Table 3. Systemic financial risk index of countries from 2003 to 2019.

Countries		Systemic financial risk index Mean value	Maximum value	Minimum value
High-income countries	Australia	0.4034	0.5013	0.3002
	Canada	0.3571	0.4487	0.2778
	Germany	0.3267	0.4421	0.2797
	France	0.3185	0.3862	0.2375
	UK	0.3228	0.3840	0.2267
	Italy	0.3086	0.3649	0.2154
	Japan	0.3287	0.3993	0.2213
	Korea	0.3749	0.4616	0.2543
	Russia	0.4283	0.5756	0.3236
	Singapore	0.3496	0.4290	0.2775
	USA	0.3516	0.4091	0.2749
	Sweden	0.3123	0.3745	0.2629
	Belgium	0.3562	0.4420	0.2885
	Ireland	0.3909	0.5219	0.2906
	Netherlands	0.3093	0.3882	0.2322
Mean value		0.3493	0.5756	0.2154
Middle-income countries	Brazil	0.5796	0.7437	0.5180
	China	0.3725	0.4658	0.2895
	Greece	0.3619	0.4637	0.2497
	Chile	0.4343	0.6242	0.2857
	Croatia	0.3835	0.4730	0.3200
	Spain	0.3520	0.4237	0.2993
	Mean value	0.4139	0.7437	0.2497
Low-income countries	Mexico	0.4348	0.5537	0.2982
	Colombia	0.4554	0.5624	0.3539
	India	0.5292	0.6505	0.3760
Mean value		0.4731	0.6505	0.2982

Source: World Bank, China Economic and Social Database, EPS data platform and author's calculations.

9.142, indicating wide variation in crime rates between countries. The largest fluctuation is also in the international crime rate, with a mean of 5.147, a minimum value of 0.156, and a maximum value of 55.805. The second highest fluctuation is capital account liberalisation, with a mean value of 1.493, standard deviation of 1.120, minimum value of −1.219, and maximum value of 2.334. This shows a wide disparity in the level of capital account liberalisation between countries. The smallest fluctuation is in the financial risk index, with a mean of 0.381, standard deviation of 0.085, minimum value of 0.215, and maximum value of 0.744. The difference between the maximum and minimum value of capital account liberalisation is 3.553. This indicates a large difference in the level of capital account liberalisation among countries.

4.2. Regression results for the benchmark model

Table 5 presents the regression results of the benchmark model. In Column (1), we consider only the effect of a single variable, capital account liberalisation, on systemic financial risk. Without adding any control variables, the estimated coefficient of the primary term of capital account liberalisation is significantly positive at the 1% significance level and has a positive impact on systemic financial risk. However, the estimated coefficient of the quadratic term of capital account liberalisation is significantly negative at the 1% level; in contrast to the coefficient of the primary term. This shows a nonlinear relationship between capital account liberalisation and systemic financial risk. Various control variables, as well as various types of fixed effects, are added to

Table 4. Descriptive statistics of variables.

Variable	Mean value	Standard deviation	Minimum value	Maximum value
FR	0.381	0.085	0.215	0.744
lnopen	1.493	1.120	−1.219	2.334
lnWGI	0.825	0.774	−0.759	1.832
lncap	3.140	0.243	2.285	3.864
lnhum	1.121	0.161	0.602	1.424
lngi	4.555	0.088	4.214	4.836
lnr	4.320	0.243	3.352	4.605
lnR&D	0.315	0.726	−1.906	1.571
lnmou	5.147	9.142	0.156	55.805
lnlab	1.981	0.586	0.642	3.719

Source: World Bank, China Economic and Social Database, EPS data platform and author's calculations.

Columns (2)-(3). Column (2) does not control for fixed effects, and Column (3) shows the addition of all control variables and fixed effects. The estimated coefficient on the primary term of capital account liberalisation remains significantly positive. The coefficient of the secondary term remained negative. The absolute value of the coefficient gradually increases, suggesting that the nonlinear effect of capital account liberalisation on systemic financial risk gradually increases.

As shown in Table 5, the results for the control variables show that the coefficients of lncap, lnhum, lnr, lnlab, and lnmou are positive. This indicates that increases in total capital formation, human capital, urbanisation level, unemployment rate, and international crime rate lead to an increase in systemic financial risk. The coefficient of the global governance index is significantly negative, indicating that the global governance index decreases the systemic financial risk of countries. Therefore, strengthening institutions will avoid external risk shocks to countries' financial markets. The coefficient of the national income level is positive, indicating that countries with high income levels have higher levels of systemic financial risk, possibly because countries with higher income levels have active financial markets. Financial openness leads to more frequent and free capital flows, and illegal capital may flow into these countries through investment and financing channels, increasing systemic financial risk; R&D negatively affects systemic financial risk. Improvements in scientific and technological innovation will help countries identify and monitor illegal financial activities, which is instrumental in reducing systemic financial risks.

4.3. Robustness tests

This study used four methods to perform robustness tests. The results are presented in Table 6. Column (1) shows the results of the baseline regression. Following Kösedağlı and Önder (2021), Umutlu et al. (2020), and Mukherjee et al. (2021), we use FDI as the explanatory variable instead of capital account liberalisation in Column (2). The primary term coefficient of FDI is positive and the secondary term coefficient is negative. Thus, there is still a nonlinear effect between capital account liberalisation and systemic financial risk. Column (3) shortens the sample interval to 2012–2019 to reduce the impact of the 2008 financial crisis. The results showed that there were differences in the estimates. These results are consistent with the benchmark model results, indicating that the results are robust. In Column (4), we replace

Table 5. Results of the benchmark model regression.

Variables	(1)	(2)	(3)
Constant term	−7.5031***	1.0678***	−9.8959***
	(0.000)	(0.012)	(0.000)
lnopen	0.0069***	0.0121*	0.0135***
	(0.012)	(0.061)	(0.001)
lnopen2	−0.0017***	−0.0106*	−0.0114***
	(0.026)	(0.072)	(0.001)
lnWGI		−0.0318**	−0.2714*
		(0.049)	(0.056)
lncap		0.0425	1.1286***
		(0.827)	(0.000)
lnhum		1.6578***	2.1674***
		(0.000)	(0.000)
lngi		0.3452	0.3236*
		(0.216)	(0.057)
lnr		1.0452***	1.9371***
		(0.004)	(0.000)
lnR&D		−0.4582	−0.4634***
		(0.827)	(0.000)
lnmou		0.0658	0.1327**
		(0.124)	(0.035)
lnlab		0.4789	0.1619**
		(0.172)	(0.018)
Time fixed effects	NO	NO	YES
Regional fixed effects	NO	NO	YES
R^2	0.85	0.40	0.58
N	408	408	408

Note:
***indicates significance at the 1% level.
**indicates significant at 5% level of significance.
*Indicates significance at the 10% level. The p-values are shown in parentheses.
Source: World Bank, China Economic and Social Database, EPS data platform and author's calculations.

R&D with the level of intelligence (lninte) to reflect the role of information technology tools in financial risk management. However, the asymmetric effect of capital account liberalisation on systemic financial risk remains. The trend of the estimated results for all control variables is also generally consistent with that in Table 5, passing the robustness test. In Column (5), to exclude possible 'confounding bias' and 'selective bias' in the model, the propensity score matching (PSM) robustness analysis was conducted. The coefficients, signs, and significance levels of the primary and secondary terms of capital account liberalisation are generally consistent with those in Table 5. Thus, the results of this study are relatively robust.

4.4. Analysis of the threshold effect of Capital account liberalisation on systemic financial risk

4.4.1. Results of the threshold test

Table 7 presents the results of the threshold test. When single-and double threshold tests are conducted for the effect of capital account liberalisation on the level of systemic financial risk, the F-values are 29.75 and 24.74, respectively. The p-values are 0.010 and 0.033, respectively, which significantly rejects the original hypothesis. Therefore, there is at least a double threshold. However, the triple threshold test for the effect of capital account liberalisation on the level of systemic financial risk fails. Thus, the double threshold has an asymmetric effect on the level of systemic financial

Table 6. Robustness tests.

Variables	(1)	(2)	(3)	(4)	(5)
lnopen	0.0135*** (0.001)	–	0.0694** (0.013)	0.0172*** (0.001)	0.0128** (0.014)
$lnopen^2$	−0.0114*** (0.001)	–	0.0571* (0.062)	0.0139*** (0.001)	0.0105** (0.026)
lnFDI	–	0.0193*** (0.012)	–	–	–
$lnFDI^2$	–	−0.0146** (0.028)	–	–	–
Controls	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES
Regional fixed effects	YES	YES	YES	YES	YES
R2	0.68	0.52	0.45	0.68	0.87
N	408	408	192	408	290

Note:
***Significance at the 1% level.
**Significant at 5% level of significance.
*Significance at the 10% level. The p-values are shown in parentheses.
Source: World Bank, China Economic and Social Database, EPS data platform and author's calculations.

Table 7. Results of the threshold test.

				Threshold value			
Number of thresholds	F-value	P-value	BS sampling times	10%	5%	1%	Model
Single-threshold test	29.75**	0.010	300	22.8182	25.7787	29.1447	Double threshold
Double-threshold test	24.74**	0.033	300	20.5502	22.4339	28.3325	
Three-threshold test	15.96	0.853	300	45.6793	50.8248	56.0849	

Note: (1) P-values and threshold values are the results obtained by repeating the 'self-sampling method' with 300 repeated samples. (2).
***Significance at the 1% level.
**Significant at 5% level of significance.
*Significance at the 10% level.
Source: World Bank, China Economic and Social Database, EPS data platform and author's calculations.

risk from capital account liberalisation. In addition, according to the threshold model test, the first threshold for capital account liberalisation is −1.2185 with a confidence interval of [−10.0190, −9.3558], and the second threshold is 2.3336 with a confidence interval of [9.0588, 9.3010].

As shown in Table 8, based on these two thresholds, capital account liberalisation can be divided into low-intensity, medium-intensity, and high-intensity capital account liberalisation zones. Brazil, China, and India are in the low-intensity capital account liberalisation zone, indicating that the systematic financial early warning systems of the three countries are subject to the same effect as capital account liberalisation. The capital account is less open, which leads to partial capital flight due to the restriction of capital freedom and is not conducive to financial risk control. Seven countries, such as Australia, Mexico, and Colombia, are in the medium-intensity capital account liberalisation zone. Liberalisation of the capital account in this zone creates financial risks. Fourteen countries, such as Canada, Germany, and France, are in the high-intensity capital account liberalisation zone, which attracts a large amount of capital to foreign exchange, stock, and other financial markets due to the large degree

Table 8. Results of the zone classification of capital account liberalisation.

The core variable	Threshold band	Countries in this zone
Degree of capital account liberalisation	$lnopen \leq -1.2185$	Brazil, China, India
	$-1.2185 < lnopen \leq 2.3336$	Australia, Korea, Mexico, Russia, Chile, Colombia, Croatia
	$lnopen > 2.3336$	Canada, Germany, France, UK, Greece, Italy, Japan, Singapore, USA, Sweden, Belgium, Ireland, Netherlands, Spain

Source: World Bank, China Economic and Social Database, EPS data platform and author's calculations.

Table 9. Results of threshold model estimation.

Variable name	Coefficient value	Standard error	T-value	P-value
Constant term	−9.9127**	3.7346	−2.65	0.014
lnWGI	−0.0564*	0.1614	−3.35	0.073
lncap	0.8057***	0.1865	4.32	0.000
lnhum	1.5727***	0.3693	4.26	0.000
lngi	0.2703	0.1619	1.67	0.109
lnr	2.3285***	0.7177	3.24	0.004
lnR&D	−0.3207**	0.1392	−2.30	0.031
lnmou	0.1403**	0.1939	2.49	0.029
lnlab	0.0647	0.1156	0.56	0.581
$lnopen \leq -1.2185$	0.0328***	0.0102	3.21	0.004
$-1.2185 < lnopen \leq 2.3336$	−0.0121***	0.0033	−3.62	0.001
$lnopen > 2.3336$	0.0414***	0.0075	5.54	0.000
R^2	0.9782			

Note:
***Significance at the 1% level.
**Significant at 5% level of significance.
*Significance at the 10% level.
Source: World Bank, China Economic and Social Database, EPS data platform and author's calculations.

of capital account liberalisation. The quality of capital is uneven and liquidity is large, which reduces the degree of financial security of the country.

4.4.2. Results of the threshold regression

In the benchmark model, the degree of capital account liberalisation has a positive effect on systemic financial risk. However, in the threshold model, the introduction of the threshold variable makes the coefficient of the impact of capital account liberalisation heterogeneous across intensity zones. In Table 9, in the low-intensity zone of capital account liberalisation, the coefficient of the impact of capital account liberalisation on systemic risk is 0.0328, which has a significantly positive impact, indicating that capital account openness increases systemic financial risks. Most countries with low-intensity capital account liberalisation are low-income countries, where capital freedom and liquidity are strictly controlled, inhibiting the development of the financial markets. In addition, it is not conducive to building a financial security monitoring system. Further, the financial market systems in these countries are not well developed and are less attractive to foreign business capital. Therefore, there are financial insecurity factors, such as capital flights and inefficient allocation of financial resources, which may increase financial risks. These countries should increase the intensity of capital account liberalisation to attract an influx of new capital and enhance the level of infrastructure and national income to promote stable financial development. Therefore, this result validates hypothesis II.

Table 10. Heterogeneity analysis.

Variables	Full sample (1)	High-income countries (2)	Middle-income countries (3)	Low-income countries (4)
Constant term	−9.8959***	7.3674***	−23.1660***	7.6088**
	(0.000)	(0.012)	(0.000)	(0.017)
lnopen	0.0135*** (0.001)	0.0345***	0.0243**	0.0040**
		(0.000)	(0.013)	(0.014)
$lnopen^2$	−0.0114*** (0.001)	−0.267***	−0.0184**	0.0032**
		(0.000)	(0.017)	(0.026)
Controls	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES
Regional fixed effects	YES	YES	YES	YES
R2	0.58	0.40	0.42	0.81
N	408	255	102	51

Note:
***Significance at the 1% level.
**Significant at 5% level of significance.
*Significance at the 10% level. The p-values are shown in parentheses.
Source: World Bank, China Economic and Social Database, EPS data platform and author's calculations.

Table 9 shows that the impact coefficient is negative at −0.0121 in the zone of medium-intensity capital account liberalisation. This indicates that capital account liberalisation has a significant negative effect on systemic financial risk in the medium-intensity zone, which is beneficial to reducing systemic financial risks. Most countries with medium-intensity capital account liberalisation have good economic development; however, increasing the intensity of capital account liberalisation can attract foreign investment in these countries. International capital flows for arbitrage or investment and financing purposes, improves the resilience and risk resistance of the financial markets in these countries and can use inflowing capital to build a financial security monitoring system, using information technology as well as intelligent means to detect financial insecurity factors. Therefore, medium-intensity capital account liberalisation is conducive to reducing systemic financial risks and safeguarding the stability of financial markets. This result validates hypothesis I.

In Table 9, the coefficient of the effect of capital account liberalisation on systemic financial risk is 0.0414 in the zone of high-intensity capital account liberalisation, which is significant at the 1% level. This indicates that high-intensity capital account liberalisation increases systemic financial risk since capital liquidity is too high in countries with a highly open capital account, increasing frequent cross-border activities. Economic agents are vulnerable to external shocks. On the one hand, a large amount of illegal funds is transferred at home and abroad through money laundering, capital flight, and international investment and financing activities, distorting the normal financial market order. On the other hand, repeated turnover and laundering of illegal funds in different financial markets affect interest and exchange rates in these countries, leading to higher systemic financial risks. Therefore, capital accounts should not be too open. The government must intervene and regulate capital accounts. Therefore, this result validates hypothesis II.

4.5. Heterogeneity analysis

As shown in Table 10, the regression results of the heterogeneity analysis shows that capital account liberalisation has heterogeneous effects on systemic financial risks in

countries with different incomes. Capital account liberalisation has a nonlinear impact on high- and middle-income countries. Their dynamic financial markets expand capital account liberalisation and the scope of resource allocation when it is within the appropriate range. These countries will reap the benefits of specialisation, scale of production, and exchange, offering them the possibility of asset diversification, risk diversification, and cross-country transactions across time. This facilitates financial reform, promotes better macro policies, and reduces systemic financial risks.

However, when capital account liberalisation crosses the threshold and is in a highly open band, financial liberalisation leads to more frequent and free capital flows. The combination of money laundering and capital flows poses potential threats to the security of the financial system in these countries, which raises systemic financial risks. In low-income countries, both the primary and secondary coefficients of capital account liberalisation on systemic financial risk are positive, suggesting that opening capital accounts increases systemic financial risk, possibly because of the low level of technology and innovation, imperfect early warning system for financial security, and the low ability of financial supervision in low-income countries. Consequently, it is difficult to identify and monitor illegal cross-border financial activities. Illegal capital from outside easily flows into low-income countries through investment and financing channels, leading to an increase in financial crime rates and systemic financial risks.

5. Conclusion and countermeasure suggestions

This study divides the systemic financial risk evaluation system into five evaluation levels and uses 21 indicators to construct systemic financial risk evaluation indices. We use a panel threshold model and panel quantile model using the data of 24 countries from 2003 to 2019 to study the impact of capital account liberalisation on systemic financial risk. The results show that the systemic risk differs heterogeneously across countries. The systemic financial risk indices of high-income countries are generally lower than those of middle- and low-income countries.

Capital account liberalisation has an asymmetric effect on systemic financial risk with a double threshold. This finding still holds in a series of robustness tests, such as replacing the core explanatory variable, narrowing the sample observation interval, replacing the control variable, and PSM analysis. Low- and high-intensity capital account liberalisation increases systemic financial risk since the intensity of capital account liberalisation in these countries is not appropriate. These countries suffer from financial instability, such as capital flights and less efficient allocation of financial resources, which increases financial risk. However, medium-intensity capital account liberalisation is effective in reducing systemic financial risk since the intensity of capital liberalisation in these countries is appropriate. International capital flows into these countries for arbitrage and investment financing increasing the resilience of financial markets.

Further, the heterogeneity results suggest that capital account liberalisation is conducive to reducing the financial risk of high- and middle-income countries and has the opposite effect on low-income countries.

This study proposes the following policy recommendations: First, countries should focus on regional supervision, crack down on illegal financial activities and pay close attention to the risk concentration of Internet finance and private finance in the field of illegal financing. Second, regulators need to have a sense of the big picture, maintain international regulatory information exchanges, and use international information effectively to monitor external risks. Countries should pre-establish risk-handling plans to respond quickly and effectively to external economic turmoil and prevent the spread of risks. Finally, many countries may have recently experienced economic difficulties (probably due to the COVID-19 pandemic). To promote economic recovery, different countries should choose the appropriate capital account liberalisation band based on their economic development.

This study has certain limitations. We consider only the impact of capital account liberalisation on systemic financial risks, reflecting the overall financial characteristics of the country from a macro perspective. We do not have access to data on systemic financial risk at the regional or firm level. There is no discussion of the fact that systemic financial risks may be characterised by heterogeneity from a micro- or regional perspective. Therefore, we can follow up with future research on systemic financial risk from other perspectives. In addition, capital account liberalisation is a core factor affecting systemic financial risk, and further research could consider the asymmetric effects of other factors on financial risk, such as policy factors and market-based factors.

Note

1. The Chinn-Ito Index (KAOPEN) is an index used to measure the openness of capital accounts for countries. This information is available at http://web.pdx.edu/~ito/Chinn-Ito_website.htm

Data availability statement

Capital account liberalisation and systemic financial risk: evidence from 24 Countries

Disclosure statement

The authors report there are no competing interests to declare.

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