The impact of exchange rate volatility on the Agricultural Export Revenues in China

|  |
| --- |
|  |

**Abstract:** The agricultural sector is one of the most important industries in China. The industry has a substantial contribution towards the GDP of the nation. Agricultural exports from China are also quite high for nations like the United States. However, some obstacles affect such exports. Exchange rate instability is one of the biggest problems that affect export levels for agricultural products. Currency market turbulence impacts the price and elasticity of demand. This alters consumer behavior and export levels of agricultural products from China. As a result, the export revenues are also affected. To analyze the same, empirical analysis has been assessed. Data has been used between 1994 and 2023. In addition, an OLS regression method has been used to analyze the data. The results of the analysis suggest that the instability of the exchange rate on agricultural exports has a negative effect on agricultural exports along with total exports.

**Keywords:** Currency Volatility, OLS Regression, Agricultural Production, International Trade Theory, Agricultural Exports.

1. Introduction

1.1 Background

The agricultural sector in China is one of the most important industries in the economy. According to the study by Carter et al. (2011), agricultural productivity in China increased from 3 billion tonnes in 1978 to over 5 billion tonnes in 2009. This growth in agricultural productivity is strongly affected by technical improvement and the influx of foreign capital to China from abroad. According to a study by Wang et al. (2019), China has increased 3.1 percent of agricultural productivity due to foreign capital. This reflects the growth in China's agricultural sector in recent decades.

1.2 Problem of Research

Despite China being a high exporting nation for agricultural products especially to the United States, there are substantial problems that China faces with respect to international trade. As per the study by Chen (2011), the RMB depreciation against the yen will hinder the export of agricultural products from China. This is one of the key problems of exports from China that will be discussed in the paper.

1.3 Research Objectives

The research objective is to analyze the trends in agricultural exports in China. Moreover, the study would also analyze the impact that exchange rate fluctuations have on agricultural exports from China.

1.4 Research Question

The primary question of the study is to analyze whether volatility in the rate of exchange has any impact on agricultural exports from China to the rest of the trading partners.

1.5 Outline of the study

The first chapter of the study provides a background on Chinese agricultural exports over the years. The chapter also discusses the research problem. The second chapter discusses the theoretical structure and analyses the literature on the impact of currency fluctuations on agricultural exports from developing countries. The third chapter discusses the methodology and the fourth chapter provides empirical analysis. The fifth chapter discussed the results and then discussed in the sixth chapter later. Conclusions are discussed in the seventh chapter

2. Literature Review

2.1 Conceptual Framework

2.1.1 Theory on International Trade

The International Trade Theory is one of the key concepts used in the paper as it determines the patterns of trade between countries. According to a study by Shuai and Wang (2011), the trade dependency of developed nations on developing nations plays an integral role in the enhancement of agricultural exports. This is because, developing nations have low labor costs, and with technology integration, productivity could be increased. This would also lead to the enhancement in the export of commodities from countries thus leading to international trade. However, the exposure to international trade also exposes certain developing countries to exchange rate fluctuations and other shocks within the globalized economy. As per Benguria and Taylor (2020), economic shocks create negative demand shocks within economics. This leads to a mismatch in demand and supply equilibrium and eventually impacts the supply side as well. As a result, this often leads to losses for producers within the economy as well. Therefore, this shows that International Trade is highly sensitive to economic shocks.

2.1.2 Currency Exchange Theory

The shocks in the currency exchange rates also impact trade globally. As per Auboin and Ruta (2013), exchange rate shocks have a short-term impact on price levels. This is because when there is a depreciation of the currency of foreign partners, the exports become more expensive. As a result, the demand for commodities reduces and a disequilibrium is created in the economy. Furthermore, shocks in the currency rates can also impact the cost structures of domestic producers. As per Agenor (1991), the appreciation in the exchange rate of domestic currency could lead to producers cutting costs of production. This would lead to a reduction in the final price of commodities and would boost exports. However, the same creates a substantial level of market failure within the economy through deadweight losses. Overall, the currency exchange theory is integral in understanding the impact of exchange rate shocks on agricultural exports from a nation.

2.2 Relation between ER and International Trade

The currency rates between countries help to determine the level of trade that is done between economies. The study by Kang and Dagli (2018) shows that there is a 35.3 percent impact of the currency rates on the value of exports from a nation. The results of the study have been concluded by using a gravity model and data for trade between two countries and currency rates for 72 countries between 2001 and 2015. The reason behind the statistical impact of the exchange rate on trade is that the exchange rate determines the final price of goods and commodities in foreign markets (Demir & Razmi, 2022). An appreciation in the exchange rate of trading partners leads to exports being cheaper than the domestic economy. As a result, this boosts the export levels from the domestic country to its trading partner. The volatility in exchange rates also impacts the export levels from various industries across the world. According to Lal et al. (2023), it could be realized that the exchange rate volatility leads to a negative impact on exports from various industrial sectors. The main reason behind such a fall in export level is that the exchange rate volatility impacts the perspective of consumers on future prices. As a result, risk-averse consumers opt out of consumption activities leading to a fall in demand. Thus, the export levels are also impacted negatively. The same has also been highlighted in another study by Dada (2021), who revealed that currency volatility has a negative and significant effect on trade because of the reaction of consumers and investors to the news of exchange rate volatility. Consumers react more to adverse news than positive news (Noh et al., 2025). As a result of this, the trade is eventually impacted negatively. Based on these insights the following research hypothesis could be formulated:

* H0: The currency fluctuation leads to a significant fall in exports.
* H1: The currency fluctuation does not lead to a significant fall in exports.

2.3 Relation between Currency Fluctuation and Exports of Agricultural Products from Developing Nations

Like the impact on other industries, the foreign exchange rate fluctuation also has a relevant impact on the export of agriculture-based products from developing nations. As per Nguyen (2022), the export of products such as rice and coffee could not reach the potential export levels because of exchange rate fluctuations in Vietnam. This could be analysed using the gravity model using data on exchange rate, macroeconomic factors and agricultural productivity and exports from Vietnam. The increase in exchange rate fluctuations increases the volatility in the market and the same discourages consumers from activities. The same diminishes the export levels and hinders agricultural exports from reaching the potential levels in developing nations such as Vietnam. A similar result is also found in the Chinese economy. A study by Abdullahi et al. (2022), found that there has been an adverse effect on the export of agricultural products from China because of currency depreciation. This currency fluctuation impacted the level of comparative advantage held by China with respect to agricultural exports, as the currency volatility led to an increase in the price of agricultural products in international markets. As a result, consumers opted for other countries, which eventually impacted the agricultural exports from China negatively. Furthermore, the same study by Abdullahi et al. (2022) also found that there has been a 51% gap in its agriculture exports with its trading partners. This further shows that exchange rate volatility plays a critical role in the determination of agricultural exports from developing countries. Based on this literature, the following hypothesis could be drawn.

* H0: The ER fluctuation statistically impacts the trade for agricultural-based products.
* H1: The ER fluctuation does not have a statistical impact on agricultural-based products.

2.4 Research Gap

From the literature, it could be assessed that studies like Abdullahi et al. (2022), used a gravity model to understand the gap in its agriculture exports due to exchange rate volatility in China. Moreover, papers like Dada (2021), provided a greater theoretical overview on how exchange rate volatility impacts the export levels and trade. However, there is a substantial gap in the literature to analyze the absolute impact of Currency market turbulence on agricultural exports from China. The same gap is addressed in the study using the latest data available.

3. Methodology

3.1 Design of the Research

A quantitative research design is used to analyze the impact of currency rate volatility on the outflow of agricultural products. As per the study by Bloomfield and Fisher (2019), the quantitative research design allows to test of the statistical significance using data and analysis of the research hypothesis. An OLS Regression methodology has been considered for the same (Archontoulis & Miguez, 2015).

The study considers trade between China and the USA. This is because as per the WITS (2025), the United States had the highest level of Agricultural Raw Materials exports from China. The absolute value for the same was 0.97 million USD, which was approximately 8.90 percent of the total agricultural trade. Hence, the currency shocks between the USA and China have been considered in the paper.

The currency volatility has been calculated using the following formula:

Equation 1: Derivation of the Exchange Rate Volatility for RMB/USD

3.2 Variables of the Study

Table 1: Variables and Abbreviation Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variables |  | Indicators | Source | Abbreviation |
| Dependent Variable |  |  |  |  |
| Agricultural Export Revenue |  | Agricultural Exports | (World Bank, 2025) | Agro ER |
| Total Export |  | Export of Goods and Services |  | Total EXP |
| Independent Variable |  |  |  |  |
| RMB/USD |  | Chinese Yuan Renminbi to U.S. Dollar Spot Exchange Rate | (FRED, 2025) | ER |
| Exchange Rate Volatility |  |  | Derived using Equation 1 | EV |
| Control Variables |  |  |  |  |
| Interest Rate |  | Interest Rate (% Annual) | (World Bank, 2025) | INT Rate |
| Foreign Investment Inflow |  | FDI Inflow (% of GDP) annual | (World Bank, 2025) | FDI Inflow |
| CPI Inflation |  | Consumer Price Index (% growth) annual | (World Bank, 2025) | INF Rate |

3.3 Empirical Model

The hypothesis of the study is to analyze whether currency fluctuations have a negative impact on the total exports and agricultural exports from China.

3.3.1 Model 1: Total Exports

Equation 2: Currency Volatility on Exports from China

3.3.2 Model 2: Agricultural Export Revenue

Equation 3: Currency Volatility on Agro-Export Revenue from China

4. Analysis

4.1 Univariate Analysis

Table 2: Aggregate statistics of the Variables

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Number of Obs. | Mean | S. Dev | Minimum | Maximum |
| Agro ER | 27 | 6.81E+09 | 3.81E+09 | 2.13E+09 | 1.35E+10 |
| Total EXP | 27 | 1.56E+12 | 1.2E+12 | 1.32E+11 | 3.72E+12 |
| ER | 27 | 7.3696 | 0.8648 | 6.1478 | 8.3700 |
| ERV | 27 | -0.0030 | 0.0294 | -0.0657 | 0.0569 |
| INF Rate | 27 | 2.6204 | 3.4673 | -1.4015 | 16.7912 |
| INT Rate | 27 | 2.6707 | 2.5785 | -1.4127 | 7.3565 |
| FDI Inflow | 27 | 3.0619 | 1.3250 | 0.2401 | 4.8809 |

Summary statistics in Table 2 show that there are a total of 27 observations considered in the study. This means that data for 27 years has been considered in the time series model. The statistics show mean revenue from Agro ER is 6.81 billion RMB. Total Exp has a value of 1560.0 billion RMB from China. The ER mean value is 7.3696 RMB/USD whereas the ERV has an average of -0.0030. The average value of the INF Rate is 2.6204 whereas the mean of the INT Rate is 2.6707. Finally, the FDI Inflow mean is recorded as 3.0619 percent.

Table 3: Dickey-Fuller Test Results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Base Model** | | **Difference** | |
| **Variable** | **Test Statistic** | **MacKinnon p-value** | **Test Statistic** | **MacKinnon p-value** |
| Agro ER | -0.478 | 0.8963 | -3.516 | 0.0076 |
| Total EXP | -0.012 | 0.9575 | -6.332# | 0.0000# |
| ER | -1.534 | 0.5165 | -2.899 | 0.0454 |
| ERV | -3.444 | 0.0096 | -6.556 | 0.0000 |
| INF Rate | -4.556 | 0.0002 | -3.950 | 0.0017 |
| INT Rate | -3.489 | 0.0083 | -5.092 | 0.0000 |
| FDI Inflow | 0.052 | 0.9626 | -3.075 | 0.0285 |

#: Second-order difference has been considered for the variable.

Table 3 shows the test statistic and probability values for the Dickey-Fuller (d-fuller) test. From the d-fuller test statistic, it could be realized that the p-values are not significant at the base level. Hence, the difference has been used to analyze the impact of RMB/USD shocks on the agricultural exports of China.

4.2 Multivariate Analysis

4.2.1 Impact of ER Volatility on Total Exports

Table 4: Regression Results of ERV on Log\_Total EXP

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable  (Log\_Total EXP) | Coef. | Std. Err. | t-Stat | P-Value | Lower confidence limit (95%) | Higher confidence limit (95%) |
| ERV | -1.5692 | 0.6365 | -2.4700 | 0.0220 | -2.8929 | -0.2454 |
| INT Rate | -0.0154 | 0.0083 | -1.8500 | 0.0790 | -0.0327 | 0.0019 |
| D\_FDI×ERV | 1.3133 | 1.3341 | 0.9800 | 0.3360 | -1.4610 | 4.0877 |
| Cons. | 0.1711 | 0.0369 | 4.6300 | 0.0000 | 0.0942 | 0.2479 |

The multivariate analysis in part 4.2.1 shows the impact that the ERV has on the Total EXP for China. Using the multivariate analysis, it is understood that ERV has an adverse impact on the Total EXP. The parameter estimate is -1.5692. The INT Rate also has a detrimental impact on the Total EXP with an estimated coefficient of -0.0154. Finally, the interaction term of D\_FDI×ERV on Total EXP has a coefficient of 1.3133.

4.2.2 Impact of ER Volatility on Agricultural Exports

Table 5: Regression Results of ERV on Log\_ Agro ER

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable (Log\_ Agro ER) | Coef. | Std. Err. | t-Stat | P-Value | Lower confidence limit (95%) | Higher confidence limit (95%) |
| ERV | -2.7539 | 0.6312 | -4.3600 | 0.0000 | -4.0666 | -1.4413 |
| INT Rate | -0.0226 | 0.0123 | -1.8300 | 0.0810 | -0.0482 | 0.0030 |
| D\_FDI×ERV | -3.1074 | 1.6629 | -1.8700 | 0.0760 | -6.5656 | 0.3508 |
| Cons. | 0.0952 | 0.0351 | 2.7100 | 0.0130 | 0.0222 | 0.1682 |

Table 5 shows the regression analysis for the impact of ERV on the Agro ER from China. The statistics show that ERV has a -2.7539 factor impact on the Agro ER from China. The INT Rate also has a coefficient of -0.0226 on the Agro ER. Finally, the D\_FDI×ERV also has a negative parameter estimate of -3.1074 on the Agro ER for China.

4.3 Post-Estimation Test

The paper also provides post-estimation test results for checking problems on multicollinearity and heteroskedasticity. From Table 6Ait has been understood that Model 1 has a total VIF of 1.87 and a Probability value of 0.6820 for the Breusch-Pagan Test. Table 6B, shows that for Model 2, the VIF mean was also 1.87 and a p-value of 0.1238 for the Breusch-Pagan Test. Based on the results of the VIF and Breusch-Pagan Test, problems regarding multicollinearity and heteroskedasticity could be ruled out.

5. Results

The results of the analysis show that Agro ER has grown in China between 1994 and 2023. During that period, the Total EXP in the region also grew substantially. The same can be observed inFigure 1. There is a downward impact on the ER levels for RMB/USD during the period of the study. The ER Levels fell from 8.6397 to 7.0809 between 1994 and 2023. The ERV shows a substantial level of fluctuation during the timeline of the research. There have been significant volatility trends during 2007-08, 2016 and 2020-21. Furthermore, the INF Rate shows a falling trend from 1994 to 2023. A similar trend is also observed for the interest rate. In 1994 the interest rate was recorded at -7.9897 per cent. However, in 2023, the same was recorded at 4.9613 percent. Finally, FDI Inflow has shown a falling trend during the timeline, as FDI inflows reduced from 5.98 percent of GDP to 0.24 percent of GDP.

The multivariate analysis in Table 4 shows that ERV has a negative impact on the Total EXP from China. As the volatility in ER for RMB/USD increased by 1 percent, the Log\_Total EXP reduced by 1.56 percent. This relation is significant as the statistical power of the coefficient has a probability value of 0.0220. INT Rate also has a negative impact on the Log\_Total EXP. When the interest rates rise by 1 unit, the value of the total outflow of exports from China decreases by 0.0154 percent. The interaction term between FDI and ERV has a positive impact on Log\_Total EXP through 0.1711 percent. However, this relation is not statistically significant.

The analysis in Table 5 shows when ERV increases, the Log\_ Agro ER is impacted adversely. A 1-point growth in volatility leads to a 2.7539 percent decline in agricultural trade revenue. The INT Rate also has a negative impact on Log\_ Agro ER. This is because when the INT Rate is raised by a point, the Agrarian export revenue falls by -0.0226 percent. Finally, the interaction between FDI and ERV shows a negative impact of -3.1074 percent on Log\_ Agro ER. The estimated coefficients for ERV are statistically significant at the 95% confidence level, while the remaining parameters are significant at the 90% confidence level.

6. Discussion

The results of the analysis reveal that the RMB/USD Shock has an adverse impact on the total exports from China. This could be understood as an increase in EV by 1 unit causing a fall in total exports by 1.5 percent. As per Lal et al. (2023), the volatility in currency creates uncertainty among consumers regarding future prices. This creates a risk-averse consumption pattern which reduces the demand in global markets. As a result, this advocates for a reduction in total exports from China. Furthermore, the results also show that there is an adverse relationship between the volatility of currencies and the export of agricultural products from China. This relation is appropriate as RMB/USD volatility shows a negative coefficient on the agricultural export levels. This could be explained by the study using Abdullahi et al. (2022). The study concludes that currency volatility adversely affects the export of agricultural commodities. This is because the shocks in prices lead to a rise in the prices of agricultural products. This leads to price-sensitive buyers to halt consumption with a price increase. Additionally, Figure 1 indicates a declining trend in the RMB/USD exchange rate. This means that there has been an appreciation in the RMB value against USD. As a result, the prices of exports increase. Thus, this makes Chinese agri exports more expensive for buyers in the US. As a result, the demand for the same decreases and the export falls.

7. Conclusion

7.1 Summary of the Study

In conclusion, currency volatility negatively affects both total exports and agricultural product exports from China to the USA. With respect to the results, both the null hypothesis considered in the research could be confirmed. A growth in currency volatility creates a negative effect on the total exports and exports of agricultural products from China. The policy rates of interest also negatively impact the total exports and the agricultural exports from China.

7.2 Limitations of the Study

One of the primary limitations of the study is that the study only considers the impact of Forex fluctuations on the agricultural exports of China toward its primary trading partners. However, both the trading partners considered in the study are developed economies. This leads to a substantial gap as the impact of the same on developing economies is not considered. Another limitation of the study is that more dynamic models such as the gravity model could be used in the study for estimation.

7.3 Directions for Future Research

Future research could incorporate data from both developed and developing economies to gain a greater understanding of the impact of currency rate fluctuations on China's agricultural exports. Moreover, dynamic models including gravity models could be used for estimation purposes.

**Data Availability Statement:**The data that support the findings of this study are openly available in Zenodo at https://doi.org/ 10.5281/zenodo.15063765, reference number15063765

References

Abdullahi, N. M., Zhang, Q., Shahriar, S., Irshad, M. S., Ado, A. B., & Huo, X. (2022). Examining the determinants and efficiency of China’s agricultural exports using a stochastic frontier gravity model. *PLoS One*, *17*(9), e0274187. <https://doi.org/10.1371/journal.pone.0274187>

Agenor, P. R. (1991). Output, devaluation and the real exchange rate in developing countries. *Review of World Economics*, *127*(1), 18-41. <https://doi.org/10.1007/BF02707309>

Archontoulis, S. V., & Miguez, F. E. (2015). Nonlinear regression models and applications in agricultural research. *Agronomy Journal*, *107*(2), 786-798. <https://doi.org/10.2134/agronj2012.0506>

Auboin, M., & Ruta, M. (2013). The relationship between exchange rates and international trade: a literature review. *World Trade Review*, *12*(3), 577-605. <https://doi.org/10.1017/S1474745613000025>

Benguria, F., & Taylor, A. M. (2020). After the panic: Are financial crises demand or supply shocks? Evidence from international trade. *American Economic Review: Insights*, *2*(4), 509-526. DOI: 10.1257/aeri.20190533

Bloomfield, J., & Fisher, M. J. (2019). Quantitative research design. *Journal of the Australasian Rehabilitation Nurses Association*, *22*(2), 27-30. DOI: 10.33235/jarna.22.2.27-30

Carter, C. A., Zhong, F., & Zhu, J. (2012). Advances in Chinese agriculture and its global implications. *Applied Economic Perspectives and Policy*, *34*(1), 1-36. <https://doi.org/10.1093/aepp/ppr047>

Chen, L. (2011). The effect of China's RMB exchange rate movement on its agricultural export: A case study of export to Japan. *China Agricultural Economic Review*, *3*(1), 26-41. <https://doi.org/10.1108/17561371111103525>

Dada, J. T. (2021). The asymmetric effect of exchange rate volatility on trade in sub-Saharan African countries. *Journal of Economic and Administrative Sciences*, *37*(2), 149-162. <https://doi.org/10.1108/JEAS-09-2019-0101>

Demir, F., & Razmi, A. (2022). The real exchange rate and development theory, evidence, issues and challenges. *Journal of Economic Surveys*, *36*(2), 386-428. <https://doi.org/10.1111/joes.12418>

FRED. (2025). *Chinese Yuan Renminbi to U.S. Dollar Spot Exchange Rate. [Data set].* Federal Reserve of St. Louis. <https://fred.stlouisfed.org/series/EXCHUS>

Kang, J. W., & Dagli, S. (2018). International trade and exchange rates. *Journal of Applied Economics*, *21*(1), 84-105. <https://doi.org/10.1080/15140326.2018.1526878>

Lal, M., Kumar, S., Pandey, D. K., Rai, V. K., & Lim, W. M. (2023). Exchange rate volatility and international trade. *Journal of Business Research*, *167*, 114156. <https://doi.org/10.1016/j.jbusres.2023.114156>

Nguyen, D. D. (2022). Determinants of Vietnam's rice and coffee exports: using stochastic frontier gravity model. *Journal of Asian Business and Economic Studies*, *29*(1), 19-34. <https://doi.org/10.1108/JABES-05-2020-0054>

Noh, S., So, E. C., & Zhu, C. (2025). Financial reporting and consumer behavior. *The Accounting Review*, *100*(1), 407-435. <https://doi.org/10.2308/TAR-2023-0293>

Shuai, C., & Wang, X. (2011). Comparative advantages and complementarity of Sino-US agricultural trade: An empirical analysis. *Agricultural Economics*, *57*(3), 118. DOI: 10.17221/46/2010-AGRICECON

Wang, Y., Xie, L., Zhang, Y., Wang, C., & Yu, K. (2019). Does FDI promote or inhibit the high-quality development of agriculture in China? An agricultural GTFP perspective. *Sustainability*, *11*(17), 4620. <https://doi.org/10.3390/su11174620>

WITS. (2025). *China Agricultural Raw Materials Exports by country and region in US$ Thousand 2022*. World Integrated Trade Solution. <https://wits.worldbank.org/CountryProfile/en/Country/CHN/Year/2022/TradeFlow/Export/Partner/all/Product/AgrRaw>

World Bank. (2025). *World Development Indicators. [Data set].* World Bank Group. <https://databank.worldbank.org/source/world-development-indicators>

Appendix A Post-Estimation Test Results

Table 6A: Test for VIF and B-Pagan for Multicollinearity and Heteroscedasticity for Model 1

|  |  |
| --- | --- |
| Variable | VIF |
| ERV | 2.33 |
| INT Rate | 1.25 |
| D\_FDI×ERV | 2.03 |
| Mean VIF | 1.87 |
| Breusch-Pagan | |
| Chi(2) | 0.17 |
| Prob>Chi2 | 0.682 |

Table 7A: Test for VIF and B-Pagan for Multicollinearity and Heteroscedasticity for Model 2

|  |  |
| --- | --- |
| Variable | VIF |
| ERV | 2.33 |
| INT Rate | 1.25 |
| D\_FDI×ERV | 2.03 |
| Mean VIF | 1.87 |
| Breusch-Pagan | |
| Chi(2) | 2.37 |
| Prob>Chi2 | 0.1238 |

Appendix B: Trend Analysis of the Key Variables



Figure 1: Trend Analysis of Key Variables: The figures should be numbered. Eg Fig 1(a), 1(b),,,