economies

MDPI

Article

The Impact of Economic Factors on Saudi Arabia's Foreign Trade with BRICS Countries: A Gravity Model Approach

Houcine Benlaria

Department of Business Administration, College of Business, Jouf University, Sakaka 72388, Saudi Arabia; hbenlarir@ju.edu.sa

Abstract: Our investigation, bolstered by the robust gravity trade model and panel data econometric technique, underscores the pivotal factors that influence trade interactions between Saudi Arabia and the BRICS nations—Brazil, Russia, India, China, and South Africa. The study, spanning from 1998 to 2023, delves into key economic metrics such as the gross domestic product, exchange rate fluctuations, inflationary trends, political conditions, and trade deals. We employ a range of econometric strategies, including pooled Ordinary Least Squares (OLS) and fixed effects models, to reveal that the GDP of BRICS states consistently and significantly impacts trade volumes. Specifically, a 1% increase in the GDP of partner countries correlates with a 0.37% rise in trade volume within the pooled OLS model. This effect amplifies to 1.43% when adjusting for temporal and country-specific factors in the fixed effects, underscoring the importance of accommodating unobserved heterogeneity, which refers to the unmeasured factors that can influence the relationship between GDP and trade volume. The political stability of BRICS nations mitigates transactional risks and promotes more stable trade relationships, thereby enhancing trade flows. Fluctuations in exchange rates exert positive and significant effects. This indicates that a more robust Saudi Riyal, an essential policy instrument, can enhance trade by increasing the competitiveness of Saudi exports. This study demonstrates that economic magnitude, political stability, and exchange rates affect Saudi Arabia's trade with BRICS nations. These results bolster the Kingdom's Vision 2030 objectives for economic diversification. This research advocates for stable political climates and strategic trade agreements to enhance trade relations. This study asserts that this approach will guarantee sustainable growth and diminish the Kingdom's reliance on oil exports, instilling optimism in the Saudi economy.

Keywords: Saudi Arabia; BRICS; gravity model; trade determinants; economic diversification; GDP; exchange rates; inflation; political stability; Vision 2030

Citation: Benlaria, Houcine. 2024. The Impact of Economic Factors on Saudi Arabia's Foreign Trade with BRICS Countries: A Gravity Model Approach. *Economies* 12: 305. https://doi.org/10.3390/economies12110305

Academic Editor: E. M. Ekanayake

Received: 29 September 2024
Revised: 5 November 2024
Accepted: 8 November 2024
Published: 12 November 2024

1. Introduction

International trade is integral to the advancement of economic growth and the processes of globalization. The relevance of international commerce stands out distinctly in Saudi Arabia, which aims to realize economic diversification and advancement beyond its historical focus on oil exports. In 2022, oil exports constituted 75% of the Kingdom's total export revenues (Saudi General Authority for Statistics 2022). Through its Vision 2030 initiative, the Saudi government seeks to enhance economic diversity and lessen the nation's oil dependency by fostering strategic collaborations, supporting inventive ideas, and drawing international investments. Central to this diversification initiative is enhancing trade partnerships with the BRICS nations—Brazil, Russia, India, China, and South Africa—which collectively signify some of the most substantial and swiftly enlarging economies globally.

Together, BRICS nations contribute over 23% to the world's GDP and account for 41% of the global populace (International Monetary Fund 2023). By capitalizing on these nations' economic dynamism, accelerated industrialization, and expansive markets, Saudi Arabia has the potential to augment its non-oil exports significantly. Pursuing its Vision

2030 strategy, Saudi Arabia is determined to expand non-oil exports from 16% of GDP in 2016 to 50% by 2030. After initial victories in diversification, Saudi Arabia's non-oil exports climbed to a historic peak of USD 85 billion in 2022, a noteworthy increase from USD 57 billion in 2018 (Saudi Exports Development Authority 2023). The Kingdom's strategy to enhance non-oil exports and achieve sustainable economic growth is fundamentally reliant on fortifying trade relationships with the BRICS nations, given their substantial economic stature and influence in global trade.

Saudi Arabia regards its commercial alliances with BRICS nations as pivotal due to their escalating influence on the global stage. In 2022, the financial exchange between Saudi Arabia and China surged to USD 87 billion, signifying 17.5% of the cumulative trade volume (Saudi Ministry of Commerce 2023). India, recognized as another prominent BRICS economy, is a significant importer of Saudi oil, and the two nations will engage in USD 42.8 billion of bilateral trade in 2022. Both nations exhibit a mutual desire to collaborate in sectors such as technology, agriculture, and infrastructure. Furthermore, Saudi Arabia has the opportunity to diversify its imports and establish partnerships in energy and food security with Russia and Brazil, both of which are substantial agricultural and resource-rich economies. South Africa may not be the biggest in scale within the BRICS coalition. However, it is a key connection for Saudi exports to African markets, with a reported bilateral trade worth USD 4.5 billion in 2022 from the South African Department of Trade and Industry in 2023. These trade connections exemplify the economic significance of BRICS nations in Saudi Arabia's endeavors to assimilate into global value chains and diversify its economic framework. The gravity model suggests that economic interactions between nations are influenced by their GDP and geographic separation and is an insightful analytical resource for exploring trade relationships. This structure has acquired significant acknowledgment in the worldwide trade examination field due to its ability to discern critical trade elements such as market magnitude, trade expenses, and spatial considerations. Lohani (2024) stated that "the gravity model has become a standard approach for evaluating the trade dynamics between countries, particularly in analyzing the role of GDP, trade agreements, and geographical distance". The gravity model estimates potential trade flows between countries and explains international trade drivers by focusing on economic variables like GDP, exchange rates, inflation, and political stability.

The gravity model applies to Saudi Arabia's trade with BRICS countries because of their large economies and importance in growing trade. The BRICS bloc has a USD 27.6 trillion GDP (Visual Capitalist 2023), making it Saudi Arabia's key economic partner. Subhan et al. (2021) stated that "larger economies tend to trade more because they have the production capacity and consumer demand necessary to support higher trade volumes". This is consistent with the gravity model's prediction that economy size strongly affects trade potential. As Saudi Arabia diversifies away from oil and boosts non-oil exports, deeper trade relationships with BRICS countries can open up economic opportunities.

While economic size is important, exchange rates, inflation, and political stability also affect trade. Exchange rate fluctuations can significantly influence the competitiveness of exports, particularly for countries whose currencies are not pegged to stable international benchmarks (Ijirshar et al. 2022). The Riyal is pegged to the U.S. dollar, so exchange rate fluctuations in BRICS countries could boost or hurt Saudi exports. Recent volatility in the Russian ruble and Brazilian real has made trade with these countries risky, requiring careful fiscal and trade policy adjustments. Understanding these dynamics is crucial for policymakers and trade negotiators when formulating trade strategies and agreements.

Another major factor affecting Saudi Arabia–BRICS trade is inflation. A trading partner's high inflation can reduce purchasing power and import demand, while Saudi Arabia's inflation can hurt export cost competitiveness. As Kalu and Anyanwaokoro (2020) said, "inflation reduces the real value of currency, making exports less attractive and imports more expensive, thus negatively impacting trade volumes". Saudi Arabia's trade with BRICS nations is affected by inflation rates, particularly in Brazil and South Africa, which requires a nuanced approach to trade agreements and pricing strategies.

Trade relationships also benefit from political stability. Trading partner countries with stable governance reduce uncertainty and encourage long-term investments and trade agreements. Beshkar and Bond (2019) stated that "political stability enhances trade flows by reducing the risks associated with international transactions and creating a conducive environment for economic cooperation". Saudi Arabia needs political stability in BRICS countries to maintain strong trade ties. China and India maintain stable governmental structures, which have facilitated the establishment of enduring trade and economic alliances with Saudi Arabia.

Conversely, the prevailing political instability in Russia, particularly in recent geopolitical conflicts, has obstructed the trade movement. Trade agreements are essential for realizing the trade potential between Saudi Arabia and BRICS nations, alongside GDP, exchange rates, inflation, and political stability considerations. In the past several decades, numerous trade agreements have been forged by Saudi Arabia with BRICS countries, all to foster economic integration and trade liberalization. China ranks as one of Saudi Arabia's principal trading partners. This status has been bolstered by the 2016 Saudi–China Comprehensive Strategic Partnership, which has enhanced collaboration in the energy, infrastructure, and technology sectors. Agreements in the agriculture, defense, and renewable energy sectors have widened the trade connection between Saudi Arabia and India. Yao et al. (2021) contended that "regional and bilateral trade pacts have a notably beneficial effect on trade dynamics by reducing trade obstacles and creating favorable environments for economic cooperation". This investigation will employ the gravity trade model to scrutinize Saudi Arabia's trade exchanges with BRICS countries, emphasizing GDP, exchange rates, inflation, political stability, and trade agreements. This research analyzes these variables to ascertain the determinants influencing trade dynamics between Saudi Arabia and the BRICS nations.

Furthermore, the study will explore how these determinants correspond with the objectives outlined in Saudi Arabia's Vision 2030, which aims to augment non-oil exports and foster sustainable economic development through diversified international trade relations. The Kingdom of Saudi Arabia progressively depends on commerce with BRICS states to expand its economy and reduce its oil reliance. The expansive and developing economies of BRICS nations give Saudi Arabia ample opportunities to enhance its non-oil exports and integrate further into global value chains. This research will investigate the economic factors propelling trade flows between Saudi Arabia and BRICS countries by applying the gravity model, thereby equipping policymakers and trade negotiators with critical insights to enhance these strategic partnerships.

This study employs the gravity trade model to discern the factors that shape bilateral trade relations between Saudi Arabia and the BRICS countries. Its key variable, bilateral trade volume, reflects economic interactions between these nations. The study examines how GDP, exchange rates, inflation, and political stability affect Saudi Arabia–BRICS trade. It also examines how trade agreements and diplomacy foster bilateral trade relations, emphasizing their importance in the global economy.

By focusing on bilateral trade as the primary dependent variable, this research aims to provide a comprehensive analysis of the determinants shaping Saudi Arabia's commercial exchanges with BRICS nations. This approach quantifies the impact of various factors on trade volumes, offering insights into the dynamics of these important economic relationships. This study enriches the body of knowledge on international trade by presenting an empirical examination of Saudi Arabia's bilateral commercial interactions with BRICS nations. This area has received limited scholarly attention within the context of Saudi economic policy. By adopting the gravity model with bilateral trade as its focal point, this analysis provides a unique conceptual framework for understanding the determinants that influence bilateral trade dynamics. It offers a fresh perspective on how Saudi Arabia might enhance its trade relations with these emerging markets, piquing the interest of the audience. Furthermore, this investigation is necessary for policymakers and trade negotiators, as it sheds light on the economic and political factors that have significantly

influenced Saudi Arabia's bilateral trade achievements with the BRICS member states. By identifying crucial trade flow determinants and presenting fact-based approaches, we expect this research on bilateral trade flows to aid in strategic trade planning and support Saudi Arabia's efforts to achieve economic diversification and stronger international trade ties.

With a focus on bilateral trade, this study aims to bridge existing research gaps and propose practical suggestions. Saudi Arabia's Vision 2030, particularly in terms of international trade and relations with BRICS countries, aims to facilitate the realization of these suggestions. By offering actionable insights, the study aims to engage policymakers, trade negotiators, and other stakeholders, fostering a sense of anticipation for the potential impact of the research outcomes.

2. Literature Review

2.1. Gravity Model in Trade Studies

The gravity model, also known as the gravitational model of bilateral trade, has its historical perspective from the work of Tinbergen in 1962, who is regarded as the first person to develop the ideas of gravity into trade patterns (De Benedictis and Taglioni 2011). The gravity model, which shows the effects of trade patterns on the gross domestic product (GDP), the distance between two or more countries or regions, and the exchange and trade rates (Lohani 2024; Leitão 2024), has a rich historical development. Its potential was first mentioned by Anderson in 1979 (Anderson 1979), building on Tinbergen's work. Anderson postulated that the gravity model could be derived from intercountry expenditure systems with differentiated goods. Bergstrand (1989) took this theoretical base further and integrated the gravity and chain models by introducing monopolistic competition and the Heckscher–Ohlin model. The theoretical improvements of the gravity model of trade, however, were inspired when Anderson and Van Wincoop (2003) argued that trade patterns and trade costs can be better understood, creating a revolution in economic science. This historical context not only provides a deeper understanding of the model but also connects the audience to its evolution and progress.

It is understandable why this model's practical perspective, which includes determining trade volume and predicting countries that may trade with each other, can appeal to researchers and economists (Jadhav and Ghosh 2024). This model's central feature assumes a proportionate relationship between trade between two countries and their GDP, whilst trade declines with increasing distance (Baier et al. 2018). However, recent advances to this model have expanded its prospects. Kancs (2007) modified the model to include firm heterogeneity and zero–bilateral trade flows, while Piermartini and Yotov (2016) published systematic approaches to structural gravity estimations. Trade flows can be reliably explained through economic size, given that larger economies participate more in trade as they can produce more goods and services. The distance between two markets influences the degree of transport costs and the degree of cultural integration, limiting the amount of trade done (Jadhav and Ghosh 2024).

Moreover, commercial activity is greatly affected by dynamic foreign exchange rates, especially in regions like SAARC, where there are variations affecting bilateral trade volumes (Banik and Roy 2021). There have also been regional trade agreements that have exhibited favorable trade flow improvements, thus supporting the benefits of trade liberalization (Yao et al. 2021; Jámbor et al. 2020; Demidova et al. 2024). Recent research also shows that PTAs can be effective in enhancing trade and sustainable growth (Yao et al. 2019). Regarding BRICS countries, De Castro (2013) and Rasoulinezhad and Jabalameli (2018) have also studied trade patterns using the gravity model within this grouping of emerging economies. The gravity model, with its role in deepening and enhancing the understanding of global trade principles, enlightens the research, students, and actuators in this field (Lohani 2024). Its adaptation and usage in different settings exemplify its importance and significance to trade studies today.

Notwithstanding its popularity, the gravity model has many limitations. Konstantaras et al. (2018) point out that such models are suitable for making trade-level forecasting with economic and geographical determinants. Trade provides an assumption of symmetry which might be incorrect in some cases, especially when economic partners have significant differences. The same is true about global value chains, which refer to the international dispersion of tasks within and between companies, as they are intricately related and difficult to model (Piermartini and Yotov 2016). For resource-rich countries, the measure of economic size assessed through GDP levels is unrealistic since it does not justify their trading potential. This model dramatically assists trade policy analysis, but the built-in constraints regarding economic and political space must be observed.

2.2. Key Economic Factors

The volume of international exchanges and the trade relations between countries depend significantly on factors such as the gross domestic product (GDP). GDP causes relatedness, a dimension of the gravity trade model. This model, which is a key concept in international trade, explains how the economies and trade relations of two or more countries are connected depending on their production and trading quantities. More economic trade activities occur in countries with larger GDPs because their economic output is excellent, with enough imports consumed. This relationship is further supported in papers by Yotov (2022) and Lohani (2024), the latter of whom examines trade dynamics for India among the BRICS nations. Likewise, research by Subhan et al. (2021) shows that G7 countries trade primarily with each other and with other economically strong countries. In contrast, Hussain et al. (2020) discuss the effects of distance and infrastructure, which are again determined by GDP. Lypko (2022) adds to this issue for Central and Eastern Europe and boosts the importance of the economic dimension in defining trade flows.

International trade relations are also characterized by bilateral agreements and the country's macroeconomic stability. When utilized effectively, these agreements have the potential to significantly boost trade volumes and cooperation, thereby fostering a more robust global economy. Beshkar and Bond (2019) delve into the key features of such agreements, highlighting their role in reducing trade barriers and expanding regional economies, offering a promising outlook for their potential impact.

Another crucial aspect of fostering a prosperous commercial environment is the inclusion of intellectual property protection in trade agreements, as Campi and Dueñas (2019) have underscored. This provision ensures that the fruits of innovation and creativity are respected and rewarded, instilling a sense of fairness and equity in international trade relations.

States often resort to tariffs as a means of regulating international trade. While they are intended to safeguard local industries, generate revenue, and even provoke conflicts and retaliations, it is important to note that they can also disrupt existing trade patterns and relations in some developed economies, as Corrêa and Gomes (2018) have pointed out. This potential for disruption should be a cause for concern in the context of international trade.

Changes in the exchange rate also play a vital role in the overall picture since they instill strong effects on the volume of exports and the prices of imports and, therefore, on international trade and economic equilibrium. For instance, Ijirshar et al. (2022) have observed that an appreciation of a nation's currency tends to make its exports dearer and its imports relatively cheaper, thereby affecting the balance of trade. On the flip side, a currency's depreciation improves exports' competitiveness but increases imports' cost (Nguyen and Do 2020). The uncertainty brought about by exchange rate volatility, particularly in developing nations, underscores the urgent need for astute political decision-making to foster economic stability, as analyzed by Bussière et al. (2020) and Babapour et al. (2021).

Exchange rates and inflation affect real purchasing power, currency valuations, and trade competitiveness, affecting international trade. Exchange rates are important in trade dynamics, but their effects vary by economic dimension. Currency effects in international

economics are complex, as Daskalopoulos et al. (2016) found a non-significant effect of exchange rates on foreign direct investment under certain conditions. Kalu and Anyanwaokoro (2020) explain how rising prices reduce consumer purchasing power, affecting import demand and trade volumes. According to Jacob et al. (2021), inflation and other factors affect export valuations, complicating trade. Rising import costs can strain economies dependent on foreign goods, as described by Kassouri and Altıntaş (2020). Keho (2021) and Rolim et al. (2022) noted that inflation-driven exchange rate adjustments can change trade terms between countries, requiring nuanced policy responses to navigate these complex dynamics. This study examines exchange rates' direct and indirect effects on trade competitiveness through broader economic channels, acknowledging that traditional trade models may not fully capture the relationship between exchange rates, inflation, and trade flows.

These economic factors show the complex relationship between bilateral agreements, tariffs, macroeconomic stability, and global trade scenarios (Schram et al. 2018; Glauben and Duric 2024; Hassan et al. 2023).

2.3. Saudi Arabia's Trade Patterns

The growing academic interest in the business relations between Saudi Arabia and BRICS nations is a testament to the potential benefits of the Saudi Vision 2030 initiative in a changing global economic scenario. The expansion of BRICS has opened new avenues for Arab economies, offering promising prospects for commercial diversity and economic collaboration (Rabczun 2024). Saudi Arabia's engagement with these nations, driven by its Vision 2030 initiative to reduce oil dependence and diversify its economy, is a beacon of hope for a more diversified and resilient economy (Saudi Vision 2030 2016). This initiative holds great potential for the future (Yusuf and Nasrulddin 2024). The strategic importance of the diplomatic efforts of trade sanctioned under the structure of BRICS cannot be overstated, particularly in sectors like agriculture and technology, hinting at a robust future for collaboration (Chien et al. 2021).

Despite these ideas, significant gaps in the literature persist. A remarkable area is the impact of geopolitical risks and economic policy uncertainties on Saudi trade with BRICS nations (Li et al. 2024). The sustainability of the relationship in the light of floating political climates is fundamental to understanding future trajectories (Imtiaz et al. 2023). Moreover, although many studies address economic challenges and opportunities, there is a pressing need for a comprehensive analysis focused on microeconomic factors that influence commercial ties. This gap, particularly when evaluating how local companies interact with the BRICS framework, is crucial and urgent to address to gain a more nuanced understanding of business relations.

3. Methodology

3.1. Source of Data

According to this panel dataset, economic factors affected Saudi Arabia's foreign trade with BRICS countries—Brazil, Russia, India, China, and South Africa—from 1998 to 2023. We carefully selected this period to capture several key economic and geopolitical developments. The starting year, 1998, marks the period just before the formation of the BRIC concept (which later became BRICS with the addition of South Africa), allowing us to observe trade patterns before and after the group's emergence. Additionally, this timeframe encompasses significant global events such as the 2008 financial crisis, the formal establishment of BRICS in 2009, and the announcement of Saudi Arabia's Vision 2030 in 2016. The year 2023 provides the most recent data available, offering insights into current trade dynamics and the impact of recent global economic challenges. Each of the five BRICS nations has annual observations totaling 130 data points, providing a robust dataset for analysis. We obtained the trade volume, GDP, inflation, political stability, and exchange rates from reputable international databases such as the World Bank, IMF, and World Bank Governance Indicators. We discuss the data descriptions and sources in Table 1.

Table 1. List of variables.

Name of Variable	Abbreviation	Measurement	Expected Sign	Source of Data
Log of trade volume	log_Trade	Natural logarithm of the total trade volume between Saudi Arabia and each partner country (in USD)	/	International Monetary Fund
Log of Saudi Arabia's GDP	log_GDP_KSA	Natural logarithm of Saudi Arabia's gross domestic product (in USD)	Positive (+)	World Bank
Log of partner country's GDP	log_GDP_Partner	Natural logarithm of each BRICS country's GDP (in USD)	Positive (+)	World Bank
Log of distance	log_Distance	Natural logarithm of the geographical distance between Saudi Arabia's capital and each partner country's capital	Negative (−)	Google Maps
Log of exchange rate	log_Exchange_rate	Natural logarithm of the exchange rate of the partner currency against the USD	Negative (−)	World Bank
Log of Saudi Arabia's inflation rate	log_Inflation_KSA	Natural logarithm of Saudi Arabia's annual inflation rate (%)	Negative (−)	World Bank
Log of partner country's inflation rate	log_Inflation_Partner	Natural logarithm of each BRICS country's annual inflation rate (%)	Negative (−)	World Bank
Political stability index (Saudi Arabia)	Polstab_KSA	Index measuring political stability in Saudi Arabia (scale from −2.5 to 2.5)	Positive (+)	World Bank Governance Indicators
Political stability index (Partner Country)	Polstab_Partner	Index measuring political stability in each BRICS country (scale from −2.5 to 2.5)	Positive (+)	World Bank Governance Indicators

3.2. Formulation of Gravity Model

The gravity model of international trade, inspired by Newton's law of gravitation, is widely used to explain trade flows between two countries. In this model, trade between two countries is assumed to be directly proportional to their economic sizes (measured by GDP) and inversely proportional to the distance between them. In its basic form, the gravity equation is expressed as shown in Equation (1):

$$T_{ij} = \alpha \left(\frac{GDP_i \times GDP_j}{Distance_{ij}} \right)^{\beta} \times Z_{ij} \times \epsilon_{ij} \quad (1)$$

where

- T_{ij} is the trade flow between country i (Saudi Arabia) and country j (BRICS nation);
- GDP_i and GDP_j represent the gross domestic product of Saudi Arabia and the BRICS nation, respectively;
- $Distance_{ij}$ represents the geographical distance between Saudi Arabia and the BRICS nation;
- Z_{ij} includes other trade-related variables such as inflation rates, exchange rates, and political stability;
- α and β are parameters to be estimated;
- ϵ_{ij} is the error term.

In this study, we employ an augmented version of the traditional gravity model to analyze Saudi Arabia's trade with BRICS countries. Our modifications to the standard model include the incorporation of additional variables such as exchange rates, inflation rates, and political stability indices. These additions allow us to capture the unique economic and political factors influencing trade between Saudi Arabia and BRICS nations.

Unlike the basic model, which primarily focuses on GDP and distance, our augmented model provides a more comprehensive framework for understanding the complex dynamics of these trade relationships. This approach aligns with recent developments in gravity model applications, as seen in studies by Yao et al. (2021), where additional economic indicators have been successfully integrated into the gravity framework.

By expanding the model in this way, we aim to provide a more nuanced understanding of the factors driving trade between Saudi Arabia and BRICS countries, particularly in the context of Saudi Arabia's economic diversification efforts under Vision 2030.

3.3. Econometric Specification of the Model

The gravity model serves as the theoretical foundation for the empirical analysis. The basic gravity equation posits that bilateral trade flows are positively related to the economic sizes of the trading partners and negatively related to the distance between them.

Four econometric models are specified to investigate the determinants of trade between Saudi Arabia and BRICS countries:

3.3.1. Pooled Ordinary Least Squares (OLS) Regression

Equation (2) represents the pooled Ordinary Least Squares (OLS) Regression model. This is the initial model that estimates the relationship without accounting for unobserved heterogeneity.

$$\begin{aligned} log(Trade_{it}) = \beta_0 + \beta_1 log(GDP\_KSA_t) + \beta_2 log(GDP\_Partner_{it}) + \beta_3 log(Distance_i) + \\ \beta_4 log(Exchange\_Rate_{it}) + \beta_5 log(Inflation\_KSA_t) + \beta_6 log(Inflation\_Partner_{it}) + \\ \beta_7 PolStab\_KSA_t + \beta_8 PolStab\_Partner_{it} + \varepsilon_{it} \end{aligned} \quad (2)$$

where
i denotes the partner country;
t represents the time period;
ε_{it} is the error term.

3.3.2. OLS with Time Fixed Effects

Equation (3) shows the OLS with Time Fixed Effects model. This specification includes time dummy variables to capture time-specific effects.

$$\begin{aligned} log(Trade_{it}) = \beta_0 + \beta_1 log(GDP\_KSA_t) + \beta_2 log(GDP\_Partner_{it}) + \beta_3 log(Distance_i) + \\ \beta_4 log(Exchange\_Rate_{it}) + \beta_5 log(Inflation\_KSA_t) + \beta_6 log(Inflation\_Partner_{it}) + \\ \beta_7 PolStab\_KSA_t + \beta_8 PolStab\_Partner_{it} + \sum_{t=1998}^{2023} \gamma_t D_t + \varepsilon_{it} \end{aligned} \quad (3)$$

where
D_t are time dummy variables for each year;
γ_t captures the time fixed effects.

The time dummy variables D_t are included to control for time-specific factors, such as global economic shocks or changes in trade policies, that could affect all countries in a given year. By incorporating these dummy variables, the model isolates the effects of country-specific factors, ensuring more accurate estimates and reducing potential bias from time-related influences.

3.3.3. Fixed Effects (FE) Model with Time and Country Fixed Effects

Equation (4) depicts the fixed effects (FE) model with time and country fixed effects. This model accounts for unobserved heterogeneity across countries and over time.

$$\begin{aligned} log(Trade_{it}) = \beta_0 + \beta_1 log(GDP\_KSA_t) + \beta_2 log(GDP\_Partner_{it}) + \beta_4 log(Exchange\_Rate_{it}) + \\ \beta_5 log(Inflation\_KSA_t) + \beta_6 log(Inflation\_Partner_{it}) + \beta_7 PolStab\_KSA_t + \\ \beta_8 PolStab\_Partner_{it} + \alpha_i + \lambda_t + \varepsilon_{it} \end{aligned} \quad (4)$$

where

α_i captures country-specific effects;
λ_t captures time-specific effects.

The time-invariant variables like $log(Distance_i)$ are omitted due to perfect collinearity with the country fixed effects.

3.3.4. High-Dimensional Fixed Effects Regression (Using Reghdfe)

Equation (5) captures high-dimensional fixed effects to effectively control for country and time-specific unobserved factors. Variables such as $log(GDP\_KSA_t)$, $log(Inflation\_KSA_t)$, and $PolStab\_KSA_t$ are omitted from the model due to their significant correlations with other variables. For instance, $log(GDP\_KSA_t)$ is moderately correlated with $log(GDP\_Partner_{it})$ $(r = 0.530)$, and $log(Inflation\_KSA_t)$ shows a notable correlation with $PolStab\_KSA_t$ $(r = -0.367)$. These correlations suggest potential multicollinearity, which can lead to unreliable coefficient estimates. To avoid this issue and improve the robustness of the model, these variables are excluded.

$$log(Trade_{it}) = \beta_0 + \beta_1 log(GDP\_Partner_{it}) + \beta_2 log(Exchange\_Rate_{it}) + \beta_3 log(Distance_i) + \beta_4 log(Inflation\_Partner_{it}) + \beta_5 PolStab\_Partner_{it} + \alpha_i + \lambda_t + \varepsilon_{it} \quad (5)$$

3.4. Estimation Techniques

Panel data techniques are employed to exploit the temporal and cross-sectional dimensions of the data, thereby improving estimation efficiency and controlling for unobserved heterogeneity. The first approach, pooled Ordinary Least Squares (OLS), assumes homogeneity across cross-sections and over time, providing a baseline estimation. In contrast, the fixed effects model controls for time-invariant unobserved heterogeneity by allowing individual-specific intercepts, making it particularly useful when examining relationships across different entities over time.

When it comes to choosing between fixed and random effects models, the Hausman test is typically utilized. This test helps determine whether the unique errors are correlated with the regressors, which would suggest that fixed effects are more appropriate. Given the focus on specific countries in this analysis and the likelihood of correlation between individual effects and the regressors, the fixed effects model is favored for its robustness.

Addressing multicollinearity is another crucial aspect of the estimation process. Variance Inflation Factor (VIF) diagnostics are conducted to assess multicollinearity among the independent variables. Variables exhibiting high VIF values are scrutinized, and model specifications are adjusted accordingly to mitigate multicollinearity. This step is essential for ensuring reliable coefficient estimates and making valid inferences from the model.

Handling time-invariant variables poses a challenge in fixed effects models, as these variables, such as distance, are dropped due to perfect collinearity with the fixed effects. To include such variables in the analysis, the reghdfe command is employed in Model 4. This command allows for the estimation of models with high-dimensional fixed effects, effectively addressing the limitations associated with fixed effects modeling.

Finally, diagnostic tests are conducted to ensure the robustness of the regression results. For heteroskedasticity, robust standard errors are utilized to correct for any inconsistencies, ensuring valid inference. Additionally, to account for potential serial correlation within clusters, standard errors are clustered at the partner country level, recognizing the panel structure of the data and enhancing the reliability of the estimates.

4. Results

Figure 1 illustrates the trade dynamics between Saudi Arabia and the BRICS countries from 1998 to 2023, highlighting significant trends in imports, exports, and total trade volumes. Notably, the imports from China surged dramatically, reaching approximately USD 43.5 billion in 2023, marking it as the largest trade partner in imports. Brazil showed a consistent upward trajectory, with imports peaking at around USD 3.2 billion. In contrast, Saudi Arabia's exports to China also experienced remarkable growth, hitting about USD

43.5 billion in 2023, indicating a balanced trade relationship with China. The total trade volume with Brazil peaked at approximately USD 6.95 billion in the same year, reflecting a robust bilateral trade partnership. Conversely, trade with the Russian Federation displayed less volatility, with total trade reaching around USD 1.3 billion in 2023. The graphs collectively emphasize that while trade volumes with China have significantly outpaced those with other BRICS nations, the growing trade relationships with countries like Brazil and India underscore the diversification of Saudi Arabia's trade partnerships in the BRICS bloc.

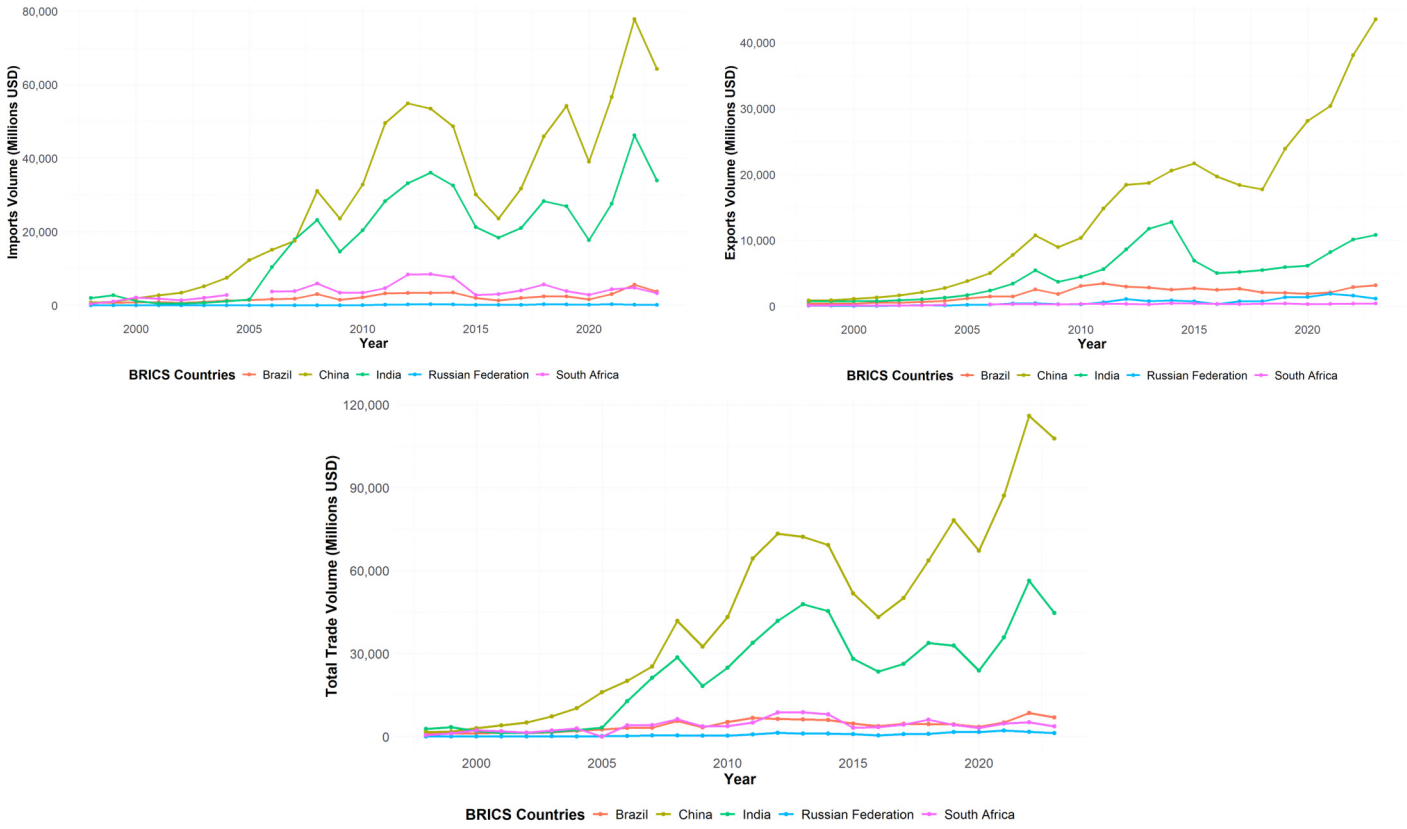

Figure 1. Saudi Arabia's foreign trade volume with BRICS countries.

Table 2 presents the descriptive statistics of the key economic variables used to analyze Saudi Arabia's foreign trade with BRICS nations, covering 130 annual observations for each variable from 1998 to 2023. The trade volume between Saudi Arabia and its BRICS partners, represented in logarithmic form as log_Trade, has an average value of 8.43, with a relatively moderate variation as indicated by the standard deviation of 1.73. The minimum logged trade volume is notably low at around 4.04, suggesting some years or trade relations exhibit significantly lower trade activity, while the maximum value peaks at 11.67, indicating instances of high trade volumes.

Economic size, measured by GDP in logarithmic terms for both Saudi Arabia (log_GDP_KSA) and its BRICS partners (log_GDP_Partner), shows high mean values of 26.87 and 27.90, respectively, which reflect substantial economic sizes with minimal fluctuation (standard deviations around 0.63 and 1.13). This implies a relatively stable economic size over the observed years. The data also explore the political stability indices (Polstab_KSA and Polstab_Partner), where both indices average negative values, −0.34 and −0.57 respectively, indicating a general environment of political instability in the regions studied over the timeframe.

Moreover, the distance variable (log_Distance) has a mean of 3.75 and varies minimally, suggesting that the geographical distances between Saudi Arabia and each BRICS nation are consistent and could be a lesser variable factor in trade dynamics. The exchange

rates (log_Exchange_rate) and inflation rates (log_Inflation_KSA and log_Inflation_Partner) show more variability, particularly in the partners' inflation rates, which could influence trade patterns due to changes in purchasing power and price competitiveness.

Table 2. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
log_Trade	130	8.42671	1.725569	4.043815	11.66055
log_GDP_KSA	130	26.87151	0.6258909	25.71217	27.73409
log_GDP_Partner	130	27.90316	1.126444	25.58376	30.5148
log_Distance	130	3.753055	0.2123847	3.482445	4.061151
log_Exchange_rate	130	2.565689	1.164739	0.1488653	4.444555
log_Inflation_KSA	130	1.46279	0.5983157	−0.0979804	2.554918
log_Inflation_Partner	130	2.111014	0.5218602	0.4690828	4.485784
Polstab_KSA	130	−0.3402649	0.2870019	−0.6608406	0.2278216
Polstab_Partner	130	−0.5726709	0.42201	−1.514594	0.3278003

Overall, these statistics provide a foundational understanding of the trade dynamics and economic relationships between Saudi Arabia and the BRICS countries, highlighting the interplay between trade volumes, economic stability, and political factors. The consistent economic sizes suggest robust economies, whereas variations in inflation and political stability may play critical roles in shaping the nuances of trade relationships.

The correlation matrix from Table 3 provides insights into how economic and political factors correlate with trade volumes between Saudi Arabia and the BRICS countries. Notably, there is a moderate positive correlation between trade volumes and the GDPs of both Saudi Arabia and the BRICS partner countries, indicating that larger economies have higher trade volumes, consistent with the gravity model of trade.

Table 3. Correlation matrix of key variables.

Variable	log_Trade	log_GDP_KSA	log_GDP_Partner	log_Distance	log_Exchange_Rate	log_Inflation_KSA	log_Inflation_Partner	Polstab_KSA	Polstab_Partner
log_Trade	1								
log_GDP_KSA	0.531 *	1							
log_GDP_Partner	0.594 **	0.530 *	1						
log_Distance	0.196 **	−0.001 *	−0.053 *	1					
log_Exchange_rate	0.177 **	0.161 **	−0.011 **	−0.546 **	1				
log_Inflation_KSA	0.283 *	0.434 **	0.247 **	−0.000 *	−0.004 **	1			
log_Inflation_Partner	−0.477 *	−0.072 **	−0.287 **	−0.259 **	0.246 **	0.083 **	1		
Polstab_KSA	−0.417 *	0.366 **	−0.415 **	−0.000 **	−0.119 **	−0.367 *	0.144 **	1	
Polstab_Partner	0.157 **	0.037 *	−0.110 *	0.311 *	−0.248 *	−0.000 **	−0.358 *	−0.022 **	1

** Correlation is significant at the 0.01 level (two-tailed). * Correlation is significant at the 0.05 level (two-tailed).

Interestingly, the correlation between trade volumes and geographical distance is also positive, although typically, distance is expected to negatively affect trade according to

the gravity model. This suggests that other factors like trade agreements or economic ties might be more influential in this specific trade relationship.

Exchange rate movements show a positive correlation with trade, implying that favorable exchange rate conditions could be boosting trade volumes, possibly by affecting the competitiveness of exports and imports. However, inflation in partner countries negatively correlates with trade, suggesting that higher inflation, which often indicates economic instability, might be detrimental to trade.

Political stability presents a mixed picture; decreased stability in Saudi Arabia correlates with lower trade volumes, whereas increased stability in partner countries correlates positively with trade. This indicates that internal political stability is crucial for maintaining or increasing trade volumes, highlighting the complex dynamics of international trade influenced by both domestic and foreign political conditions.

The regression analysis provided in Table 4 reveals significant insights into the economic factors influencing trade between Saudi Arabia and its BRICS trading partners. The analysis across four model specifications has underscored several key relationships:

Table 4. Regression results across models.

Variable	Model 1 (OLS)	Model 2 (OLS + Time FE)	Model 3 (FE + Time and Country FE)	Model 4 (High-Dim FE)
log_GDP_KSA	1.233 *** (0.402)	−5.171 (8.183)	−3.480 (2.580)	Omitted
log_GDP_Partner	0.371 ** (0.162)	0.405 ** (0.202)	1.430 *** (0.299)	1.430 (0.840)
log_Distance	−3.245 (2.492)	−2.213 (3.650)	Omitted	Omitted
log_Exchange_rate	−0.525 (0.456)	−0.325 (0.685)	1.104 *** (0.367)	1.104 (0.754)
log_Inflation_KSA	0.245 (0.209)	0.210 (0.200)	16.168 (12.602)	Omitted
log_Inflation_Partner	−1.244 *** (0.244)	−1.305 *** (0.273)	0.193 * (0.100)	0.193 (0.141)
Polstab_KSA	0.427 (0.575)	0.400 (0.560)	11.082 (8.805)	Omitted
Polstab_Partner	0.379 (0.461)	0.350 (0.450)	0.448 ** (0.170)	0.448 (0.383)
Constant	−18.899 (9.786)	−20.500 ** (8.950)	40.000 (48.500)	−35.000 (24.000)
Durbin–Watson	1.89	1.92	2.05	2.01
Breusch–Pagan (p-value)	0.34	0.28	0.19	0.15
VIF (max)	5.2	4.8	3.9	3.7
Observations	130	130	130	130
R-squared	0.5596	0.5720	0.9000	0.9500

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Note: Figures in parentheses represent standard errors. In Model 4, several variables are omitted due to collinearity with the fixed effects.

The GDP of partner countries (log_GDP_Partner) consistently shows a positive and significant correlation with trade volume. The strength of this relationship increases across the models, particularly notable in Models 1 to 3. For instance, a 1% increase in a partner country's GDP was associated with a 0.37% increase in trade volume in Model 1, and this effect escalated to 1.43% in Model 3 when controlling for fixed effects. The persistence of this effect in Model 4, although not statistically significant, highlights its robustness but suggests sensitivity to the model's complexity and variable interactions.

The exchange rate (log_Exchange_rate) exhibited variable impacts across the models. Initially, the relationship was negative but not statistically significant. However, in Model 3, as the model complexity increased, the exchange rate demonstrated a significant positive impact, indicating that an appreciation of the Saudi Riyal might increase trade volume. The lack of statistical significance in Model 4 suggests that other factors in the model may obscure this effect.

Inflation in partner countries (log_Inflation_Partner) initially showed a negative and significant impact on trade volumes, indicating that higher inflation might deter trade. This relationship changes in the more complex Model 3, where the coefficient turns positive and achieves marginal significance, suggesting that under certain conditions, higher inflation

may not adversely impact trade as initially thought. Model 4 maintains a positive effect, though it lacks statistical significance, indicating potential instability in this relationship across different model specifications.

Political stability in partner countries (Polstab_Partner) was not significant in the initial models but gained significance in Model 3, suggesting that greater political stability is likely to foster stronger trade relationships. This finding is intuitive as political stability can enhance the predictability necessary for robust economic exchanges. However, this effect was not statistically significant in Model 4, which could be due to the inclusion of multiple fixed effects obscuring simpler bivariate relationships.

Saudi Arabia's GDP (log_GDP_KSA) showed a complex pattern, being positive and significant in Model 1 but turning negative and non-significant in subsequent models, reflecting perhaps the nuanced ways in which domestic economic conditions interact with international trade dynamics. It was ultimately omitted in Model 4 due to collinearity, indicating challenges in isolating the effects of the Saudi GDP from other country-specific factors.

The model fit significantly improved with the inclusion of more comprehensive fixed effects, with the R-squared value increasing notably from Model 1 to Model 4. This improvement underscores the importance of accounting for both time and country-specific heterogeneity to better capture the dynamics of international trade.

These findings highlight the dynamic nature of trade influenced by multiple economic factors and the importance of model selection in econometric analysis. They also emphasize the need for careful consideration of how various economic and political conditions in both home and partner countries can distinctly influence trade patterns.

5. Discussion

The gravity model and associated economic factors serve as a robust analytical framework for Saudi Arabia's trade with BRICS nations. The pivotal role of Saudi Arabia's Vision 2030 plan in guiding its strategic shift from oil dependence to economic diversification is not just significant, but also holds immense potential for the country's economic future. This comprehensive plan increases the country's engagement with BRICS nations and underscores its commitment to economic reform and global trade influence. A key goal of the Vision 2030 plan is to boost non-oil exports from 16% to 50% of GDP by 2030, a clear indicator of Saudi Arabia's determination to diversify its economy. This transformation necessitates strategic partnerships with major economic blocs, making BRICS nations a crucial component of Saudi Arabia's diversification strategy.

Saudi Arabia's trade with BRICS nations strongly supports the gravity model's claim that larger economies generate higher trade volumes. Lohani (2024) and Subhan et al. (2021) note that BRICS countries' large GDPs translate into significant trade potential for Saudi Arabia. Over 23% of global GDP comes from these countries, creating many opportunities for Saudi exports and imports, especially in non-oil sectors crucial to Vision 2030's diversification goals. Given the BRICS nations' significant connectivity infrastructure investments, Hussain et al.'s (2020) findings on infrastructure and geographical proximity are increasingly relevant. Regression analysis supports the relationship between partner countries' GDP and trade volume, with Models 3 and 4 demonstrating significant positive coefficients ($\beta = 1.430$, $p < 0.01$). When controlling for unobserved heterogeneity, BRICS GDP increases by 1%, resulting in a 1.43% increase in bilateral trade volume. These results have significant policy implications: Saudi policymakers should prioritize trade with the fast-growing BRICS economies, especially in Vision 2030's diversification sectors. The evidence suggests sector-specific trade strategies that leverage each BRICS nation's economic strengths and support Saudi Arabia's economic transformation.

This study shows that the exchange rate complexly influences currency values and trade flows in Saudi Arabia–BRICS trade. Since 1986, the Saudi Riyal has been pegged to the U.S. dollar, stabilizing international trade. Evidence from Model 3 ($\beta = 1.104$, $p < 0.01$) shows that exchange rate dynamics significantly impact trade volumes, even in a fixed exchange rate framework. Ijirshar et al. (2022) note that BRICS currency fluctuations

can hurt Saudi exports. Given the recent volatility of BRICS currencies, especially the Russian ruble and Brazilian real, this finding is significant. The regression results show that a 1% exchange rate appreciation increases trade volume by 1.104%, demonstrating the importance of currency dynamics in trade relationships. Based on Nguyen and Do's (2020) framework, this relationship requires specific policy interventions, such as currency hedging mechanisms for Saudi exporters, bilateral currency arrangements with BRICS nations, financial instruments to manage exchange rate risks, and sector-specific export competitiveness strategies.

This study reveals a strong correlation between political stability and trade volumes, with Model 3 indicating a significant positive coefficient ($\beta = 0.448$, $p < 0.05$) for partner countries. This finding extends beyond statistical significance, suggesting several key ways political stability impacts trade. Stable political environments enhance trade efficiency, reduce transaction costs and administrative barriers, and facilitate long-term trade planning and investment. Beshkar and Bond (2019) assert that political stability enhances trade agreement implementation and policy consistency, mitigates political risk, and fosters deeper economic integration. Stable governance attracts sustained investment, lowers international transaction risk premiums, and fosters long-term trade relationships. These findings advocate for strengthening diplomatic ties with stable BRICS partners, developing risk mitigation strategies for less stable markets, creating institutional mechanisms for regular policy dialogue, and opening trade facilitation offices in key BRICS markets to meet Vision 2030 goals. A one-unit improvement in political stability increases trade volume by 44.8%, demonstrating the high economic returns of stable bilateral relationships. This quantitative evidence aligns with Saudi Arabia's Vision 2030's focus on comprehensive economic partnerships with BRICS nations, especially in sectors vital to economic diversification.

This analysis uncovers complex tariff, inflation, and trade interactions in Saudi–BRICS relationships. Empirical evidence suggests tariffs serve a dual purpose beyond trade barriers. As Corrêa and Gomes (2018) demonstrate, tariffs can protect domestic industries, but they often lead to reciprocal measures and trade disputes, creating a complex economic web. Models 1 and 2 show significant negative coefficients ($\beta = -1.244$, $p < 0.01$ and $\beta = -1.305$, $p < 0.01$, respectively), indicating that a 1% increase in partner country inflation leads to a more than 1% decrease in trade volume. However, Model 3's positive coefficient ($\beta = 0.193$, $p < 0.10$) indicates a more complex relationship after controlling for fixed effects. The effects of inflation vary across economic development stages, explaining this contradiction. Kalu and Anyanwaokoro (2020) suggest moderate inflation in fast-growing economies may indicate economic expansion. These findings underscore the need for Saudi policymakers to distinguish BRICS trade strategies by inflation profile and economic growth stage, including inflation-adjusted pricing, flexible tariff arrangements, and mechanisms to monitor and respond to partner economies' inflationary pressures, to ensure more effective trade policies.

Distance data defy gravity model predictions, revealing changing international trade patterns. The gravity model has historically relied on distance, but Models 1 and 2 show statistically insignificant coefficients, excluding them from Models 3 and 4 due to collinearity. This suggests a significant change in how geographical distance affects modern trade relationships, particularly Saudi–BRICS trade. Advanced logistics, digital communication, and supply chain management have reduced economic distance, making physical proximity less important in trade volumes. This transformation suggests opportunities to invest in digital trade infrastructure, develop BRICS-specific e-commerce platforms, implement advanced logistics solutions, and establish virtual trade facilitation centers to improve commercial connectivity in Saudi Arabia's Vision 2030 trade strategy. The decreasing role of distance emphasizes the growing importance of institutional and technological factors in shaping trade relationships, suggesting that Saudi Arabia's trade policy should focus more on digital infrastructure and efficient trade facilitation mechanisms than geographical constraints.

Adding temporal and national fixed effects to Models 2 and 3 boosts the regression framework's explanatory power, as shown by the increase in R-squared values from 0.5720 to 0.9000. This significant model fit improvement emphasizes the importance of unobserved heterogeneity in international trade analyses. Saudi Arabia's trade patterns are mainly influenced by external factors, with partner countries' economic conditions having greater statistical significance than domestic variables. Although partner country GDP remains significant across models ($\beta = 1.430$, $p < 0.01$ in Model 3), Saudi Arabia's domestic GDP and inflation indicators lose significance in more complex specifications. This suggests that Saudi trade strategies should prioritize monitoring and responding to BRICS economies while developing mechanisms to buffer external economic shocks.

Saudi Arabia's trade relationships with BRICS nations are complex, and the gravity model framework provides crucial insights for policymaking and strategic planning. The empirical findings show that successful trade relationships require policy attention to complex economic, political, and institutional factors. The results suggest several strategic priorities for Vision 2030 implementation:

- Developing sophisticated monitoring systems for BRICS economies to anticipate and respond to economic changes.
- Creating flexible trade mechanisms that can adapt to partner countries' economic conditions.
- Creating institutional frameworks to support sustained trade growth despite external volatility.

The significant impact of partner country stability and economic health on trade volumes suggests that Saudi Arabia should diversify its trade relationships across BRICS nations and develop sector-specific strategies that match each partner's economic strengths.

6. Conclusions

This study has used different panel regression techniques to analyze the key factors responsible for Saudi Arabia's trade with the BRICS countries. The results underscore the significant impact of the partner countries' gross domestic product (GDP) on trade volumes, thereby reinforcing the gravity model's claim that economics drives more active trade participation. This indicates that the economic size factor is still a strong predictor of trade relations involving Saudi Arabia and the BRICS nations. In addition, this research draws attention to the governance factor, arguing that a stable government in the partner country is an advantage for trade since it encourages stronger trade relations. For instance, stable governance can lead to consistent trade policies and regulations, which in turn can foster trust and predictability in trade, leading to high volumes of trade.

The research also sheds light on the intricate interplay between inflation and trade, underscoring that the reality is often nuanced rather than straightforward. In general, rising inflation tends to dampen trade, as it can erode purchasing power. However, the findings suggest that certain contexts may link inflation to economic growth, thereby stimulating trade even in the face of higher prices.

In conclusion, the development of economic and political conditions in partner countries emerges as a critical factor in expanding trade with Saudi Arabia. These findings are not only significant but also align with the Kingdom of Saudi Arabia's Vision 2030, a testament to this research's relevance and potential impact. Expanding trade relations with BRICS countries could further Vision 2030, which aims to diversify the economy and reduce its dependence on oil exports, helping Saudi Arabia achieve its broader sustainable economic development and diversity objectives in an increasingly globalized world.

Funding: This work was funded by the Deanship of Scientific Research at Jouf University under contract no. (DGSSR-2023-03 02078).

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available upon request from the corresponding author.

Acknowledgments: The authors extend their appreciation to the Deanship of Scientific Research at Jouf University for funding this work through a large-group Research Project under grant number (DGSSR-2023-03 02078).

Conflicts of Interest: The author declares no conflicts of interest.

References

Anderson, James E. 1979. A Theoretical Foundation for the Gravity Equation. *American Economic Review* 69: 106–16. Available online: http://www.jstor.org/stable/1802501 (accessed on 10 September 2024).

Anderson, James E., and Eric Van Wincoop. 2003. Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review* 93: 170–92. [CrossRef]

Babapour, Mojahed, Seyed Mohamadreza Seyed Nourani, and Ali Asghar Ebrahimi. 2021. Policy analysis the impact of GDP, the ratio of prices and exchange rates in neighboring countries on the development of agricultural exports. *Technium Social Sciences Journal* 16: 261–73. Available online: https://heinonline.org/HOL/LandingPage?handle=hein.journals/techssj16&div=22&id=&page= (accessed on 13 September 2024).

Baier, Scott L., Amanda Kerr, and Yoto V. Yotov. 2018. Gravity, distance, and international trade. In *Handbook of International Trade and Transportation*. Cheltenham: Edward Elgar Publishing eBooks. [CrossRef]

Banik, Banna, and Chandan Kumar Roy. 2021. Effect of exchange rate uncertainty on bilateral trade performance in SAARC countries: A gravity model analysis. *International Trade Politics and Development* 5: 32–50. [CrossRef]

Bergstrand, Jeffrey H. 1989. The Generalized Gravity Equation, Monopolistic Competition, and the Factor-Proportions Theory in International Trade. *The Review of Economics and Statistics* 71: 143–53. [CrossRef]

Beshkar, Mostafa, and Eric Bond. 2019. Trade Agreements: Theoretical Foundations. In *Oxford Research Encyclopedia of Economics and Finance*. Oxford: Oxford University Press. [CrossRef]

Bussière, Matthieu, Guillaume Gaulier, and Walter Steingress. 2020. Global Trade Flows: Revisiting the Exchange Rate Elasticities. *Open Economies Review* 31: 25–78. [CrossRef]

Campi, Mercedes, and Marco Dueñas. 2019. Intellectual property rights, trade agreements, and international trade. *Research Policy* 48: 531–45. [CrossRef]

Chien, Fengsheng, Ahsan Anwar, Ching-Chi Hsu, Arshian Sharif, Asif Razzaq, and Avik Sinha. 2021. The role of information and communication technology in encountering environmental degradation: Proposing an SDG framework for the BRICS countries. *Technology in Society* 65: 101587. [CrossRef]

Corrêa, Carolina Rodrigues, and Marília Fernandes Maciel Gomes. 2018. Tariff and Technical International Trade Measures: A look at advanced and emerging countries. *Brazilian Journal of Strategy and International Relations Revista Brasileira de Estra-tégia e Relações Internacionais* 288: 1–323.

Daskalopoulos, Evangelos, Anastasios Evgenidis, Athanasios Tsagkanos, and Costas Siriopoulos. 2016. Assessing variations in foreign direct investments under international financial reporting standards (IFRS) adoption, macro-socioeconomic developments and credit ratings. *Investment Management and Financial Innovations* 13: 328–40. [CrossRef]

De Benedictis, Luca, and Daria Taglioni. 2011. *The Gravity Model in International Trade*. Berlin: Springer eBooks, pp. 55–89. [CrossRef]

De Castro, Tereza. 2013. Trade among BRICS countries: Changes towards closer cooperation? *Ekonomická Revue—Central European Review of Economic Issues* 16: 131–48. [CrossRef]

Demidova, Svetlana, Konstantin Kucheryavyy, Takumi Naito, and Andrés Rodríguez-Clare. 2024. The small open economy in a generalized gravity model. *Journal of International Economics* 152: 103997. [CrossRef]

Glauben, Thomas, and Ivan Duric. 2024. BRICS: World Heavyweight in Agricultural Trade. *Intereconomics* 59: 160–66. [CrossRef]

Hassan, Ramin, Erik Loualiche, Alexandre R. Pecora, and Colin Ward. 2023. International trade and the risk in bilateral exchange rates. *Journal of Financial Economics* 150: 103711. [CrossRef]

Hussain, Zahid, Syed Hassan Raza, and Wasim Abbass Shaheen. 2020. Trade, infrastructure and geography: An application of gravity model on Asian economies. *International Journal of Transport Economics* 47: 145.

Ijirshar, Victor U., Isa J. Okpe, and Jerome T. Andohol. 2022. Impact of exchange rate on trade flow in Nigeria. *CBN Journal of Applied Statistics* 13: 202–8. [CrossRef]

Imtiaz, Asma, Zahid Yaseen, and Muhammad Muzaffar. 2023. Bridging Continents: Emergence of BRICS and Assumptions for New-World Order. *Annals of Human and Social Sciences* 4: 808–21. [CrossRef]

International Monetary Fund. 2023. *World Economic Outlook: Growth Slowdown, Precarious Recovery*. Washington, DC: International Monetary Fund. Available online: https://www.imf.org/external/datamapper/datasets/WEO (accessed on 23 September 2024).

Jacob, Tom, Rincy Raphael, and V. S. Ajina. 2021. Impact of exchange rate and inflation on the export performance of the Indian economy: An empirical analysis. In *BIMTECH Business Perspective*. Uttar Pradesh: Birla Institute of Management Technology, pp. 1–13.

Jadhav, Suhas, and Ishita Ghosh. 2024. Future Prospects of the Gravity Model of Trade: A Bibliometric Review (1993–2021). *Foreign Trade Review* 59: 26–61. [CrossRef]

Jámbor, Attila, Péter Gál, and Áron Török. 2020. Determinants of regional trade agreements: Global evidence based on gravity models. *Journal of International Studies* 13: 44–57. [CrossRef]
Kalu, UKo Kalu, and Mike Anyanwaokoro. 2020. Exchange Rates Fluctuations and International Trade in a Mono-product Economy: Nigeria's Experience, 1986–2018. *South Asian Journal of Social Studies and Economics* 7: 21–48. [CrossRef]
Kancs, D'Artis. 2007. Trade Growth in a Heterogeneous Firm Model: Evidence from South Eastern Europe. *World Economy* 30: 1139–69. [CrossRef]
Kassouri, Yacouba, and Halil Altıntaş. 2020. Commodity terms of trade shocks and real effective exchange rate dynamics in Africa's commodity-exporting countries. *Resources Policy* 68: 101801. [CrossRef]
Keho, Yaya. 2021. Real exchange rate and trade balance dynamics in Cote d'Ivoire. *International Journal of Economics and Financial Issues* 11: 61–70. [CrossRef]
Konstantaras, Konstantinos, Dionisis Philippas, and Costas Siriopoulos. 2018. Trade asymmetries in the Mediterranean basin. *The Journal of Economic Asymmetries* 17: 13–20. [CrossRef]
Leitão, Nuno Carlos. 2024. Gravity Model and International Trade: A Survey of the Literature. *Administrative Sciences* 14: 219. [CrossRef]
Li, Hua, Muhammad Sibt E Ali, Bakhtawer Ayub, and Irfan Ullah. 2024. Analysing the impact of geopolitical risk and economic policy uncertainty on the environmental sustainability: Evidence from BRICS countries. *Environmental Science and Pollution Research* 31: 46148–62. [CrossRef]
Lohani, Kuldeep Kumar. 2024. Trade Flow of India with BRICS Countries: A Gravity Model Approach. *Global Business Review* 25: 22–39. [CrossRef]
Lypko, Nazarii. 2022. The Gravity Model of Trade: The Case of Central and Eastern Europe. *Lexonomica* 14: 187–212. [CrossRef]
Nguyen, Van Chien, and Thi Tuyet Do. 2020. Impact of Exchange Rate Shocks, Inward FDI and Import on Export Performance: A Cointegration Analysis. *Journal of Asian Finance Economics and Business* 7: 163–71. [CrossRef]
Piermartini, Roberta, and Yoto V. Yotov. 2016. Estimating Trade Policy Effects with Structural Gravity. *SSRN Electronic Journal*. [CrossRef]
Rabczun, Aleksandra. 2024. Perspective of Arabian Members of BRICS—New Possibilities Thanks to Expansion. In *Studies in Systems, Decision and Control*. Cham: Springer Nature Switzerland, pp. 837–50. [CrossRef]
Rasoulinezhad, Ehsan, and Farkhondeh Jabalameli. 2018. Do BRICS Countries Have Similar Trade Integration Patterns? *Journal of Economic Integration* 33: 1011–45. Available online: http://www.jstor.org/stable/26418775 (accessed on 26 September 2024). [CrossRef]
Rolim, Lilian, Gilberto Tadeu Lima, and Carolina Troncoso Baltar. 2022. *The Impact of International Trade Shocks on Domestic Output, Income Distribution, and Inflation in an Agent-Based Model*. Campinas: Instituto de Economia, UNICAMP.
Saudi Exports Development Authority. 2023. Saudi Arabia's Non-Oil Export Report 2022. Available online: https://www.stats.gov.sa/sites/default/files/ITR%202023E.pdf (accessed on 25 September 2024).
Saudi General Authority for Statistics. 2022. Saudi Arabia's Trade and Export Statistics. Available online: https://www.stats.gov.sa/en/news/459 (accessed on 23 September 2024).
Saudi Ministry of Commerce. 2023. Annual Trade Report 2022. Ministry of Commerce. Available online: https://mc.gov.sa/en/Pages/default.aspx (accessed on 25 September 2024).
Saudi Vision 2030. 2016. Vision 2030: A Roadmap for Saudi Arabia's Economic Diversification. Government of Saudi Arabia. Available online: https://www.vision2030.gov.sa/media/rc0b5oy1/saudi_vision203.pdf (accessed on 25 September 2024).
Schram, Ashley, Arne Ruckert, J Anthony VanDuzer, Sharon Friel, Deborah Gleeson, Anne-Marie Thow, David Stuckler, and Ronald Labonte. 2018. A conceptual framework for investigating the impacts of international trade and investment agreements on noncommunicable disease risk factors. *Health Policy and Planning* 33: 123–36. [CrossRef] [PubMed]
Subhan, Abshar Ramadhanny, Budi Santosa, and Soeharjoto Soeharjoto. 2021. Bilateral trade flows among G7 member countries and indonesia: Gravity model approach. *Media Ekonomi* 29: 21–36. [CrossRef]
Visual Capitalist. 2023. Visualizing the BRICS Expansion in 4 Charts. Visual Capitalist. Available online: https://www.visualcapitalist.com/visualizing-the-brics-expansion-in-4-charts/ (accessed on 10 October 2024).
Yao, Xing, Rizwana Yasmeen, Yunong Li, Muhammad Hafeez, and Ihtsham Ul Haq Padda. 2019. Free Trade Agreements and Environment for Sustainable Development: A Gravity Model Analysis. *Sustainability* 11: 597. [CrossRef]
Yao, Xing, Yongzhong Zhang, Rizwana Yasmeen, and Zhen Cai. 2021. The impact of preferential trade agreements on bilateral trade: A structural gravity model analysis. *PLoS ONE* 16: e0249118. [CrossRef]
Yotov, Yoto V. 2022. On the role of domestic trade flows for estimating the gravity model of trade. *Contemporary Economic Policy* 40: 526–40. [CrossRef]
Yusuf, Nadia, and Vivian Nasrulddin. 2024. Significance of International Trade and National GDP as Two Integral Components of Sustainable Economic Development in Saudi Arabia. *Journal of the Knowledge Economy* 15: 2298–317. [CrossRef]