Analysis of the Correlation between HIBOR and Northbound Funds

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Abstract: To promote capital interconnectivity and enhance capital allocation efficiency, the Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect have been established to facilitate market integration. The Hong Kong capital inflow into the A-share market, known for its mature timing and stock selection capabilities, has achieved excess investment returns and garnered significant market attention. This paper aims to explore the dynamic interrelationship between the Hong Kong Interbank Offered Rate (HIBOR) and the net inflow of northbound funds by establishing a Vector Autoregression (VAR) model. This study is of theoretical and practical significance for understanding the investment logic behind northbound funds, identifying their sensitivity to interest rate fluctuations, utilizing the signaling role of interest rate changes, discovering market investment opportunities, and promoting market integration.

Keywords: VAR model; interbank lending rate; northbound funds; HIBOR; stock market

1. Introduction

The Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect have been successively launched, establishing a bridge for the interconnection between domestic and foreign capital, as well as between the domestic and international capital markets, broadening the channels for Hong Kong and foreign capital to enter the Chinese capital market. The Hong Kong capital that enters the mainland capital market through the Shanghai and Shenzhen Stock Connects is referred to as "Northbound Funds."

Since 2017, the paper profits of Northbound Funds have reached approximately one trillion yuan, with a cumulative return rate of about 70%, which is more than 50 percentage points higher than the 17% return of the Shanghai Composite Index. In 2021, the investment return rate of Northbound Funds exceeded 4.5%, which is basically in line with the return of the Shanghai Composite Index. Coupled with its indicative nature in industry selection, it helps stock market investors to make targeted asset allocation to obtain greater returns.

At the same time, China's Securities Regulatory Commission indicated at the beginning of 2022 that expanding and optimizing the connectivity mechanisms between domestic and international capital markets is a pragmatic measure to advance systemic openness. This is beneficial for broadening two-way financing channels and encouraging enterprises to use both domestic and international "two markets and two resources" in accordance with laws and regulations. It accelerates financing development, enhances the ability of China's capital market to serve the real economy and its international competitiveness, and provides a more diverse range of investment options for investors both domestically and abroad.

The inflow and outflow of Northbound Funds are increasingly drawing the close attention of investors and influencing their behavior, thereby affecting the operation and trend of the mainland A-share market. A substantial amount of empirical research indicates that Northbound Funds are a "smart money", mainly reflected in their precise stock selection ability, timing skills, and long-term value investment. With the continuous influx of foreign capital, their investment experience becomes richer, and their investment style becomes more distinct. Studying their flow conditions has a certain reference significance for market participants.

Interest rates, as the value signals for capital allocation, influence the scale and speed of capital flow in the international market. Grasping the linkage between interest rates and capital can help investors identify investment value and enhance their profitability. At the same time, it also has certain theoretical and practical guidance significance for the formulation and implementation of monetary policy, the regulation of market capital supply and demand, the improvement of the international investment environment, the function of interest rate value discovery, and the promotion of optimized resource allocation.

The interrelationship between interest rates and the securities market has attracted considerable attention from the academic community. Against the backdrop of deepening interest rate marketization reforms, some scholars have discussed the positive impacts brought about by the reforms: Dai et al. (2021) [1] conducted an empirical test using data from listed companies in the Shanghai and Shenzhen A-share markets, and pointed out that the interest rate marketization reform has heterogeneous effects on the improvement of corporate financing constraints, with more significant improvements observed in small and non-state-owned enterprises

compared to large and state-owned enterprises. Ye et al. (2019) [2], based on listed A-share companies, used the system GMM estimation method and found that the marketization of interest rates helps to alleviate the credit constraints on corporate technological innovation, particularly for private and high-tech enterprises. Shen et al. (2019) [3] pointed out that under the reform background, studying the changes in the cost of borrowing and lending has practical significance for both lenders and borrowers, and explored the impact of interest rate changes on the asset structure of listed companies using panel regression models. Zhang et al. (2021) [4] noted that as the reforms deepen, corporate debt financing costs decrease and credit availability increases. Ma et al. (2022) [5] pointed out that China's bond market is in a strategic opportunity period and suggested prioritizing the development of interest rate liberalization in the bond market, using interest rate differentials to attract foreign capital inflows, and guiding the allocation of long-term capital to RMB bonds.

Some scholars have also pointed out the negative impacts of the reform on the market: Wu et al. (2022) [6] established a multi-period DID empirical model, and the study indicates that the innovation output of listed companies under market-oriented influence has significantly decreased, especially for high-risk and small-scale listed companies, where the suppressive effect is more pronounced. Wu et al. (2019) [7], through the establishment of a VAR model, pointed out that interest rate marketization can significantly impact asset prices and exacerbate systemic risk. Deng (2021) [8], combining the experience of foreign interest rate marketization reforms and the current process of China's reforms, analyzed and pointed out that interest rate marketization has promoted the optimal allocation of capital in market resources, added market vitality, but at the same time, it has also brought corresponding risks.

The mutual integration of capital between the mainland and Hong Kong further promotes the process of interest rate marketization reform. The Northbound Funds that flow into the A-share market through the Shanghai-Shenzhen-Hong Kong Stock Connect(short as SH-SZ-HK Stock Connect), due to their superior profit-making skills, have sparked active discussions in both the investment and academic communities.

In terms of the characteristics of Northbound Funds' holdings, Zhang et al. (2020) [9], through empirical research, found that foreign capital prefers to avoid risk and suggested that the opening of foreign capital to the mainland stock market should be gradual to improve the information efficiency of the capital market and reduce stock price volatility. Wang (2019) [10], based on the analysis of various data on the inflow of foreign capital in recent years, pointed out that international capital prefers leading stocks with larger market value and higher liquidity in the A-share market. The scholar Shi (2018) [11], starting from the perspective of financial management, demonstrated that Northbound Funds have the characteristics of "concentrated holdings and preference for rare product investment" in the A-share market. By comparing the difference between the inflow value of Northbound Funds in the A-share market and the market value of the assets they hold, it was pointed out that Northbound Funds have achieved significant excess returns.

Some scholars have analyzed the profitability of Northbound Funds by establishing empirical models: Cai et al. (2020) [12] started from both short-term and long-term perspectives, respectively studying and comparing the relationship between the changes in the proportion of Northbound Funds' holdings and future returns and excess returns. Regression analysis was used to demonstrate that Northbound Funds have strong short-term market-timing capabilities and long-term value investment capabilities. He Sheng, starting from the holdings and trading behavior of Northbound Funds, established a multi-factor model, thereby proving that Northbound Funds have strong stability in predicting returns.

Some scholars have integrated the degree of market integration to analyze and demonstrate the impact of the SH-SZ-HK Stock Connect on the operation of the capital market. Xu et al. (2019) [13], based on the concept of dependency, constructed a time-varying econometric model. Starting from the probability of the stock market's synchronized rises and falls and the correlation of the upper and lower tails of the stock market, the study found that the Shanghai-Hong Kong Stock Connect has enhanced the degree of market integration. Liao (2017) [14], through the construction of a DCC-GARCH model, analyzed the stock market linkage between the mainland and Hong Kong from both static and dynamic perspectives after the SH-SZ-HK Stock Connect. She offered insights from the angles of RMB internationalization and the openness of the capital market. Duan et al. (2018) [15] used a VAR model to demonstrate that after the launch of the Shenzhen-Hong Kong Stock Connect, the volatility of the Shanghai market has decreased, while the connection between Shenzhen and Hong Kong has been strengthened. Scholar Wang et al. (2019) [16] also studied the linkage of the mainland and Hong Kong stock markets under the background of the SH-SZ-HK Stock Connect using time series analysis and the DCC-GARCH model, and pointed out its role in promoting resource allocation. Lin et al. (2022) [17] combined the EEMD and high-order matrix volatility model to study the impact of the capital inflow and market attention through the Stock Connect on the stock market. It was found that short-term changes in the mainland stock market are more dependent on the inflow of Hong Kong capital, and long-term structural changes have a significant correlation with the attention of stock market investors. Huo et al. (2016) [18] used high-frequency data and dynamic forecasting techniques and found that after the Shanghai-Hong Kong Stock Connect, the Shanghai market has a leading role in terms of mean spillover effect and volatility spillover effect on the Hong Kong stock market. The opening of China's stock market to the outside world can enhance the leading ability of the mainland's stock market and improve market efficiency. Qiang et al. (Note: The year "2107" seems to be a typo, assuming it should be "2017") [19] explored the impact of

the Shanghai-Hong Kong Stock Connect on the high-frequency volatility spillover between the Shanghai and Hong Kong stock markets through BEKK-GARCH and VAR modeling. The empirical study confirmed the hypothesis that the Shanghai-Hong Kong Stock Connect indeed increased the capital connection between the two markets and found that there was no volatility spillover in the pre-connection period, while there was a strong two-way volatility spillover in the post-connection period.

In summary, some scholars, starting from the perspective of interest rate marketization reform, have found through theoretical and empirical analysis that the reform has brought positive effects: it can alleviate financing for some enterprises, enhance the availability of credit, and improve corporate capital structure; as well as the negative externalities brought to the market by the reform: increased systemic risk, etc. As an important measure of interest rate marketization reform, the connection and opening of the stock markets in Shanghai, Shenzhen, and Hong Kong have accelerated the pace of reform and strengthened the linkage of the capital market. Among them, the timing and stock selection strategies of Hong Kong capital flowing into the mainland, and its impact on the capital market, have attracted widespread attention in the academic community. This paper is based on the follow-up value of northbound funds, starting from the correlation between the money market and the capital market, establishes a Vector Autoregression (VAR) model to explore the relationship between northbound funds and short-term lending rates, and then discovers their timing strategies, and finds the guiding role of interest rates on the market. This has practical significance for discovering the quantitative relationship between interbank lending rates and the inflow of capital markets and identifying the role of interest rate marketization.

2. Variable Selection

On April 10, 2014, the China Securities Regulatory Commission (CSRC) and the Hong Kong Securities and Futures Commission (SFC) jointly issued an announcement, deciding to initiate a pilot program for the connection and trading mechanism between the mainland's stock trading market and Hong Kong's stock trading market. On November 17, 2014, the Shanghai-Hong Kong Stock Connect was officially launched, consisting of two parts: the Shanghai Stock Connect, which allows Hong Kong investors to purchase some of the stocks listed on the Shanghai Stock Exchange through brokers and the Joint Trading Service Company; and the Hong Kong Stock Connect, which allows mainland investors to purchase some of the stocks listed in the Hong Kong region through mainland brokers and the Joint Exchange. The Shenzhen-Hong Kong Stock Connect began in November 2016. In 2020, the net inflow of the Shenzhen-Hong Kong Stock Connect reached 123.4 billion yuan, far exceeding that of the Shanghai-Hong Kong Stock Connect. As of April 8, 2022, the cumulative net inflow of the Shanghai-Hong Kong Stock Connect amounted to 831.633 billion yuan. Overall, the net capital flow through the Shanghai Stock Connect has shown a fluctuating trend. This paper selects data from the Shanghai Stock Connect and Shenzhen Stock Connect to measure the trading volume of "northbound" funds.

HIBOR, evolved from the benchmark interest rate LIBOR, is an interest rate indicator that refers to the short-term transaction costs in the interbank wholesale market for Hong Kong dollar activities, that is, the borrowing cost or return of short-term funds (usually under one year) between Hong Kong banks. It serves as an indicator of liquidity in the local currency market and acts as a conductor for the extensive financial intermediary services in Hong Kong. HIBOR is quoted by 20 designated banks with quotation qualifications in the Hong Kong interbank market, and the final Hong Kong dollar settlement rate is determined by the Hong Kong Association of Banks through pricing processing. In terms of interest rate maturities, there are 8 categories, and this paper uses the overnight lending rate.

Considering the availability, timeliness, and consistency of the time nodes of the data, the article sets the research period from July 2017 to March 2022. It selects the daily net inflow data of the Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect, as well as the Hong Kong interbank market lending interest rates, totaling three columns of time series data from the "Tonglian Data" database.

3. Model Establishment

3.1 Model Formulation

This paper employs the VAR (Vector Autoregression) model to analyze the relationship between Northbound Funds and Hong Kong LIBOR. The VAR model is an autoregressive method of characterizing a weakly stationary process, representing multiple variables over the same sample period as linear combinations of their own past values. Its mathematical expression is provided below as Equation(1):

$$Y_t = \phi_0 + \phi_1 Y_{t-1} + \cdots + \phi_p Y_{t-p} + BX_t + \varepsilon_t, \ t = 1,2 \cdots ,T \tag{1}$$

Y_t denotes the k-dimensional column vector of endogenous variables; Y_{t-i}, $i = 1,2,\cdots,p$ for lagged endogenous variables; X_t denotes a d-dimensional column vector of exogenous variables; p represents the lag order; T denotes the number of samples.

3.2 Stationarity Test

To avoid the phenomenon of spurious regression results and ensure the feasibility of the research plan, this paper employs objective testing methods for the selected variables: the Augmented Dickey-Fuller test (ADF), the Phillips-Perron test (PP), and the Kwiatkowski-Phillips-Schmidt-Shin test (KPSS), a total of three testing methods, to provide a statistically significant judgment of stationarity.

Table 1. Results of the serial stationarity test.

	ADF test	PP test	KPSS test	Result
CNH	0.01	0.01	0.02	Stationary
HE	0.01	0.01	0.01	Stationary

In the test results Table 1, the P-values are close to zero, indicating that the original series are statistically stationary and suitable for VAR modeling.

3.3 Determination of the Lag Order

Based on the AIC (Akaike Information Criterion), HQ (Hannan-Quinn Information Criterion), SC (Schwarz Criterion), and FPE (Final Prediction Error) criteria, the determined lag orders are 8, 6, 5, and 8, respectively. Considering the economic interpretation and the effectiveness of parameter estimation, a lag order of 5 is selected; to ensure the completeness of the model's dynamic characteristics, a lag order of 8 is chosen. Among the fitting models with different lag orders, the fifth-order lag fitting equation passes the significance test to the greatest extent.

By determining the coefficients of the equation, we can obtain the Table2:

Table 2. Regression results.

	Estimate	Std.Error	t value	P(>|t|)	
HE.1	0.26587	0.02956	8.944	<2e-16	***
CNH.1	-3.44469	2.25018	-1.531	0.126089	
HE.2	0.20311	0.03056	6.645	4.71e-11	***
CNH.2	-2.00331	2.40880	-0.832	0.405621	
HE.3	0.04806	0.03108	1.546	0.122360	
CNH.3	0.33328	2.43163	0.137	0.891006	
HE.4	0.04944	0.03052	1.620	0.105509	
CNH.4	-3.72076	2.41045	-1.544	0.122969	
HE.5	0.10228	0.02952	3.456	0.000550	***
CNH.5	-7.67712	2.24562	-3.419	0.000652	***

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Table 2 reflect the relationship between the net inflow of the SH-SZ-HK Stock Connect and the interbank lending rate in Hong Kong. So, we can get the Equation (2):

$$HE=0.27HE_{(t-1)}-3.44CNH_{(t-1)}+0.20HE_{(t-2)}-2.00CNH_{(t-2)}+0.05HE_{(t-3)}+0.33CNH_{(t-3)}+0.49HE_{(t-4)}-3.72CNH_{(t-4)}+0.10HE_{(t-5)}-7.68CNH_{(t-5)} \qquad (2)$$

In Table 2, in the P-value column, the coefficients of the net inflow lagged by one, two, and five orders, and the coefficient of the interest rate lagged by five orders, have P-values approaching zero, passing the parameter significance test. Among them, the changes in the net inflow lagged by one and two orders significantly affect the current value of the net inflow. The interest rates lagged by one, two, three, and five periods have a negative correlation with the current value of the net inflow, which is in line with common sense and expectations.

3.4 Granger Causality Test

The Granger causality hypothesis is divided into four scenarios: First, CNH and HE are Granger causes for each other; second, CNH is a Granger cause of HE; third, HE is a Granger cause of CNH; fourth, CNH and HE are independent. Combined with the regression results from the previous text, the null hypothesis 1 is proposed: CNH is not a Granger cause of the change in HE, with the test result being "P-value < 0.05"; the null hypothesis 2 is proposed: HE is not a Granger cause of the change in CNH,

with the test result being "P-value < 0.05". From the results, it is necessary to reject the null hypothesis and acknowledge that at the 95% confidence interval, HE and CNH are Granger causes for each other, and they influence each other.

3.5 Impulse Response Analysis
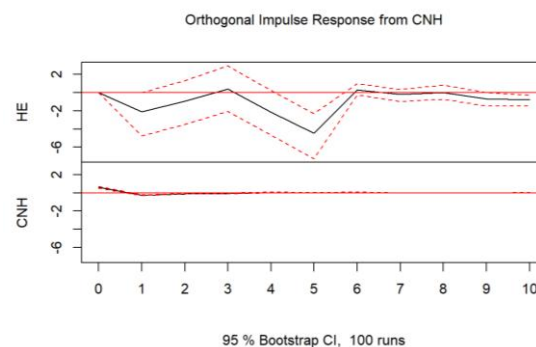
Figure 1. Impulse response results.

Figure 1 presents the impulse response results of the interbank lending rate on itself and the net inflow of funds. From the result figure 1, the impact of the interest rate on the inflow, negative in the first six periods, then alternates between positive and negative, and tends to stabilize; the impact of the interest rate on itself is more pronounced in the first period, then fluctuates around the 0 value, with essentially no amplitude of change. This indicates that the interest rate fluctuations in the early period have a significant impact on the inflow, but as time increases, the degree of impact of the inflow by the interest rate fluctuations decreases and tends to stabilize.

3.6 Coefficient Stability Test
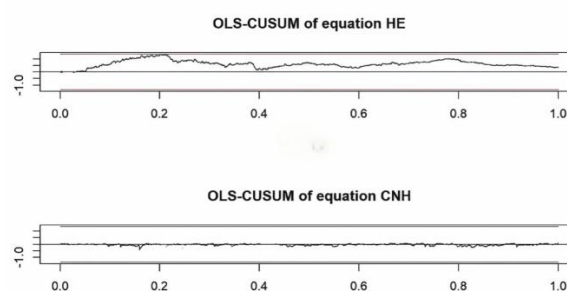
Figure 2. Model stability test.

Figure 2 is the result of the CUSUM (Cumulative Sum) test. The figure 2 presents the cumulative sum curve of residuals along with two critical lines. This cumulative sum curve uses time as the horizontal axis and plots the cumulative sum of deviations between each sample value and the target value. As can be seen from Figure 2, the cumulative sum does not exceed the two critical lines, and the null hypothesis of "coefficients stability" cannot be rejected. Therefore, the model coefficients mentioned in the text are stable.

4. Conclusion

By constructing a VAR model, it was found that the

Hong Kong interbank overnight lending rate and the daily net inflow of Northbound Funds are Granger causal to each other, and there is an effective linkage relationship between the two. The change in the interest rate lagged by five orders has the greatest influence on the change in the net inflow. The lagging impact and shock effect of the inflow on the interest rate are relatively weak and statistically close to zero. The impulse response results indicate that the offshore RMB interest rate has a certain reverse impact on the net inflow of Northbound Funds, which has a certain lag, specifically manifested as follows: giving an exogenous shock to the inflow, namely CNH, the inflow will tend to stabilize after 6 periods. It can be seen that the two have formed a positive linkage relationship.

Due to the imperfect transmission mechanism of monetary policy, the connection between the money market and the securities market is not close enough, and the impact of interest rates on the securities market has a time lag and does not have a decisive influence on the changes in the securities market. When the economic situation is too good or during a great depression, the impact of interest rate adjustments on the market becomes minimal. Therefore, it is necessary to cultivate the sensitivity of market entities and reduce the lag in impact. At the same time, the transmission mechanism by which interest rates are affected by the fluctuations in the securities market is not robust, and it is necessary to improve the reserve requirement policy to prevent imbalances in the distribution of market funds and the emergence of banking liquidity crises.

With the in-depth development of economic integration, we need to go with the trend while being prepared for risks, to make good use of the leverage of interest rates in regulating the economy, and to convey economic and policy signals effectively through interest rates: by adjusting interest rates, we can affect market consumption demand, provide the market with a variety of asset combinations; increase or decrease the production and operating costs of enterprises, thereby affecting their profitability; and influence the intrinsic value of stocks and the supply of funds in the stock market. On the one hand, we should leverage the role of interest rate marketization in optimizing the allocation of capital, and on the other hand, we should combine it with the government's macroeconomic control and regulatory constraints to advance the reform of interest rate marketization.

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