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China's Exports to Asian Islamic Economies: Do Bilaterally Currency Swap Agreements Matter?

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Abstract: *This study examines the impact of bilateral currency swap agreements on China's exports to 14 Islamic economies in Asia between 2015 and 2022. Using a gravity trade model, we find that the depreciation of the Chinese yuan (CNY) against the US dollar (USD) reduces China's exports to these countries. However, bilateral currency swap agreements (BCSA) mitigate the negative effects of exchange rate change on trade flows. The result provides new evidence on the stabilizing effect of BCSA, offering insights into how these agreements can support trade resilience in volatile currency environments. The results also reveal a significant negative relationship between per capita income disparity and exports, consistent with the Linder Hypothesis, which posits that countries with similar income levels engage in more bilateral trade. Furthermore, China's increasing foreign direct investment (FDI) in Islamic economies is positively associated with export growth, supporting Kiyoshi Kojima's argument that FDI promotes international trade.*

Keywords: China, Islamic Economies, Exports Trade, Gravity Equation, Bilateral Currency Swap Agreement

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1. Introduction

The COVID-19 pandemic, the adjustment of the CNY/USD exchange rate mechanism in 2015, and the U.S. Federal Reserve's interest rate fluctuations have led to significant volatility in the Chinese yuan (CNY) against the U.S. dollar (USD) between 2015 and 2022, greatly affecting China's international trade. Exchange rate change can directly impact a country's export competitiveness, as currency depreciation is typically viewed as a tool to boost exports by making them more price-competitive for foreign buyers. As China's economic influence in Asia continues to expand, its trade relationships with Islamic economies in the region have become increasingly important (Sun, 2021; Visvizi et al., 2019), particularly under the Belt and Road Initiative (BRI), which aims to enhance regional connectivity and economic cooperation.

During this period, the USD/CNY exchange rate experienced significant changes. As shown in Figure 1, From February 2015 to December 2016, the Chinese yuan (CNY) gradually depreciated against the U.S. dollar (USD), primarily due to the U.S. Federal Reserve's announcement to end the quantitative easing program initiated after the 2008 subprime crisis. Additionally, the People's Bank of China adjusted the central parity rate mechanism of the CNY in August 2015, causing a one-time depreciation of 1.86%. This was followed by the inclusion of the CNY in the Special Drawing Rights (SDR) basket in October 2016, further influencing the exchange rate. Subsequent trends included appreciation between December

2016 and April 2018, depreciation from April 2018 to March 2020 due to the U.S.-China trade war, and further fluctuations during the COVID-19 pandemic and post-pandemic economic recovery.

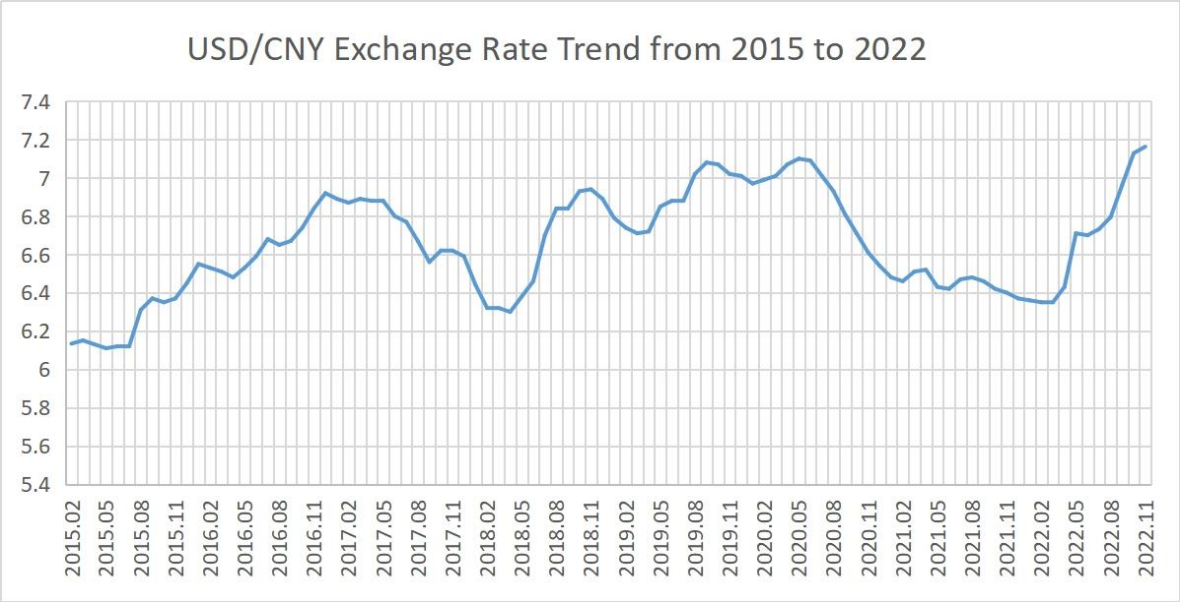

Figure 1: USD/CNY Exchange Rate Trend From 2015 To 2022
Source: The People's Bank of China

Given their economic importance, strategic geographic locations, and historical trade relationships with China, this study focuses on 14 representative Islamic economies, most of which are active participants in the Belt and Road Initiative (BRI), including Bangladesh, Brunei, Indonesia, Iran, Iraq, Kazakhstan, Malaysia, Kuwait, Oman, Pakistan, Qatar, Saudi Arabia, the UAE, and Turkey. These countries are critical trade partners for China, accounting for 90% of China's exports to all Islamic economies in Asia. Some of these countries have signed bilateral currency swap agreements (BCSA) with China, facilitating trade settlements in local currencies and reducing reliance on the USD. Understanding the factors driving China's export performance to these countries is crucial for policymakers seeking to stabilize trade flows and enhance economic cooperation under the BRI framework.

Despite the growing significance of China's trade with Asian Islamic economies, limited research has examined the role of bilateral currency swap agreements in mitigating the impact of exchange rate changes on trade flows. International economic theory suggests that currency depreciation typically enhances export competitiveness by lowering prices for foreign buyers (Krugman et al., 2017). However, excessive exchange rate changes risks that can undermine trade stability. BCSA offer a potential solution by enabling trade settlements in local currencies and reducing exposure to USD exchange rate fluctuations. Since 2008, China has signed BCSAs with numerous countries to stabilize trade flows, but their effectiveness remains underexplored in the context of specific regions, particularly Islamic economies in Asia.

This study addresses this research gap by exploring whether BCSA have successfully stabilized China's exports to Asian Islamic economies amid exchange rate fluctuations. The primary research question is: Do BCSA help stabilize China's exports to Asian Islamic economies in the face of exchange rate changes? To answer this question, this study employs a gravity model to analyse trade flows between China and 14 Islamic economies from 2015 to 2022. The key objectives are:

1) To assess the impact of CNY depreciation against the USD on China's exports to Islamic economies.
2) To evaluate the role of bilateral currency swap agreements in mitigating the negative effects of exchange rate change on export trade flows.
3) To examine the impact of economic factors such as GDP, per capita income disparity, and foreign direct investment (FDI) on China's export performance.

Although previous studies have examined the impact of exchange rate change on trade, few have focused specifically on China's export relationships with these 14 Asian Islamic economies. By analysing the economic and policy factors affecting these trade relationships, this study provides valuable insights for policymakers seeking to stabilize trade flows in a volatile global environment.

The remainder of this paper Is structured as follows: Section 2 reviews recent trade literature and discusses the theoretical background of the gravity model. Section 3 introduces the data sources and the gravity model used in this study. Section 4 presents the empirical results and discusses the findings. Finally, Section 5 concludes the study, provides policy recommendations, and identifies the study's limitations.

2. Literature Review and Hypotheses

2.1 Literature Review

In 1961, Staffan Linder introduced a theory to explain why trade is more frequent between countries with similar characteristics, a perspective that diverges from the Heckscher-Ohlin (H-O) theory by emphasizing the role of demand preference similarity in driving international trade. This theory, known as the Linder Hypothesis, specifically addresses trade in manufactured goods. Linder argued that the production and export of manufactured goods are primarily determined by domestic demand preferences. A country will initially develop and produce goods to meet its own demand and, subsequently, these goods are more likely to be exported to countries with similar demand preferences. Given this similarity in demand structures and wealth levels, a country tends to export a larger volume of manufactured goods to countries with comparable preferences (Johnson, 1964). The Linder Hypothesis therefore posits that international trade is influenced not only by differences in factor endowments but also by similarities in demand preferences. This hypothesis provides a valuable explanation for the post-World War II trade relationships among developed countries in Europe and North America, where trade was largely driven by similarities in consumer preferences. Countries with comparable levels of wealth tend to share similar demand structures and consumption patterns, making them more likely to engage in significant bilateral trade.

The Heckscher-Ohlin (H-O) theory, also known as the factor endowment theory, was developed by Swedish economists Eli Heckscher and Bertil Ohlin. It is a foundational theory in international trade that explains the traditional patterns of trade through the abundance and scarcity of production factors. The core premise of the H-O theory is that differences in factor endowments between countries result in comparative advantages in the production of different goods. The theory emphasizes the crucial role that a country's factor endowment differences play in driving international trade (Krugman et al., 2017).

The H-O theory illustrates that countries with abundant capital have a comparative advantage in producing capital-intensive goods, while countries with abundant labor have a comparative advantage in producing labor-intensive goods. When engaging in international trade, countries

export goods that intensively use their relatively abundant and cheaper production factors, while importing goods that intensively use their relatively scarce and expensive factors. The H-O theory is an extension and development of the theory of comparative advantage and provides a strong explanation of the trade relationships between developed and developing countries based on their differing factor endowments.

According to the latest World Bank classification of national income levels (*World Bank Country Classifications by Income Level for 2024-2025*), China is classified as an upper-middle-income country. Among its 14 Islamic trade partners, two—Bangladesh and Pakistan—are classified as lower-middle-income countries, while six are classified as high-income countries, namely Brunei, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. A common characteristic among these high-income countries is that they are all oil producers. The remaining six countries—Iran, Iraq, Turkey, Kazakhstan, Malaysia, and Indonesia—are classified as upper-middle-income countries.

From the perspective of per capita income, Qatar's GDP per capita exceeds $60,000, while the per capita GDP of Pakistan and Bangladesh are both below $2,000. The Linder Hypothesis emphasizes that trade volumes are larger between countries with similar income levels, as these countries are more likely to share similar demand preferences. In contrast, the Heckscher-Ohlin (H-O) theory highlights that trade volumes are greater between countries with different factor endowments. This theory suggests that trade is more likely to occur between countries with significant differences in wealth, as these disparities drive the production and export of different types of goods based on each country’s factor endowments.

Given the substantial differences between China and its 14 Islamic trade partners in terms of income levels and economic characteristics, it is important to examine whether their trade relationships are better explained by the H-O theory or the Linder Hypothesis. Understanding the underlying drivers of China’s trade relations with these countries is crucial for formulating trade policies and enhancing bilateral trade cooperation.

The Gravity Model is a classical model in the study of international trade, widely used to explain and predict the trade flows between two countries. It was first applied to trade analysis by Jan Tinbergen in 1962, who drew inspiration from the law of universal gravitation in physics. Tinbergen proposed that trade flows between two countries can be viewed as being jointly determined by their economic size and geographical distance. According to the model, the trade volume between countries is directly proportional to their economic size (measured by GDP). Larger economies generally have greater trade flows, as they tend to have higher levels of production and purchasing power. On the other hand, the model suggests that trade volume is inversely proportional to geographical distance—longer distances typically lead to lower trade volumes.

Geographical distance has a negative impact on trade flows, as indicated by the Gravity Model. In addition to measuring distance between countries' capitals, the model often substitutes transport costs to reflect the influence of distance on trade (Martinez-Zarzoso & Nowak-Lehmann, 2003).

Building on the Heckscher-Ohlin (H-O) theory, the Gravity Model can be integrated with various factors to explain trade relations between different countries. For instance, (Gul & Yasin (2011) and Sultan (2015) found that trade volumes between countries sharing the same language or similar cultures are significantly higher than those between countries with distinct

languages and cultural differences. Cultural differences often increase trade costs, thus affecting the flow of goods between nations.

In this study, we use GDP to measure the impact of economic size on bilateral trade flows. The larger the economies of China and its trading partners, the greater the flow of bilateral trade. Since geographical distance increases transportation costs, it is expected that the distance between China and these Islamic countries will have a negative effect on bilateral trade. This study uses the physical distance between the capitals of the countries as a variable to represent geographical distance.

In his discussion on FDI and trade flows, Mundell proposed that FDI and trade are substitutes, where foreign direct investment reduces international trade flows. In contrast, Kiyoshi Kojima put forward a completely different view, suggesting that FDI and trade are complementary, with increased FDI promoting international trade flows (Krugman et al., 2017). Whether FDI and international trade have a substitutive or complementary relationship remains inconclusive, as the outcomes depend on the economic sectors and industries involved. Helpman et al. (2008) analyzed panel data on foreign investment and trade across 52 industries in 38 countries, concluding that a country's foreign investment has a substitutive effect on its export trade. Pfaffermayr (1994) found that for market-oriented industries, foreign direct investment and trade are substitutes, while for production-oriented industries, they complement each other. Maza & Gutiérrez-Portilla (2022) explored the relationship between Spain's outward foreign direct investment (OFDI) and exports, finding a significant positive impact of OFDI on exports in the long term. Taiwanese scholar Chen et al. (2012) similarly found a positive correlation between Taiwan's exports and its firms' outward FDI, supporting Kojima's view that OFDI complements home-country exports.

In this study, we examine whether China's direct investment in Islamic countries complements or substitutes for its exports to these nations, considering the overall structure of China's economic sectors.

In recent years, scholars have conducted extensive empirical research on the relationship between exchange rate and international trade. Shaikh et al. (2019) found that in Pakistan, exchange rate change has a negative relationship with GDP and imports, while it shows a positive relationship with inflation and exports. Specifically, the depreciation of the USD/PKR exchange rate boosted Pakistan's exports, but the sudden exchange rate change had a negative impact on GDP growth. However, the study did not thoroughly discuss the structural differences in import and export goods that could have influenced these results. Akça (2021) examined the relationship between real exchange rates, exports, and trade openness in sub-Saharan Africa, finding a bidirectional causality between real exchange rates and exports, while the causality with imports was unidirectional. This suggests that exchange rate change are both influenced by and can impact exports and imports. However, Alege & Osabuohien (2015) through regression analysis using export and import gravity equations, concluded that exports and imports in sub-Saharan African countries are inelastic to exchange rate changes.

There is a limited amount of literature examining the impact of exchange rate change on trade flows between China and Islamic countries. Few studies focus on the long-term impact of USD/CNY exchange rate movements on China's export flows to Asian Islamic countries.

The theory of Optimum Currency Areas (OCA) was first proposed by (Mundell, 1957), with its core idea being that within a common currency area, member states can achieve optimal

economic efficiency and price stability through the free movement of production factors by implementing a single currency or a unified fixed exchange rate. Krugman et al. (2017), through his GG-LL model, further demonstrated that the formation of an optimum currency area needs to be based on close ties in the trade of goods and services and factor mobility. He argued that if trade and factor mobility between countries are high, establishing a common currency area (fixed exchange rate) could bring significant economic benefits; otherwise, it may not be suitable.

Currency swap agreements represent a novel financial arrangement, serving as an alternative to achieve some of the objectives of the OCA theory in the absence of a unified currency (fixed exchange rate). Such agreements involve two central banks exchanging local and foreign currencies at a predetermined exchange rate for a specific period to provide liquidity support and stabilize exchange rates, thereby promoting bilateral trade or investment (Mohammed, 2023). In international trade, most transactions are settled in US dollars, and fluctuations in the dollar's exchange rate introduce uncertainties in costs and revenues for exporters and importers, increasing trade risks. Currency swap agreements allow trade to be settled in local currencies, reducing dependence on the US dollar and mitigating exchange rate risks (Hao et al., 2022).

In recent years, many scholars have conducted empirical analyses on the role of currency swap agreements in international trade. Mohammed (2023) using a gravity model, examined the impact of bilateral currency swap agreements (BCSA) on bilateral trade and found that currency swaps, as a new institutional arrangement, can effectively promote trade growth, particularly between China and countries willing to accept the renminbi. However, this study did not fully consider the direct impact of exchange rate change on trade, nor did it analyze how differences in national policy environments might affect the results. Liu (2023) through the use of gravity models and instrumental variables, found that currency swap agreements have a significant role in promoting bilateral foreign direct investment (FDI). Although Liu's research provides strong evidence of the relationship between currency swaps and FDI, it focused on investment rather than trade flows, thus failing to directly reveal the effects of currency swap agreements on bilateral trade, especially exports.

The existing literature generally acknowledges the positive role of currency swap agreements in promoting bilateral trade and investment, but there are still some gaps. Most studies focus on the impact of currency swap agreements between China and the Belt and Road Initiative (BRI) countries or specific regions, lacking a comprehensive analysis of China's currency swaps with Asian Islamic countries. Moreover, few studies incorporate the interaction between currency swap agreements and exchange rate change, leaving an insufficient exploration of whether these agreements can mitigate the adverse effects of exchange rate change on trade. The study enriches the understanding of how financial agreements, such as BCSA, can address changes in exchange rate, offering a new dimension to the study of international trade.

2.2 Hypotheses

1) According to the H-O theory, the larger the economic sizes of two countries, the greater their bilateral trade volume. We expect that larger economies in China and Asian Islamic countries will facilitate China's increased exports to these countries.

2) The classical gravity model demonstrates that geographical distance is negatively correlated with trade flows between two countries. We expect that distance will have a significantly negative correlation with China's exports to major Asian Islamic countries.

3) According to the H-O theory, the coefficient of per capita income disparity is expected to be positive. On the other hand, based on the Linder Hypothesis, the coefficient would be negative. We anticipate that the coefficient of per capita income disparity between China and Asian Islamic countries will be negative.

4) Mundell's view suggests a negative relationship between foreign direct investment (FDI) and trade flows, while Kiyoshi Kojima argues that FDI and trade are positively related. We expect the coefficient of China's FDI inflows into Islamic countries to be positive.

5) Traditional international trade theory suggests that the depreciation of a domestic currency relative to the US dollar (an increase in the exchange rate) promotes exports. We expect the coefficient of the exchange rate (EXCH) to be positive.

6) Bilateral currency swap agreements (BCSA) reduce exchange rate risk and indirectly promote bilateral trade. We expect that, under the existence of a BCSA, the negative impact of exchange rate change on export flows will be mitigated.

3. The Equation, Sample and data source

3.1 The Specific Gravity Equation

The traditional gravity model, when transformed into a logarithmic form, is expressed as follows:

$$\ln(Trade_{ijt}) = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(GDP_{jt}) - \beta_3 \ln(Dis_{ijt}) + \varepsilon_{ij} \quad (1)$$

Equation (1) represents the traditional gravity model. In addition to the typical variables such as GDP and distance, as discussed in the literature review in Section 2, recently various studies have included other factors such as per capita GDP (Aksenov et al., 2023), population (Zhai, 2023), exchange rate (Shaikh et al., 2019), diplomatic visits (Hong et al., 2020), currency swap agreements (Hao et al., 2022; Mohammed, 2023), infrastructure (Hussain et al., 2020; Zhang et al., 2020), and common characteristics such as language, borders, and bilateral trade agreements (Irshad et al., 2018).

Building on the traditional gravity model, this study develops a specific gravity model to examine the factors influencing China's exports to its Asian Islamic trade partners:

$$\ln EX_{ijt} = \alpha + \beta_1 \ln GDP_{ijt} + \beta_2 \ln Dis_{ijt} + \beta_3 \ln GDPPC_{ijt} + \beta_4 \ln FDI_t + \beta_5 \ln EXCH_t + \beta_6 \ln EXCH_t \times BCSA + \varepsilon_{ij} \quad (2)$$

Where:
i=China, j=trade partners of China, t=time period, α=intercept, ε_{ij}= error term,
$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$= parameters,
EX_{ij}= Exports trade between China (country i) and China's 14 trade partners (country j)
GDP_{ij}=Gross Domestic Product of China and country j
Dis_{ij}=Geographic distance between China and country j
$GDPPC_{ij}$=Per capita GDP differential between China and country j
FDI=China's Direct Investment in country j
$EXCH$= USD/CNY

BCSA= whether China and country j have signed a bilateral currency swap agreement (dummy variable)

4. Data and Source

This study utilizes a balanced panel dataset covering the period from 2015 to 2022 for 14 Islamic economies. Panel data allows for the simultaneous analysis of both cross-sectional and time-series variations, providing richer information, reducing multicollinearity among explanatory variables, and increasing degrees of freedom, which enhances the robustness of the estimates. The dataset includes 112 observations (8 years × 14 countries). Calculations show that China's exports to these 14 Islamic economies account for 90% of China's total exports to all Islamic countries in Asia.

The study period starts in 2015 because, in August 2015, the People's Bank of China adjusted the USD/CNY exchange rate midpoint mechanism. The end of the period is set at 2022, as December of that year marks the reopening of China's borders following COVID-19 lockdowns. It is important to note that the term "China" in this study refers solely to mainland China, with all data excluding Hong Kong, Macau, and Taiwan of China.

The dependent variable in this study is EX_{ijt}, which represents China's export flows to its trade partners. The data is sourced from the China Customs Statistics, and the values are expressed in millions of US dollars.

The main explanatory variables in this study include the following:

1) GDP_{ij}: The economic scale of China and its trading partners, measured as the product of their Gross Domestic Products. Data is sourced from the World Bank Database and expressed in constant 2015 US dollars (millions).
2) $GDPPC_{ij}$: The absolute difference in per capita income between China and its trading partners, measured as the absolute value of the difference in per capita Gross Domestic Product in constant 2015 US dollars. Data is sourced from the World Bank Database.
3) DIS_{ij}: The geographic distance between the capitals of China and its trade partners. Data is sourced from the CEPII database and expressed in kilometers.
4) FDI: China's stock of direct investment in its trade partners, measured in millions of US dollars. Data is sourced from the Ministry of Commerce of China.
5) $EXCH$: The exchange rate between the Chinese yuan and the US dollar, measured using the direct quotation method (USD/CNY). The exchange rate data is sourced from the IMF Database and represents the annual average.
6) $BCSA$: A dummy variable indicating whether a bilateral currency swap agreement has been signed between the People's Bank of China and the central bank of a trade partner. It takes the value of 1 if an agreement was signed in year t, and 0 otherwise. Data is sourced from the People's Bank of China. To examine whether BCSA helps stabilize export flows in the face of exchange rate change, an interaction term $\ln \mathrm{EXCH} * \mathrm{BCSA}$ is included in the model.

Table 1: Data Sources and Description of Variables in the Specific Gravity Model

	Variable	Description	Expected Sign	Source
Dependent variable	ln EX	China's exports flows to 14 the islamic trade partners		China Customs Statistics
Explanatory variable	$\ln GDP_{ij}$	The product of the Gross Domestic Products of China and it's 14 trade partners (Constant 2015 USD millions)	+	World Bank database
Explanatory variable	$\ln GDPPC_{ij}$	The absolute value of the difference in per capita (GDP) between China and it's trade partners (Constant 2015 USD)	-	World Bank database
Explanatory variable	$\ln DIS_{ij}$	Capital distance between China and it's trade partners	-	CEPII data
Explanatory variable	lnFDI	Stock FDI of China in 14 the islamic trade partners (current, million US dollars)	-	China's Ministry of Commerce
Explanatory variable	$\ln EXCH$	Official Exchange Rate of USD/CNY	+	IMF Database
Explanatory variable	$\ln(EXCH) * BCSA$	Bilateral currency swap agreement	+	The People's Bank of China

(Source: Authors, 2024)

5. Estimation results and discussion

5.1 Descriptive Statistics, Correlation, and Multicollinearity Analysis

Table 2 presents the descriptive statistics for the variables used in the analysis. The dataset comprises 112 balanced panel observations spanning from 2015 to 2022. The dependent variable is the logarithm of exports (ln EX), while the independent variables include the logarithms of GDP (ln GDP), per capita GDP differences (ln GDPPC), distance (ln DIS), foreign direct investment (ln FDI), exchange rate (ln EXCH), and the interaction term between exchange rate and currency swap agreements (ln (EXCH)*BCSA).

From the descriptive statistics, the mean value of ln EX is 9.297, with a standard deviation of 1.218, suggesting moderate variability in exports across the sample period and countries. Ln GDP has a mean of 28.836 and a relatively low standard deviation of 1.108, indicating that the sample countries are relatively similar in terms of economic size. The variable ln GDPPC, which measures the absolute difference in GDP per capita between China and its trading partners, has a wider dispersion with a mean of 8.831 and a standard deviation of 1.328. The other independent variables, such as ln FDI, ln DIS, ln EXCH, and (ln (EXCH)*BCSA), show moderate variability, as indicated by their respective standard deviations.

Overall, the data display sufficient variability to support robust econometric modeling, with no apparent signs of extreme outliers, as indicated by the minimum and maximum values of the variables.

The correlations among the independent variables are generally low to moderate, with none of the pairwise correlation coefficients exceeding the commonly used multicollinearity threshold of 0.8. For instance, the correlation between ln GDP and ln FDI is 0.742, significant at the 1% level, reflecting a positive association between a country's economic size and its foreign direct investment. The correlation between ln GDPPC and ln GDP is negative and significant at -0.300, indicating that countries with higher GDP levels tend to have smaller GDP per capita

differences with China. Additionally, the correlation between (ln(EXCH)*BCSA) and ln FDI is 0.610, suggesting that currency swap agreements may be linked to higher foreign direct investment.

Although the correlations suggest that multicollinearity is not severe, further diagnostics using the Variance Inflation Factor (VIF) are conducted to ensure robustness. The VIF values for all variables are well below the critical threshold of 10, indicating that multicollinearity is not a concern in the model. The highest VIF value is 3.08 for ln FDI, which remains within acceptable limits, ensuring that including FDI does not introduce significant multicollinearity issues. Other key variables, such as ln GDP and the interaction term (ln (EXCH)*BCSA), have VIF values of 2.30 and 1.65, respectively, further confirming the absence of serious multicollinearity problems.

These results imply that the model's estimates are unlikely to be biased or inefficient due to multicollinearity. Consequently, the regression analysis can proceed without the need for further adjustments to address multicollinearity concerns.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lnEX	112	9.297	1.218	6.145	11.426
lnGDP	112	28.836	1.108	25.686	30.601
lnGDPPC	112	8.831	1.328	3.201	10.985
lnDIS	112	8.7	.555	8.018	10.507
lnFDI	112	7.507	1.413	4.298	10.115
lnEXCH	112	1.895	.033	1.829	1.933
ln(EXCH)*BCSA	112	.947	.952	0	1.933

Source: (Authors' compilation from EViews 13.0, 2024)

5.2 OLS regression and GLS regression

First, we conducted a baseline regression using Ordinary Least Squares (OLS) to examine the impact of various independent variables on China's exports to 14 Islamic economies in Asia. As shown in Table 3, the OLS regression results indicate an adjusted R-squared of 0.8763, which means the model explains 87% of the variation in exports, demonstrating a good fit.

The F-statistic for the OLS regression is 124.0333 with a p-value of 0.0000, indicating that the overall model is highly statistically significant. Furthermore, the Durbin-Watson statistic of 0.5082 suggests the potential presence of serial correlation in the OLS regression results. To determine whether a fixed effects model or a random effects model would be more appropriate, we conducted a Hausman test. The test yielded a Chi-square statistic of 0.0000 and a p-value of 1.0000, leading us to fail to reject the null hypothesis. This suggests that the random effects model is more suitable for the analysis, avoiding the potential estimation bias that could arise from using a fixed effects model.

To validate the reliability of the model estimates, a heteroskedasticity test was conducted. The results from the likelihood ratio (LR) test for heteroskedasticity revealed significant cross-sectional heteroskedasticity (p-value = 0.0000), while no significant heteroskedasticity was found in the time-series dimension (p-value = 0.9997). Given these findings, Generalized Least Squares (GLS) estimation was applied, incorporating cross-sectional weighting to address the heteroskedasticity and ensure robust and reliable model estimates.

As shown in Table 3, the GLS regression results indicate improved significance levels for the independent variables, and the signs of the coefficients align with theoretical expectations. The adjusted R-squared increased to 0.9273, significantly higher than that of the OLS model, suggesting that the GLS model provides stronger explanatory power and more robust estimates.

From the GLS regression results, we observe that the coefficient for economic scale (ln GDP) is 0.5796 and significant at the 1% level, indicating a positive and significant impact of economic scale on exports. This result suggests that as the economic size of China's Islamic trading partners increases, export flows also rise. Larger Islamic economies tend to have greater purchasing power and market demand, providing China with a broader market for its exports. Additionally, the economic complementarity arising from similar economic scales may further enhance trade relationships.

The coefficient for the per capita GDP gap (ln GDPPC) is -0.2540 and significant at the 1% level, indicating that the larger the income gap between China and its trading partners, the lower the exports. This can be explained by the fact that, as income disparity widens, consumption patterns between countries may diverge, reducing trade opportunities. The regression results support the Linder Hypothesis, which posits that countries with similar income levels are more likely to engage in bilateral trade. An increase in the income gap could lead to greater differences in consumption structures, thereby decreasing opportunities for bilateral trade.

The coefficient for distance (ln DIS) is -0.3925 and significantly negative, consistent with traditional international trade theory. This result indicates that greater geographic distance reduces trade flows, as distance increases transportation costs and undermines the competitiveness of both trading partners.

The coefficient for foreign direct investment (ln FDI) is 0.3454 and significantly positive. This reflects that China's direct investments in Islamic countries promote its exports. This finding supports Kiyoshi Kojima's viewpoint that foreign direct investment can foster trade growth by facilitating technology transfer and creating supply chain linkages. While this finding aligns with Kiyoshi Kojima's viewpoint, it is worth noting that the potential bidirectional causality between FDI and exports warrants further exploration in future studies.

The coefficient for ln EXCH is -2.39807 and significant at the 5% level, indicating that the depreciation of the Chinese yuan against the US dollar (ln EXCH increases) did not promote China's exports but rather led to a decrease in exports, which contradicts traditional international trade theory.

The interaction term between the currency swap agreement and exchange rate (ln (EXCH)*BCSA) becomes significant in the GLS regression, with a coefficient of -0.1282. This indicates that under the currency swap agreement (BCSA), the negative impact of exchange rate change on exports is mitigated. The currency swap agreement reduces exchange rate risks in bilateral trade by allowing both parties to settle transactions in their respective local currencies, thereby reducing dependence on the US dollar and enhancing the stability of exports.

Based on the regression results, we derive the following gravity model for this study:

$$\ln EX = 0.266517 + 0.579628 * \ln GDP_{ij} - 0.253903 * \ln GDPPC_{ij} - 0.392489 * \ln DIS_{ij} + 0.345443 * \ln FDI - 2.397854 * \ln EXCH - 0.1278162 * \ln EXCH * BCSA$$

Table 3: Regression of OLS and GLS

	OLS Coefficient	Std. Error	GLS Coefficient	Std. Error (White Cross-section).
$\ln GDP_{ij}$	0.559453***	8.579828	0.579628***	0.032085
$\ln GDPPC_{ij}$	-0.203880***	0.035815	-0.253903***	0.035740
$\ln DIS_{ij}$	-0.465203***	0.084161	-0.392489***	0.051797
$\ln FDI$	0.368812***	0.051866	0.345443***	0.014178
$\ln EXCH$	-3.860517***	1.284355	-2.397854**	0.703805
$\ln(EXCH) * BCSA$	-0.023390	0.056345	-0.128162***	0.023463
Constant	3.580762	3.037105	0.266517	1.861923
Number of Obs	112		112	
R^2	0.876360		0.931216	
Adjusted R^2	0.869295		0.927286	
Durbin-Waston Statistics	0.508315		0.812360	
F-statistic	124.039861		236.9201	
Prob(F-statistic)	0.000000		0.000000	

Source: (Authors' compilation from EViews 13.0, 2024)
*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

6. Conclusion, Limitations and Future Research

This paper investigates the key drivers of China's exports to 14 Islamic economies in Asia over the period 2015 to 2022. By applying a Generalized Least Squares (GLS) regression model, it addresses heteroskedasticity concerns and improves the robustness of the results. The findings identify several significant economic and policy-related factors that shape China's export performance.

First, economic scale has a significant positive impact on exports. A 1% increase in the economic size of China's trading partners leads to a 0.58% increase in China's exports to those countries. This supports the international trade theory, which posits that larger economies generate greater export flows. Second, per capita GDP disparity (lnGDPPC) shows a significant negative relationship with exports. A 1% increase in the income gap between China and its trading partners results in a 0.25% reduction in exports. This finding supports the Linder Hypothesis, which suggests that countries with similar income levels are more likely to engage in bilateral trade.

Additionally, distance has a significantly negative effect on exports. A 1% increase in the geographic distance between China and its trading partners leads to a 0.39% decrease in exports. Greater distance increases transportation costs and trade barriers, thus reducing trade flows. Foreign direct investment (FDI) also exhibits a significant positive relationship with exports. A 1% increase in China's direct investment in its trading partners leads to a 0.35% increase in exports. This finding supports Kiyoshi Kojima's theory, which posits that FDI can stimulate bilateral trade growth. However, the relationship between FDI and exports may involve bidirectional causality. While GLS effectively handles heteroskedasticity, it does not

resolve potential endogeneity concerns. Future studies could employ Generalized Method of Moments (GMM) to address the issue and provide more precise insights into this relationship.

Notably, CNY depreciation (ln EXCH increase) does not promote exports as expected, but rather decreases export flows. A 1% depreciation of the Chinese yuan against the US dollar results in a 2.40% reduction in China's exports to Islamic countries. This finding contradicts the traditional view in international economics that currency depreciation enhances export competitiveness. One possible explanation for this unexpected result is that this study relies on aggregate export data, which may obscure sectoral or product-level dynamics. Different industries or products may respond differently to exchange rate changes, depending on their reliance on imported inputs or their sensitivity to price competitiveness.

The interaction term (ln (EXCH)*BCSA) is significant in the GLS regression, with a coefficient of -0.1282. This indicates that under a bilateral currency swap agreement (BCSA), the negative impact of CNY depreciation on exports is mitigated. BCSA help reduce the uncertainty and cost increases associated with US dollar exchange rate change, thereby stabilizing export flows. Specifically, in the presence of a currency swap agreement, the decrease in exports due to exchange rate change is reduced by 2.4% adjust to reduce by 0.13%. The result demonstrates that BCSA play a critical role in stabilizing trade flows by mitigating the negative effects of exchange rate changes, particularly in China's exports to Asian Islamic economies. This finding underscores the importance of the BCSA mechanism in fostering trade stability and advances the existing literature. Policymakers in China should prioritize negotiating agreements with key trading partners, especially Asian Islamic economies that have not yet signed BCSA.

The study examines aggregate exports between China and 14 Islamic economies in Asia, providing a comprehensive overview of trade flows. However, aggregate data may obscure heterogeneity across industries, as the impact of exchange rate changes and bilateral currency swap agreements (BCSA) could vary significantly across sectors such as agriculture, manufacturing, or high-tech industries. Future research should integrate sectoral trade data to better understand how export structures influence the effectiveness of BCSA in mitigating exchange rate risks.

Additionally, this study focuses exclusively on China's trade with Islamic economies in Asia and does not include Islamic economies in other regions such as the Middle East, North Africa, or Sub-Saharan Africa. Expanding the geographic scope in future research could provide a more comprehensive understanding of the role of BCSA in stabilizing trade flows. Furthermore, future studies could consider additional factors such as political dynamics and trade agreements to enrich the analysis.

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