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The research on the impact of short-term cross-border capital flows on stock market prices in China

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ABSTRACT

This paper examines the long-term dynamic impact of short-term cross-border capital flows on the Shanghai Composite Index and the CSI 300 Index using monthly data from 2010 to 2020 and a Vector Autoregression (VAR) model. With the financial opening and the internationalization of the renminbi in China, the stock market has gradually liberalized its management of foreign capital. As a result, the A-share market has become a target for passive capital inflows from overseas investors. This has further intensified the volatility of asset prices and posed challenges to China's cross-border capital regulation. According to the study, short-term cross-border capital flows have a negligible impact. However, a positive correlation appears between 4 to 9 months, followed by a significant negative impact in the 10th month, reflecting the oscillatory risks that cross-border capital flows pose to China's stock prices. This finding reflects how Chinese capital controls have limited the short-term negative impact of cross-border capital flight on stock prices. The paper recommends strengthening the regulation of short-term cross-border capital, cautiously advancing the financial opening system, and actively improving the stock market system.

Contribution/Originality: The results of the paper reflect that China's capital controls have limited the short-term negative impact of cross-border capital flight on stock prices. It suggests China should further accelerate interest rate marketization reforms and the internationalization of the Renminbi, reducing the volatility risk of cross-border capital.

1. INTRODUCTION

In 2020, amidst the global outbreak of COVID-19, the domestic economic recovery in China gradually became optimistic. This has attracted a substantial amount of foreign capital, focusing on the favorable trend of China's economic growth and leading to fluctuations in the Chinese stock market. However, short-term cross-border capital, which is speculative due to its large volume and high liquidity, can flow into the financial sector through direct or indirect channels. This enhances the appreciation trend and expectations of the renminbi, further attracting speculative foreign capital into the stock market (Wang, Tsai, Li, & Huang, 2023; Yang, Sun, Wang, & Wang, 2024).

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In fact, since 2014, China's foreign capital has shifted from net inflow to net outflow. Frequent cross-border capital movements in and out of the capital market have had a negative impact on the stability of the stock market.

Nevertheless, with China's financial opening and the internationalization of the renminbi, the management of foreign capital in China's stock market has gradually liberalized (He, Liang, & Liu, 2024; Li, Jia, & Li, 2023; Wang et al., 2023; Zu, 2024). Various mechanisms such as QFII (Qualified Foreign Institutional Investors) (Hu, Li, & Wang, 2024; Li & Wang, 2024; Zhang, Zheng, Ye, & Xu, 2023) QDII (Qualified Domestic Institutional Investors) (Han, Wang, & Zhao, 2024; Meng, Xiong, Xiao, & Bai, 2023; Wu & Yu, 2023) RQFII (RMB Qualified Foreign Institutional Investors) (Cortina, Martinez Peria, Schmukler, & Xiao, 2024; Goghie, 2024; Liu, 2024; Wang et al., 2023) Shanghai-Hong Kong Stock Connect, and Shenzhen-Hong Kong Stock Connect have been introduced. A-shares were included in the FTSE (Financial Times Stock Exchange) Russell Index and the S&P Emerging Markets Index for the first time in 2019, making them a target for passive capital inflows from overseas investors, further intensifying asset price volatility and posing challenges to China's cross-border capital regulation.

This paper examines the correlation between short-term cross-border capital flows and stock prices using the latest macroeconomic monthly data from 2010 to 2020. The extended sample period and higher frequency monthly data better reflect the impact of short-term cross-border capital flows on stock prices. Additionally, the paper incorporates data from the COVID-19 period in 2020 to examine the impact of short-term cross-border capital flows on stock prices, verifying the robustness of the quantitative relationship under external shock conditions and providing a reference for theories on capital flows and capital markets. It also includes a comparative analysis of models before and after the "8.11 Exchange Rate Reform" (Hao, Ma, & Pan, 2024; Jiang & Yoon, 2024) to deepen existing research. In light of current financial opening policies, the paper proposes regulatory suggestions for domestic cross-border capital inflows into the capital market. Finally, a Vector Autoregression (VAR) model and impulse response graphs are used to construct the relationship model between the two, with graphical representation enhancing the visualization of the results.

The subsequent sections of this paper has following structure: The second section summarizes and reviews related theories and literature. The third section analyzes the theoretical relationship between short-term cross-border capital flows and the stock market. The fourth section establishes a VAR model to empirically analyze the impact of short-term cross-border capital on the renminbi. The fifth section summarizes the main conclusions and research findings, as well as offers recommendations.

2. LITERATURE REVIEW

2.1. Research on Short-Term Cross-Border Capital Flows

Scholars have proposed various theories from different perspectives in cross-border capital flows measurement methods. Cuddington and Vinals (1986) were among the first to propose a direct quantitative method, primarily using the sum of non-differential omitted items and short-term capital in the private sector. Later, Kang and Shivdasani (1996) added international debt and equity investments to this direct method. However, the World Bank proposed an indirect method, calculated as "increment in foreign exchange reserves - trade surplus - net inflow of FDI - change in external debt." Since then, many scholars abroad have begun to examine the factors affecting cross-border capital flows (Besedeš, Goldbach, & Nitsch, 2017; Deng, Xie, & Zhao, 2023; Eller, Huber, & Schuberth, 2020; Koepke, 2019; Kohler, 2022; Nguyen, Nasir, & Vo, 2024; Park & Yang, 2021). Among them, Takagi and Shi (2011), using Japanese economic data, found that exchange rates are a major driving factor of cross-border capital flows. Kodongo and Ojah (2013) believed that there is a long-term stable relationship between Japanese exchange rate fluctuations and cross-border capital flows. Poussou, Mazumdar, Plesniak, Sojka, and Chen (2010) further proposed that the volatility caused by cross-border capital flows in financial markets is driven by exchange rate speculation.

Understanding whether and how cross-border capital flows introduce new and valuable information into local markets is crucial, given their significant role in the international market. There are differing opinions regarding previous results on this aspect. Some studies suggest that foreign investors possess informational advantages and

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their cross-border transactions enhance the efficiency of local markets (Abou Tanos & Jimenez-Garcès, 2022; Ahsan, Gubbi, & Popli, 2023; Albuquerque, Bauer, & Schneider, 2009; Bae, Ozoguz, Tan, & Wirjanto, 2012; Ding, Li, Song, & Sahut, 2024; Kacperczyk, Sundaresan, & Wang, 2021). However, other research indicates that local investors have superior information, possibly due to their familiarity with the local market. Due to relatively low frequency of data used, these studies rarely provide evidence of the transmission of information between local and foreign markets and the consequences of this transmission (Bian, Chan, Han, & Shi, 2023). Buchner, Espenlaub, Khurshed, and Mohamed (2018) examined global investments from 1971 to 2009 and found that the performance of cross-border investments was significantly lower than that of comparable domestic investments. Geographical distance, cultural differences, and institutional disparities between the home and host countries negatively affect returns. Fan, Gou, Peng, and Xie (2020) used the EPFR's comprehensive portfolio allocation dataset and a newly constructed high-frequency Similar Weighted Average Capital Control (SWACC) index for 19 emerging market economies in other regions of the world from 2001 to 2015 to empirically explore the capital spillover effects. They aimed to clarify the multilateral impact of capital controls on capital flows and the risk contagion of global financial shocks to emerging market economies (EMEs). Their findings revealed a positive correlation between SWACC, the global fund allocation to a country's investment portfolio weight, total portfolio inflows into the country, and the capital market linkages between the country and developed nations.

Choi and Furceri (2019) used data from the Bank for International Settlements on local banking statistics to explore the impact of higher uncertainty in specific countries on cross-border bank flows. The results of the analysis indicated that the uncertainty in the source country (domestic economy) is both a lender-specific push factor and a pull factor, strongly predicting a decrease in capital outflows (cross-border lending) and inflows (cross-border borrowing). Opperman and Adjasi (2017) employed a panel framework with data from 1990 to 2011 to investigate the fundamental factors of fluctuation patterns in foreign direct investment, securities investment, and cross-border bank loan inflows in Sub-Saharan African countries. Unlike other studies that focus specifically on Sub-Saharan Africa in examining the determinants of private capital flow volatility, the research found that global liquidity reduced the volatility of FDI, while private sector credit increased it; the quality of macroeconomic policies and the degree of trade openness were significant pull factors in reducing the volatility of cross-border bank loans, whereas financial openness increased risk. Dahaj and Cozzarin (2019) used venture capital investment data from 26 countries from 1998 to 2013 and found that mixed-structure government venture capital investments generally had a crowding-out effect compared to pure-structure government venture capital. It attracted domestic and foreign private venture capital into the domestic venture capital market, increasing the total amount of private venture capital. In contrast, pure government venture capital funds had a crowding-out effect on foreign private venture capital compared to mixed government venture capital funds.

As China steadily progresses with its capital account liberalization, the impact of short-term cross-border capital flows on its financial system has become increasingly significant. Using a Vector Autoregression (VAR) model, the interaction effects between exchange rates and short-term international capital flows and their spillover effects on the capital market have been theoretically and empirically analyzed. The research results indicate that there is a bidirectional causal relationship between exchange rates and short-term international capital flows, with the impact of short-term international capital flows on exchange rates being more significant. There is a unidirectional causal relationship between the capital market and the Renminbi exchange rate, as well as between short-term international capital flows and the capital market. The short-term international capital flows towards the capital market have a unidirectional causal relationship with it (Wang, 2023).

2.2. The Impact of Short-Term Cross-Border Capital Flows on Stock Prices

Although Ferreira and Laux (2009) found that the liberalization of short-term cross-border capital can enhance the efficiency of stock markets, Eckhardt (2017) argued that national capital controls are beneficial to mitigate market

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failures; thus, countries should be cautious of the financial risks caused by short-term cross-border capital flows.

Bathia, Bouras, Demirer, and Gupta (2020) explored the impact of capital flows on financial markets and studied the influence of cross-border capital flows on financial markets, stock and debt flows, and their relative effects on the returns and volatility of emerging stock markets. Using the panel GARCH method for nine emerging market economies, they found that both stock and debt flows possess incremental information about stock market returns and volatility, which is not captured by overall capital market risk factors. Loayza, Olaberria, Rigolini, and Christiaensen (2012), in their research using cross-national panel data, found that short-term cross-border capital inflows are more beneficial than harmful to developed country stock markets but can cause asset bubbles in emerging market countries. Alderighi, Cleary, and Varanasi (2019) extended existing evidence on cross-border equity flows to emerging markets using a proprietary database containing foreign exchange transaction data from 20 stock exchanges from 2006 to 2018. They explored whether explicit and implicit investment barriers, corporate governance standards, and market structural characteristics affect cross-border equity inflows. Their research found that pull factors are important determinants of foreign capital inflows, while push factors have a lesser impact.

Yao, He, Chen, and Ou (2018) used a weak measurement approach to derive a normalized index to study the impact of China's financial liberalization policies from 2000 to 2015 on the integration of its stock market with the rest of the world. The study verified that, despite significant volatility, China's stock market has generally become more integrated with global markets, especially noting the consistent positive impact of QFII, QDII, and RQFII on market integration. However, other policy reforms had negative effects, and some legal policy reforms, such as the liberalization of the RMB (Renminbi) exchange rate, had varying effects depending on other market conditions. Koepke (2019) verified that push factors such as global risk aversion and external interest rates had the greatest impact on portfolio debt and equity flows, but less so on banking flows. Pull factors like domestic output growth, asset returns, and country risk were important for all three components of capital flows but had the greatest impact on banking flows.

Tao, Liu, Gao, and Xia (2017) using signaling theory and an institution-based view, explored the stock market's reaction to cross-border M&A announcements based on an event study of a sample of Chinese firms from 2000 to 2012. The results showed that cross-border M&A announcements elicited positive responses in the stock market, with this effect being more pronounced in mainland China's stock market (Shanghai and Shenzhen) than in Hong Kong. Bian et al. (2023) used the unique context of the China-Hong Kong Stock Connect, studied the impact of two-way cross-border equity flows on stock returns, volatility, and valuation differences. Through the Stock Connect, international investors in Hong Kong (Mainland China) can trade eligible stocks listed in Shanghai (Hong Kong). They found that net buying by southbound (northbound) investors positively predicts the returns of Hong Kong (Shanghai) stocks. However, the impact of southbound and northbound stock flows on stock volatility was opposite: a positive (negative) relationship existed between southbound (northbound) capital flows lagged and volatility in Hong Kong (Shanghai) stocks. A higher premium for A-shares over H-shares led to increased net buying through the Stock Connect, resulting in a lower AH share premium. Liu and Zhao (2023) used a semiparametric generalized additive model to study how market interest rates and interest rate distortions in China's shadow banking system affect the country's short-term capital flows. They estimated the nonlinear impact of shadow banking interest rate differentials and interest rate distortions on short-term capital flows. Higher shadow banking interest rate differentials led to more short-term capital flows, while the level of interest rate distortion had an inverted U-shaped effect on the short-term capital flows.

Previous research reveals a high correlation between short-term cross-border capital and the stock market, particularly after China's capital account opened, intensifying its impact on stock prices and increasing the risk of bubbles in domestic stock prices. This reflects that speculative capital is detrimental to the stability of stock prices. However, few scholars have directly analyzed the impact of short-term cross-border capital on stock prices. This paper will use a Vector Autoregression (VAR) model to examine the dynamic relationship between the two.

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3. ANALYSIS OF THE CHANNELS THROUGH WHICH SHORT-TERM CROSS-BORDER CAPITAL FLOWS AFFECT CHINA'S STOCK MARKET PRICES

3.1. Channels of Short-Term Cross-Border Capital Inflows into China

3.1.1. Current Account Channel

Firstly, the trade channel is an important conduit for short-term cross-border capital inflows into China. Foreign enterprises can achieve this by importing into China and purchasing Chinese products at high prices, thereby boosting the foreign exchange earnings of domestic enterprises, which they can convert into Renminbi upon entering the country. Secondly, in trade activities, foreign-funded enterprises can also enter China through prepayments or deferred foreign exchange settlements. Finally, capital inflows and outflows can also occur through individual business accounts, involving non-trade foreign exchange transactions as well as trade loans, borrowed funds, and investment funds.

3.1.2. Capital Account Channel

Firstly, the most common channel is through Foreign Direct Investment (FDI) into China, which can involve additional investments, establishing companies, or setting up shell companies. After converting foreign exchange capital into Renminbi, these funds flow into China's financial market. Secondly, foreign-funded companies investing in China can also inject overseas funds into domestic enterprises. Finally, companies can use their overseas affiliated enterprises for financial transactions, increasing their foreign exchange liabilities, and then use currency exchange services to convert these into Renminbi and enter the domestic market.

3.1.3. Illegal Channels

Illegal channels refer to the entry of overseas capital into the domestic market through unlawful means, distinct from the current and capital account channels, which comply with Chinese domestic laws but may exploit regulatory loopholes. Illegal channels mainly include underground banks, gambling, smuggling, drug trafficking, fraud, and other money laundering methods.

3.2. Short-Term Cross-Border Capital Flows Affecting Stock Market Prices Through Direct Channels

Due to the short-term, profit-seeking, and highly liquid nature of cross-border capital, financial markets that allow for short-term speculative cashing out are the primary choices for such capital. In addition to the appreciation of the Renminbi, RMB asset markets such as bonds, the stock market, and futures are all attractive speculative targets. An approval system has historically regulated China's stock market, resulting in slow growth in the number of listed companies and a limited issuance of new stocks. This has resulted in a situation where demand exceeds supply in the stock market, allowing it to support high price-to-earnings ratios. Moreover, China's stock market is predominantly composed of individual investors, and the "herd mentality" of investors, characterized by chasing rising stocks and selling falling ones, significantly influences stock prices. This environment is conducive for foreign capital to engage in "market manipulation" by leveraging their scale to speculate and profit from stock market volatility.

3.3. Short-Term Cross-Border Capital Flows Indirectly Affect Stock Market Prices

When short-term cross-border capital flows into the domestic market, it generally needs to be exchanged from foreign currency to Renminbi, thereby disrupting the current balance of supply and demand in the local currency market. As the demand for the local currency increases, and its supply does not change in the short term, this will lead to an appreciation of the local currency. Moreover, if short-term cross-border capital continues to flow in, the foreign exchange market will form an appreciation expectation for the local currency, keeping the exchange rate at a high level. An increase in the exchange rate will also affect the country's current account, leading to a deterioration of the trade surplus, a reduction in the scale of the trade surplus, or even a trade deficit. This is also reflected in real

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economic activities, slowing down economic growth, which is not favorable for the fundamentals of listed companies. This could lead to a decline in the stock prices of trade-related listed companies. This explains why international hot money will cash out and leave the Chinese market, triggering a stock price crash when stock prices deviate from fundamentals.

4. EMPIRICAL ANALYSIS OF THE IMPACT OF SHORT-TERM CROSS-BORDER CAPITAL FLOWS ON CHINA'S STOCK MARKET PRICES

4.1. Selection of Variables and Model

4.1.1. Selection of Variables

This paper uses a time series model to examine the impact of short-term cross-border capital flows on China's stock market prices. The dependent variables chosen for the study are the logarithmic values of the Shanghai Composite Index and the CSI (China Securities Index) 300 Index. Short-term cross-border capital flow is the explanatory variable. Due to the availability of data and data volume requirements, the indirect method is chosen to measure short-term cross-border capital flows, and logarithmic values are used to eliminate heteroscedasticity. Additionally, considering the presence of control variables in the model and referencing the research findings of Wang (2023), the Renminbi to US Dollar exchange rate, the SHIBOR interest rate, and the broad money supply M2 are used as control variables (reported in Table 1).

Table 1. Variable settings.

Variable type	Variable name	Computing method	Code
Dependent variable	Stock price	The natural logarithm of the CSI 300 index The natural logarithm of the Shanghai index	CSI300 SSEC
Independent variable	Short-term international cross-border flows	Short-term cross-border capital flows measured by the indirect method (US $10 billion)	FLOW
Control variable	SHIBOR interest Exchange rate Money supply	Average monthly SHIBOR rates Exchange rate of RMB against US dollar Growth rate of Broad money supply M2 (%)	DI FCPI M2

4.1.2. Empirical Model

The Vector Autoregression (VAR) model is a multivariate regression model based on time series analysis. It constructs the long-term dynamic relationship between independent variables and dependent variables by using the lagged values of all endogenous variables within the model as explanatory variables. Wang (2023) in his analysis, suggests that the coefficients of vector autoregression sufficiently reflect the dynamic relationships within the economic system and can be specifically used to examine the long-term impact effects of short-term cross-border capital flows on stock prices in China. The general expression of the Vector Autoregression model VAR(p) is as follows:

$$Y_t = \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{i=1}^{p} \alpha_i X_{1_{t-i}} + \cdots \ldots + \sum_{i=1}^{p} \alpha_i X_{n_{t-i}} + C + \varepsilon_t$$

In the model, Y represents the dependent variable, X represents the explanatory variables, n corresponds to the number of different explanatory variables, t represents different time periods, ε represents the unobservable standard error, and C represents the constant term. This paper will use an econometric model to examine the dynamic impact on stock prices in the event of changes in short-term cross-border capital flows.

4.1.3. Data Source and Processing

This paper sources all its data from the Wind database. All missing data were imputed using the linear interpolation method. The time series data collection spans from January 2010 to December 2020, encompassing a

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total of 132 observational samples. The descriptive statistical results of the model are presented in Table 2, presenting the statistical indicators of short-term cross-border capital flows and stock price indices. Looking at the various indicators, the average value of short-term cross-border capital flows (in billion USD) is -4.278, with a median of -4.032, indicating an overall net outflow. Additionally, the average values of the Shanghai Composite Index and the CSI 300 Index (in natural logarithms) are 7.925 and 8.056, respectively, with standard deviations of 0.181 and 0.222. This indicates substantial differentiation between the two, ensuring that outliers will not affect the reliability of the regression model.

Table 2. Descriptive statistical analysis.

Variable	FLOW	M2	EXC	SHIBOR	CSI300	SSEC
Mean	-4.278	9.365	6.538	3.736	8.056	7.925
Median	-4.032	9.378	6.546	3.682	8.075	7.965
Maximum	8.548	9.867	7.156	8.132	8.556	8.435
Minimum	-55.413	7.954	6.054	1.313	7.665	7.591
Standard deviation	7.732	0.242	0.312	1.263	0.222	0.181
Skewness	-3.056	-1.373	0.194	0.813	-0.066	-0.058
Kurtosis	20.665	10.561	1.819	3.792	2.179	2.683

Note: FLOW: Short-term cross-border capital flows measured by the indirect method; M2: Year-over-year growth rate of the broad money supply M2; EXC: The exchange rate of Renminbi to US dollar; SHIBOR: Shanghai interbank offered rate, monthly average interest rate; CSI300: The natural logarithm of the CSI 300 index; SSEC: The natural logarithm of the Shanghai composite index.

Furthermore, this paper uses the Pearson correlation coefficient to test the autocorrelation of short-term cross-border capital and control variables in order to prevent "spurious regression" interference with the stock price model. According to the correlation coefficient analysis in Table 3, all correlation coefficients are below 0.6, indicating that it is appropriate to use multiple regression analysis to construct the VAR model.

Table 3. Pearson correlation coefficient analysis.

Variable	FLOW	M2	EXC	SHIBOR
FLOW	1.000			
M2	-0.238	1.000		
EXC	0.015	0.352	1.000	
SHIBOR	0.221	-0.336	-0.595	1.000

Next, the study further utilizes the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979) to examine whether short-term cross-border capital flows, Chinese stock prices, and control variables contain a unit root, which is a primary method to prevent spurious regression (in Table 4). Therefore, the research uses a 12-lag length to test whether the ADF statistics can pass at the 10% significance level. Testing revealed that only the short-term cross-border capital flows successfully passed the ADF test at the 5% significance level. The other series need to be differenced and tested again.

Table 4. Stationarity analysis.

Variable	Statistics	Prob
CSI300	-0.986	0.756
SSEC	-2.213	0.205
FLOW	-3.665	0.006
M2	-0.552	0.875
EXC	-1.953	0.305
SHIBOR	-2.432	0.137

Note: If $p<0.05$, that is, passing the significance level test, indicating stable.

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Following the stationarity test on the differenced series, the ADF test produced ideal results, with all series passing the 1% ADF test. This indicates that the CSI 300, the Shanghai Composite Index, the growth rate of M2, the exchange rate, and the SHIBOR interest rate are all first-order integrated series (in Table 5). The Granger causality tests, and vector autoregression analysis will utilize the first differences of these variables in the upcoming sections.

Table 5. Stationarity analysis of first-order difference.

Variable	Statistics	Prob
CSI300	-10.031	0.000
SSEC	-9.626	0.000
M2	-10.868	0.000
EXC	-8.256	0.000
SHIBOR	-5.016	0.000

Note: If p<0.05, that is, passing the significance level test, indicating stable.

4.2. Empirical Research on China's Stock Market Prices Based on the Shanghai Composite Index

4.2.1. Cointegration Test

Before conducting vector autoregression model analysis, it is necessary to use cointegration tests to analyze whether there is a long-term stable relationship in the same direction between the series. This paper uses the Johansen method as the test model, adding the first difference of the Shanghai Composite Index and short-term cross-border capital flows to the test. Table 6's trace statistic and maximum eignvalue method results indicate that the null hypothesis 'At most 1' remains unrejectable at the 5% significance level, indicating the existing of the least one cointegrating relationship. However, the p-value of the null hypothesis 'None' is below the 1% significance level in the Table 7, indicating a statistical rejection of the hypothesis that there is no cointegration, thus confirming through the cointegration test that there is a cointegrated relationship between the Shanghai Composite Index and short-term cross-border capital flows.

Table 6. Trace statistics test.

Number of cointegration vectors	Characteristic root	Trace statistic	0.05	
			Critical value	Prob.
None *	0.204	33.835	25.872	0.004
At most 1	0.051	6.238	12.518	0.431

Note: Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level.

Table 7. Maximum feature root test.

Number of cointegration vectors	Characteristic root	Trace statistic	0.05	
			Critical value	Prob.
None *	0.203	27.597	19.387	0.002
At most 1	0.051	6.239	12.518	0.431

Note: Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level ; * denotes rejection of the hypothesis at the 0.05 level.

4.2.2. Granger Causality Test

The Granger causality test model helps to examine whether two time series have statistical precedence and correlation, I.e., the explanatory power of each series over the other. According to the test results (in Table 8), the p-value for the null hypothesis 'Short-term cross-border capital flows are not a Granger cause of the Shanghai Composite Index' is 0.012, which passes the 5% significance level, indicating that short-term cross-border capital flows can explain changes in the Shanghai Composite Index; the p-value for the null hypothesis 'The Shanghai Composite Index is not a Granger cause of short-term cross-border capital flows' is 0.564, which does not pass the 10% significance level. Therefore, the results indicate that there is a unidirectional Granger causality relationship from short-term cross-border capital flows to the Shanghai Composite Index.

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Table 8. Granger causality test.

Null hypothesis	Obs.	F-statistic	Prob.
The Shanghai index is not the Granger cause of short-term cross-border capital flows	122	0.859	0.564
Short-term cross-border capital flows are not the Granger cause of the Shanghai index	122	2.518	0.012

4.2.3. Vector Autoregression Test

Before conducting the vector autoregression test, it is necessary to determine the optimal lag order, in order to minimize the random error of the model. Based on the test principle of the Akaike Information Criterion (AIC), the optimal lag order is identified as VAR (5) from the tests ranging from VAR (1) to VAR (8) in the Table 9. This indicates that the results of the VAR (5) model for the Shanghai Composite Index should be considered as the standard in this paper.

Table 9. Optimal lag term test.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-249.345	NA	0.000	4.142	4.252*	4.178
1	-207.471	79.656	0.000	3.858	4.538	4.143*
2	-170.222	67.843	0.000	3.661	4.924	4.171
3	-141.105	50.652	0.000	3.593	5.431	4.342
4	-116.391	40.978	0.000	3.602	6.012	4.573
5	-77.438	61.428*	2.07e-05*	3.368*	6.343	4.582
6	-54.552	34.251	0.000	3.412	6.954	4.844
7	-31.838	32.123	0.000	3.437	7.558	5.115
8	-12.857	25.285	0.000	3.541	8.231	5.448

Note: *indicates lag order selected by the criterion; LR: Likelihood ratio test statistic (Each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

Table 10 presents the VAR (5) output results of the model analyzing the impact of short-term cross-border capital flows on the SSE (Shanghai Stock Exchange) Composite Index. Following the analysis methods of previous scholars, this paper will further employ impulse response graphs to assist in analyzing the net impact of short-term cross-border capital flows on the SSE Composite Index, thereby enhancing the interpretability of multiple lag coefficients.

Table 10. Test results of vector autoregressive model.

Variable	Coefficient	Std.	T statistic
D(SSEC(-1))	0.096	-0.101	[0.945]
D(SSEC(-2))	-0.081	-0.104	[-0.767]
D(SSEC(-3))	-0.013	-0.105	[-0.113]
D(SSEC(-4))	0.112	-0.106	[1.045]
D(SSEC(-5))	-0.018	-0.103	[-0.188]
FLOW(-1)	-0.001	-0.001	[-0.294]
FLOW(-2)	0.001	-0.001	[0.275]
FLOW(-3)	0.001	-0.001	[0.844]
FLOW(-4)	0.001	-0.001	[0.343]
FLOW(-5)	-0.001	-0.001	[-1.251]
D(M2(-1))	-0.008	-0.036	[-0.226]
D(M2(-2))	-0.032	-0.055	[-0.587]
D(M2(-3))	-0.037	-0.066	[-0.554]
D(M2(-4))	0.735	-0.789	[0.931]
D(M2(-5))	-1.083	-0.828	[-1.312]
D(EXC(-1))	-0.108	-0.097	[-1.117]
D(EXC(-2))	0.002	-0.098	[0.017]
D(EXC(-3))	0.078	-0.097	[0.805]

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Variable	Coefficient	Std.	T statistic
D(EXC(-4))	0.126	-0.096	[1.322]
D(EXC(-5))	-0.071	-0.098	[-0.728]
D(SHIBOR(-1))	0.006	-0.008	[0.813]
D(SHIBOR(-2))	0.008	-0.008	[1.018]
D(SHIBOR(-3))	0.013	-0.008	[1.618]
D(SHIBOR(-4))	0.014	-0.008	[1.715]
D(SHIBOR(-5))	0.005	-0.008	[0.566]
C	0.005	-0.009	[0.515]
R^2	0.149		
Adj. R^2	0.064		

4.3. Empirical Study on the Impact of Main Board A-share Market Based on CSI 300 Index on China's Stock Market Prices

4.3.1. Cointegration Test

To examine the robustness of the conclusions of this study, the CSI 300 Index is used in place of the SSE Composite Index for further analysis of the relationship between short-term cross-border capital flows and the CSI 300 Index. Based on the Johansen test with eight lags in the Table 11, the results of the trace statistic and maximum eigenvalue method are similar to previous findings. The null hypothesis "At most 1" has a P-value higher than 10%, while the null hypothesis "None" has a P-value below the 1% significance level. The results in the Table 12 suggest that there is cointegration between the CSI 300 Index and short-term cross-border capital flows.

Table 11. Trace statistics test.

Number of cointegration vectors	Characteristic root	Trace statistic	0.05	
			Critical value	Prob.
None *	0.218	35.029	25.872	0.003
At most 1	0.0390	4.848	12.5180	0.618

Note: Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level ; * denotes rejection of the hypothesis at the 0.05 level.

Table 12. Maximum feature root test.

Number of cointegration vectors	Characteristic root	Trace statistic	0.05	
			Critical value	Prob.
None *	0.219	30.179	19.386	0.001
At most 1	0.039	4.848	12.518	0.617

Note: Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level ; * denotes rejection of the hypothesis at the 0.05 level.

4.3.2. Granger Causality Test

According to the Granger causality test statistical method, the null hypothesis "Short-term cross-border capital flows are not a Granger cause of the CSI 300 Index" has a P-value of 0.022, which passes the 5% significance level. The results in Table 13 indicate that short-term cross-border capital flows can explain the variations in the CSI 300 Index. Additionally, the null hypothesis "The CSI 300 Index is not a Granger cause of short-term cross-border capital flows" has a P-value of 0.755, which does not pass the 10% significance level. Therefore, the results are consistent with those for the SSE Composite Index, suggesting that short-term cross-border capital flows are a unidirectional Granger cause of the CSI 300 Index.

Table 13. Granger causality test.

Null hypothesis	Obs.	F-statistic	Prob.
The 300 index is not the Granger cause of short-term cross-border capital flows	123	0.625	0.755
Short-term cross-border capital flows are not the Granger cause of the 300 index	123	2.357	0.022

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4.3.3. Vector Autoregression Test

In the results of the final lag order test, this paper also follows the tests from VAR (1) to VAR (8) and includes control variables in the model, and the results are presented in the Table 14. VAR (5), with an AIC statistic of 3.533 is the optimal lag order determined. This result is consistent with the model for the SSE Composite Index, indicating that the VAR (5) model results for the CSI 300 Index should be considered standard.

Table 14. Optimal lag term test.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-258.791	NA	0.000	4.286	4.405*	4.342
1	-217.916	77.758	0.000	4.028	4.716	4.312*
2	-180.618	67.963	0.000	3.832	5.087	4.341
3	-151.313	50.961	0.000	3.758	5.592	4.512
4	-126.312	41.457	0.000	3.763	6.158	4.742
5	-87.212	61.671*	2.43e-05*	3.533*	6.512	4.735
6	-63.878	34.886	0.000	3.561	7.112	4.995
7	-43.374	29.013	0.000	3.633	7.746	5.314
8	-23.077	27.062	0.000	3.712	8.395	5.613

Note: *indicates lag order selected by the criterion; LR: Likelihood ratio test statistic (Each test at 5% level);FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion

Table 15 presents the VAR (5) output results of the model analyzing the impact of short-term cross-border capital flows on the CSI 300 Index. Similarly, this paper will utilize impulse response graphs to visualize the net effect of short-term cross-border capital flows on the CSI 300 Index.

Table 15. Vector autoregressive model test.

Variable	Coefficient	Std.	T statistic
D(CSI300(-1))	0.047	-0.112	[0.466]
D(CSI300(-2))	-0.044	-0.105	[-0.415]
D(CSI300(-3))	-0.011	-0.107	[-0.103]
D(CSI300(-4))	0.096	-0.106	[0.932]
D(CSI300(-5))	-0.024	-0.106	[-0.241]
FLOW(-1)	0.000	-0.001	[-0.024]
FLOW(-2)	0.001	-0.001	[0.242]
FLOW(-3)	0.001	-0.001	[0.741]
FLOW(-4)	0.000	-0.001	[0.173]
FLOW(-5)	-0.001	-0.001	[-1.299]
D(M2(-1))	-0.014	-0.041	[-0.358]
D(M2(-2))	-0.041	-0.060	[-0.667]
D(M2(-3))	-0.059	-0.073	[-0.801]
D(M2(-4))	0.752	-0.867	[0.867]
D(M2(-5))	-1.159	-0.909	[-1.274]
D(EXC(-1))	-0.116	-0.107	[-1.095]
D(EXC(-2))	-0.001	-0.108	[-0.011]
D(EXC(-3))	0.072	-0.107	[0.672]
D(EXC(-4))	0.135	-0.106	[1.266]
D(EXC(-5))	-0.081	-0.107	[-0.752]
D(SHIBOR(-1))	0.007	-0.008	[0.846]
D(SHIBOR(-2))	0.007	-0.008	[0.958]
D(SHIBOR(-3))	0.012	-0.008	[1.443]
D(SHIBOR(-4))	0.014	-0.009	[1.573]
D(SHIBOR(-5))	0.003	-0.007	[0.354]
C	0.007	-0.009	[0.729]
R^2	0.129		
Adj. R^2	-0.088		

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5. CONCLUSIONS

This paper reviews the theories related to short-term cross-border capital flows and stock prices, analyzes the direct and indirect impacts of short-term cross-border capital flows on stock prices, and delves into their logical mechanisms through the VAR model. The paper also reviews the history of China's financial opening and the current status of stock prices, noting an increasing degree of financial openness in recent years and more liberal policies towards foreign investors. However, since 2014, China's short-term cross-border capital flows have been negative, indicating a unilateral capital flight situation. Therefore, the primary focus of China's current capital controls is to stem this capital flight. Further, this paper uses monthly data from 2010 to 2020 to examine the relationship between short-term cross-border capital flows and stock prices, employing a vector autoregression model to investigate the long-term dynamic impact of short-term cross-border capital flows on the Shanghai Composite Index and the Shanghai and Shenzhen 300 Index. It is found that there is a long-term stable cointegration relationship between short-term cross-border capital flows and stock prices, and that short-term cross-border capital flows are unidirectional Granger causes of both indices. The impulse response graphs reveal that short-term cross-border capital flows have no significant impact in the short term but will show a positive correlation in 4-9 months, followed by a substantial negative impact in the 10th month, reflecting the volatility risk that cross-border capital flows pose to China's stock prices. Finally, the paper divides the sample into two periods: January 2010 to December 2015 and January 2016 to December 2020. The comparative analysis reveals that the results from January 2010 to December 2015 align with the entire sample. However, after 2016, there was no significant impact in the first 8 months, but a positive shock in stock prices occurred in the 9th month, followed by a negative shock in the 10th month, with the magnitude of the negative impact far exceeding that of the positive. This finding reflects that China's capital controls have limited the short-term negative impact of cross-border capital flight on stock prices.

In terms of China's financial opening policies, there is still a need to focus on the systematic construction of a short-term cross-border capital regulatory framework. After 2021, it's important to plan phased measures for capital account opening, enhancing the orderliness of capital account liberalization. Concurrently, in line with China's strategy for the internationalization of the Renminbi, a set of prudent regulatory measures should be formulated, finding a reasonable balance between speculative capital control and the market economy system. China could explore joint regulatory measures for capital account opening with other developing countries, preventing speculative activities of cross-border capital among developing nations. Additionally, it's recommended that China perfect its cross-border capital flow system to identify anomalous cross-border transaction entities, establish methods to combat illegal cross-border capital flows, such as underground banking, drug trafficking, gambling, fraud, etc., and use the tax system to increase the cost of cross-border capital flows. Furthermore, China could cooperate with countries along the "Belt and Road" to explore joint regulatory policies for capital account opening, preventing transnational speculative activities of cross-border capital in developing countries and keeping speculative capital "at bay" through joint regulation. In the future, China needs to optimize its financial opening policies, focusing on the multi-level and comprehensive development of the financial market. It should cautiously open up to complementary foreign financial entries to prevent unnecessary capital flight. The opening steps could progress from local to global. To guide domestic industries to learn cutting-edge technologies from abroad, foreign direct investment policies should provide a preferential approval bias for long-term investment projects that align with China's goals of industrial structure optimization and upgrading, giving priority to multinational corporations in the fields such as new energy vehicles, medical technology, and artificial intelligence.

Moreover, China should further accelerate interest rate marketization reforms and the internationalization of the Renminbi, reducing the volatility risk of cross-border capital. This paper suggests taking opportunities such as free trade zones, the "Belt and Road," and the China-EU trade agreement to increase the proportion of Renminbi in global foreign exchange reserves and enhance its usage in trade settlements, gradually advancing financial opening measures and securing China's initiative in international financial policies. Meanwhile, China should further promote the long-

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term development of the stock market, accelerate the reform from an approval system to a registration system, and improve the stock market mechanism. Especially in the monitoring system of stock market funds, various monitoring methods should be used to analyze the proportion of short-term cross-border capital in the stock funds of listed companies, establishing the effectiveness and coordination of regulation through a financial safety net. Establishing a multi-level financial market reform will reform small and medium enterprises with reasonable listing opportunities, thereby improving the investment environment in the capital market. Simultaneously, China should actively prevent regulatory arbitrage and perverse incentives in stock market investment, promptly establish early warning mechanisms for key risk events, and prevent the exacerbation of capital flight due to major incidents like the COVID-19 pandemic. Furthermore, China should steadfastly maintain confidence in the development of a "policy-driven market," adhering to the principle of regulating stock market development through policies, avoiding the intervention of hot money speculation on investor sentiment, guiding cross-border capital to transition from short-term to long-term, and allowing it to provide long-term funding for China's capital market, aiding the rapid economic recovery of China post-COVID-19.

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