The Impact of Exchange Rate Fluctuations on China's Industrial Stock Prices: An Empirical Analysis

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Abstract. This paper investigates the impact of RMB exchange rate fluctuations on China's industrial stock prices using daily data from January 1, 2016, to December 31, 2022. A vector autoregression (VAR) model is constructed based on the RMB/USD exchange rate and the Shanghai Industrial Index. The empirical results indicate a long-term cointegration relationship between the exchange rate and industrial stock prices. A depreciation of the RMB tends to drive up industrial stock prices in the short term. The findings support the existence of a positive transmission mechanism from the foreign exchange market to the stock market, particularly within the industrial sector. Policy implications are discussed in the context of exchange rate reform and capital market development.

Keywords: exchange rate, industrial stocks, VAR model, cointegration, stock price.

1. Introduction

In the current era, the rapid development of economic globalization has gradually made the foreign exchange market more important and complete, while also giving it a more prominent role in global economic development. However, due to the volatile international economic and political landscape and the inherent complexity of the foreign exchange market itself, the magnitude and frequency of exchange rate changes are increasing. In 2022, against the backdrop of the COVID-19 pandemic, steep interest rate hikes by the Federal Reserve, multiple crises, tense international geopolitical situations, and a lack of global governance, the US dollar continued to strengthen, leading to significant depreciation of currencies in various countries worldwide. Compared to European currencies, although the RMB faced depreciation pressure, the pressure was relatively minor. Nevertheless, global inflation and consecutive Fed rate hikes exerted considerable downward pressure and impact on the RMB exchange rate, making the RMB/USD exchange rate highly unstable, even falling below 7.3 at one point. Fluctuations in the RMB exchange rate can subsequently cause changes in the securities market. Therefore, studying the impact of the RMB exchange rate on China's securities market is particularly important and necessitates relevant research.

2. Literature Review

2.1. International Literature Reviews

Empirical findings on the exchange rate-stock price nexus vary. Aggarwal (1981) found a positive correlation [1], while Soenen and Hennigar (1988) demonstrated a significant negative correlation [2]. In contrast, Franck and Young (1972) argued that there was no significant correlation [3]. Later studies, such as Bahmani-Oskooee and Sohrabian (1992) and Nieh and Lee (2001), concluded that there was no long-term relationship, only short-term causality [4, 5]. Recent research, including Salah Ansari (2022), generally confirms the existence of causal relationships, albeit complex and context-dependent [6].

Regarding the industrial sector, studies often focus on investment. Linda S. Goldberg (1993) found that dollar depreciation reduced US manufacturing investment [7]. Conversely, Francesco Nucci et al. (2001), studying Italian data, found mixed effects depending on the channel (revenue vs. cost) [8]. Research by Ping HUA (2007) on China suggested that real RMB appreciation had a significant negative impact on manufacturing employment [9].

2.2. Domestic Literature Review

Domestic research also presents diverse findings. Yuan Dongmei and Liu Jianjiang (2006) found JPY appreciation caused long-term stock declines but short-term rises [10]. Chen Yanyun and Zhao Wei (2006) posited that short-term effects evolve into medium-to-long-term impacts [11]. Post-2005 reform studies, like Zhang Bing et al. (2008), often identified long-term cointegration relationships [12]. Recent analyses, such as Zhou Baicheng et al. (2021), confirm significant correlations and spillover effects, especially after the "811 Exchange Rate Reform" [13].

For industrial impacts, Mao Risheng (2013) found RMB appreciation suppressed industrial employment via export and import channels [14]. Liu Laihui (2017), using OECD data, confirmed this but noted a smaller countervailing effect from cheaper imported materials [15]. Other scholars examined productivity and trade. Zhang Tao et al. (2015) found exchange rate appreciation typically reduced firm productivity, except in certain non-exporting firms [16]. Wang Chunping et al. (2007) and Zhou Xuan et al. (2020) highlighted a significant negative correlation between the real exchange rate and industrial exports, with depreciation boosting exports [17, 18].

While extensive research exists on exchange rates affecting stock prices or the industrial sector separately, few studies focus specifically on industrial stock prices. This paper aims to fill this gap.

3. Theoretical Mechanism and Research Hypotheses

3.1. Theoretical Mechanism

Exchange rate fluctuations alter the trade conditions for industrial manufactured goods by affecting import and export prices. These changes impact the business operations and profitability of industrial enterprises, ultimately influencing their stock prices. The transmission channel operates as follows: a depreciation in the RMB (direct quotation increase) makes exports more competitive, potentially leading to expanded production, increased employment, improved financial performance, and consequently, higher stock prices. This effect is generally more pronounced in the short term due to immediate adjustments in trade volumes and investor expectations.

3.2. Research Hypotheses

Based on this, this paper proposes the following hypotheses:

Hypothesis 1: Fluctuations in China's exchange rate (direct quotation) are positively correlated with China's industrial stock prices, meaning that RMB depreciation leads to an increase in industrial stock prices.

Hypothesis 2: The positive correlation between China's exchange rate (direct quotation) and industrial stock prices is more significant in the short term.

Hypothesis 3: The transmission of the exchange rate (direct quotation) to industrial stock prices requires a certain reaction time and cannot be instantaneous.

4. Empirical Analysis

4.1. Sample Data and Sources

This paper uses the Shanghai Industrial Index (SZGY) to reflect industrial stock prices and the RMB against USD nominal exchange rate (direct quotation) (EX) to represent the exchange rate price. The selected period is from January 1, 2016, to December 31, 2022. The daily closing price data of the Shanghai Industrial Index (SZGY) represents industrial stock prices, and the daily data of the RMB against USD benchmark exchange rate (EX) represents the RMB exchange rate. After screening out missing data due to non-working days, holidays, or other special reasons, 1703 data points remain.

4.2. ADF Test

To avoid spurious regression, before empirical testing, this paper uses the ADF unit root test on SZGY and EX to determine the stationarity of each time series data. This paper chooses to take the logarithm of the variables SZGY and EX, denoted as lnSZGY and lnEX, to eliminate heteroscedasticity and reduce volatility, and then performs first-order differentiation, represented by d1lnSZGY and d1lnEX. Using Stata16 software, the level values and first-order difference values of the variables are tested, yielding the following results:

Table 1. Unit Root Test for Shanghai Industrial Index and RMB/USD Benchmark Exchange Rate

Variable	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Result
lnSZGY	-1.988	-3.430	-2.860	-2.570	Non-stationary
lnEX	-1.429	-3.430	-2.860	-2.570	Non-stationary
d1lnSZGY	-28.719	-3.430	-2.860	-2.570	Stationary
d1lnEX	-27.851	-3.430	-2.860	-2.570	Stationary

4.3. Cointegration Test

If variables have a cointegration relationship, it indicates a long-term equilibrium relationship between them, allowing further discussion of their relationship. Therefore, it is necessary to conduct a cointegration test to examine whether there is a long-term equilibrium relationship between the RMB/USD exchange rate and the Shanghai Industrial Index. Using the E-G two-step method based on the residual term of the cointegration regression equation, this paper conducts a cointegration test on the Shanghai Industrial Index series lnSZGY and the RMB/USD exchange rate lnEX, with lnEX as the independent variable and lnSZGY as the dependent variable, establishing a linear regression equation. Then, the ADF unit root test is performed on the residual sequence of the equation. As shown in Table 2, the two have a long-term cointegration relationship.

Table 2. Unit Root Test for Residual Sequence

Variable	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Result
e	-29.022	-3.430	-2.860	-2.570	Stationary

4.4. VAR Model Analysis

4.4.1. Determining the Optimal Lag Length

From the previous ADF unit root test, the first-order difference series d1lnSZGY and d1lnEX of lnSZGY and lnEX have been obtained. Before establishing the Vector Autoregression (VAR) model and conducting the Granger causality test, we first need to determine the optimal lag order for the VAR model. We can use Stata 16 software to obtain the following table and determine the optimal lag order based on the AIC, HQIC, and SBIC information criteria.

Table 3. Lag Length Selection Criteria Results

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	12688.4				0.000	-14.996	-14.993	-14.989
1	12719.6	62.301	4	0.000	0.000	-15.028	-15.0207	-15.0086

From Table 3, we can observe that the HQIC and SBIC information criteria results are consistent. Among the VAR models with a maximum lag of 10 given in Table 3, both select an optimal lag length of 1. Therefore, this paper will establish a VAR (1) model with a lag order of 1, based on which subsequent Granger causality tests will be conducted.

4.4.2. Stability Test

Since no characteristic root falls outside the unit circle, the VAR model constructed in this study is considered stable overall, allowing for further impulse response analysis.

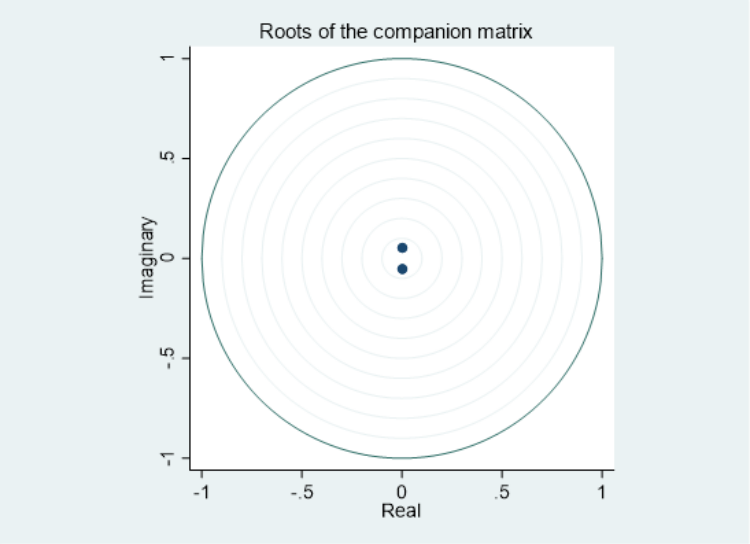

Figure 1. Stability Test Result

4.4.3. Granger Causality Test

As known from the previous test process, even after taking logarithms, the Shanghai Industrial Index series lnSZGY and the RMB/USD benchmark exchange rate series lnEX are still not integrated of order one I(1). However, the Granger causality test for time series data requires the premise that the time series must be stationary; otherwise, spurious regression may occur. The previous section also concluded that the first-order difference series d1lnSZGY and d1lnEX of the Shanghai Industrial Index series lnSZGY and the RMB/USD benchmark exchange rate series lnEX are I(1). Therefore, this paper conducts the Granger causality test on the first-order difference series d1lnSZGY and d1lnEX of SZGY and EX. Here, d1lnSZGY and d1lnEX represent the change amount of the industrial index and the change amount of the RMB/USD exchange rate, respectively. The results are shown in Table 4:

Table 4. Unit Root Test for Residual Sequence

Equation	Excluded	chi2	df	Prob > chi2
d1lnSZGY	d1lnEX	0.889	1	0.346
d1lnEX	d1lnSZGY	51.652	1	0.000

From Table 4, it can be concluded that since the p-value is less than 0.05, at the 99% confidence level, the change in the RMB/USD exchange rate d1lnEX is the Granger cause of the change in the industrial index d1lnSZGY, indicating a causal relationship between the two.

4.5. Impulse Response Analysis

From the impulse response function image of industrial stock prices, it can be seen that in response to an orthogonalized shock from the RMB/USD exchange rate (direct quotation), the industrial stock price shows no response in the contemporaneous period, followed by a relatively slow upward trend, showing a positive response. However, the impact duration is not long, reaching its peak at the first period and then showing a relatively slow downward trend, also with a short duration. The decline slows further by the second period until the response becomes zero by the third period, stopping the decline. This analysis result can be interpreted as follows: fluctuations in the RMB/USD exchange rate (direct quotation) can cause positive changes in the Shanghai Industrial Index. An increase in the RMB/USD exchange rate (direct quotation), i.e., a depreciation of the RMB, leads to an increase in the industrial index price. However, the transmission of exchange rate changes to stock price fluctuations requires a certain reaction time and cannot be instantaneously reflected in the current period, or the reaction in the current period is not obvious. Furthermore, the effect of exchange rate changes on the industrial index does not last long. This result indicates that the positive change in the

Shanghai Industrial Index caused by fluctuations in the RMB/USD exchange rate (direct quotation), i.e., the negative change in the Shanghai Industrial Index caused by RMB value fluctuations, is only effective in the short term.

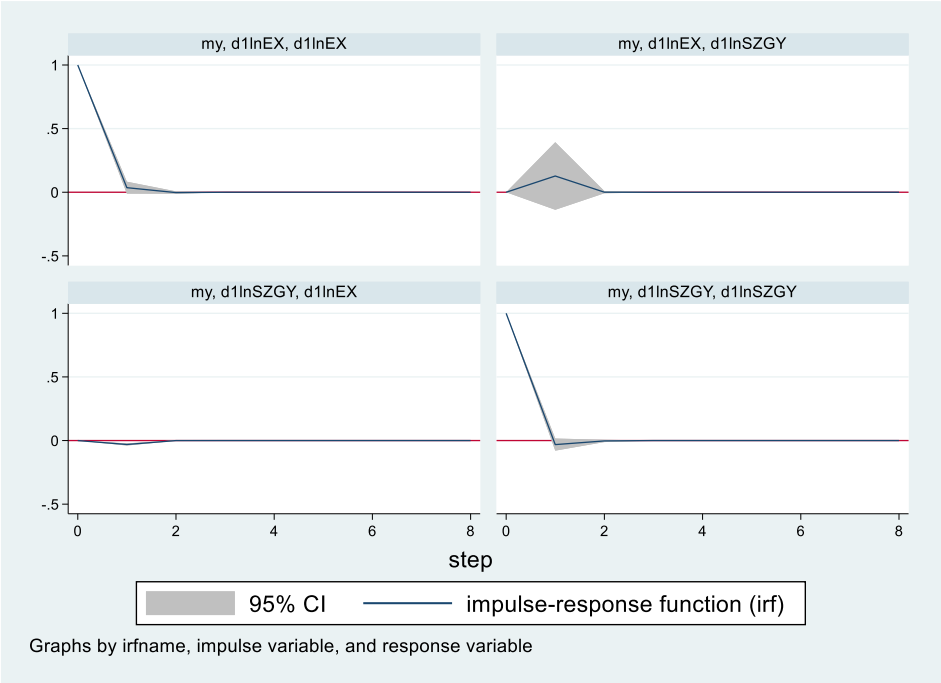

Figure 2. Impulse Response Function Graph

4.6. Impulse Response Analysis

Regarding the relationship between the RMB/USD exchange rate and industrial stock prices, the empirical analysis results of this paper indicate a negative correlation between the value of China's currency and industrial stock prices. That is, RMB depreciation leads to an appreciation of industrial stock prices, and the negative change in industrial stock prices caused by exchange rate fluctuations is only effective in the short term. In the relationship between the exchange rate and industrial stock prices, the exchange rate holds a relatively dominant position, consistent with the flow-oriented model.

5. Research Conclusions and Recommendations

5.1. Research Conclusions

Based on the research conclusions, the following policy recommendations are proposed:

First, strengthen and improve the management of exchange rate expectations, effectively stabilize and guide market expectations.

Second, improve the operating mechanism of the stock market so that it reflects the overall economic situation and becomes a "barometer" of China's social and economic development.

5.2. Policy Recommendations

References are cited in the text just by square brackets [1]. (If square brackets are not available, slashes may be used instead, e.g. /2/.) Two or more references at a time may be put in one set of brackets [3, 4]. The references are to be numbered in the order in which they are cited in the text and are to be listed at the end of the contribution under a heading References, see our example below.

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