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A Heckscher-Ohlin Analysis of Philippine-Involved Bilateral Trade: Evidence from the Tinbergen Gravity Model

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ABSTRACT

This study investigates Philippine-involved bilateral trade with 25 key partner countries—including the United States, Japan, China, Singapore, Hong Kong, South Korea, Thailand, Malaysia, Indonesia, Germany, the Netherlands, Vietnam, Saudi Arabia, Australia, France, the United Kingdom, India, the United Arab Emirates, Canada, the Russian Federation, Belgium, Italy, Brazil, Switzerland and Ireland—from 2011 to 2018. Anchored in the Heckscher-Ohlin (1933) theory and the Tinbergen Gravity Model (1962), the research assesses how factor endowments—capital, labor, and land—along with per capita GDP, population, remoteness, and trade agreements, correlate with trade flows. Through pooled ordinary least squares (OLS) regression, the results validate the Gravity Model, particularly with regard to remoteness and trade agreements. Partial support is found for the Heckscher-Ohlin theory, as GDP per capita, labor, and population aligned with expectancy, while capital and land deviated. The study demonstrates the nuanced nature of Philippine-involved bilateral trade and presents policy recommendations informed by the observed correlations.

Keywords: Heckscher-Ohlin Theory, Gravity Model, Bilateral Trade, Factor Endowments, Capital Endowment, Labor Endowment, Land Endowment, GDP per Capita, Population, Remoteness, Trade Agreements, Ordinary Least Squares (OLS)

CHAPTER 1
INTRODUCTION

1.1 Background of the Study

The Heckscher-Ohlin (H-O) theory stands as a fundamental principle in international trade economics, standing as a critical framework for understanding how countries allocate resources to optimize trade advantage. Originally developed by Eli Heckscher and Bertil Ohlin in the early 20th century, this theory posits that countries tend to specialize in producing goods that intensively use their abundant factors of production—capital, labor, and land—resulting in distinct patterns of comparative advantage and trade flows (Heckscher, 1919; Ohlin, 1933). The theory presses that disparities in these factor endowments largely determine comparative advantages, thereby shaping global trade patterns.

Complementing this, the Tinbergen Gravity Model (1962) serves as a quantitative lens for analyzing trade, suggesting that trade flows between two nations are directly related to their economic sizes—commonly measured by GDP—and inversely related to the distance between them (Tinbergen, 1962). Integrating the H-O theory and Gravity Model enables a multidimensional view of trade dynamics that account for both

resource endowments and geographic-economic factors. However, a gap remains in the literature concerning the combined application of these models to Philippine trade, particularly in relation to its key international partners.

Addressing this gap, a deeper examination of the Philippines' evolving trade relationships is both timely and relevant. Over the past two decades, the Philippines has deepened its integration with global markets through regional and interregional frameworks such as the ASEAN Free Trade Area (AFTA) and bilateral agreements. Currently, over 90% of products within ASEAN are traded tariff-free, generating significant economic gains for member states (Noble et al., 2022). For instance, the Philippines and Vietnam have elevated their bilateral ties into a strategic alliance, driven by aligned trade priorities. The country's participation in ASEAN has bolstered economic resilience, though it has also increased exposure to external shocks (World Integrated Trade Solution, n.d.).

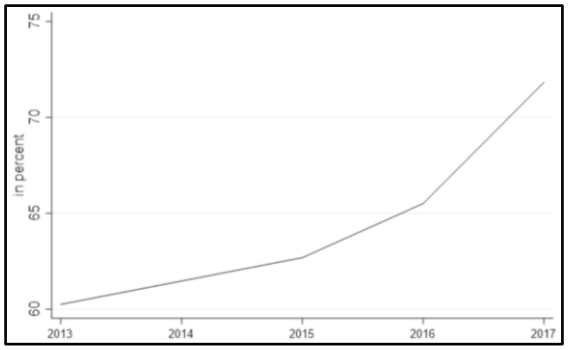

Figure 1. Philippines Total Trade as a Percentage of GDP
Sourced from WITS, n.d.; as mentioned by Rahnema, 2024

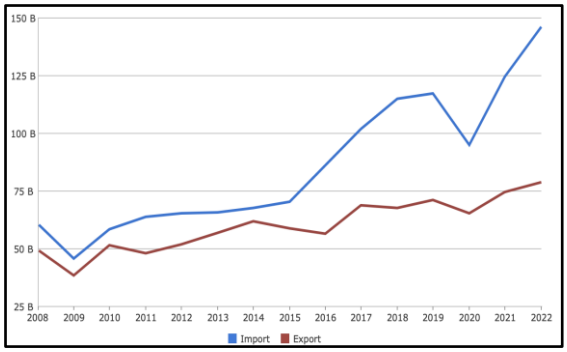

Figure 2. Philippines Trade Summary (2008-2022)
Sourced from WITS, (2020)

Figures 1 and *2* illustrate the rising trade-to-GDP ratio of the Philippines and summarize its import-export dynamics, respectively. These trends demonstrate increased bilateral trade brought on by intensified regional economic integration between the Philippines and its counterparts. The figures further contextualize how enhanced inter- and intra-regional trade not just within ASEAN, but also with major global economies.

Due to these shifts, the study centers on Philippine-involved bilateral trade with 25 strategic partners: the United States, Japan, China, Singapore, Hong Kong, South Korea, Thailand, Malaysia, Indonesia, Germany, the Netherlands, Vietnam, Saudi Arabia, Australia, France, the United Kingdom, India, the United Arab Emirates, Canada, the Russian Federation, Belgium, Italy, Brazil, Switzerland and Ireland—a heterogeneous composition of regional neighbors and global economic powers, demonstrating both geographical proximity and international strategic value. The research aims to apply both the H-O and Gravity models to investigate how the Philippines' factor endowments relate to trade flows with these nations from 2011 to 2018. Furthermore, it assesses the role of GDP per capita, population, remoteness, and trade agreements—such as AFTA and bilateral treaties—in defining trade dynamics. Fundamentally, the study contributes to a deeper understanding of Philippine trade and provides policymakers with actionable information for enhancing international competitiveness through strategic resource allocation and optimized trade policies.

1.2 Statement of the Problem

Despite the Philippines' growing economic integration into global trade, the factors surrounding bilateral trade flows with its principal trading partners remain underexplored. While previous studies have applied the Heckscher-Ohlin (1966) model and Tinbergen's Gravity Model (1962), there remains to be a gap in comprehensive analyses of how fundamental economic factors—factor endowments, GDP per capita, population, remoteness, and trade agreements—are related to Philippine trade patterns.

The primary aim of this study is to investigate the relationship between the explanatory variables and the bilateral trade flows of the Philippines. Particularly, the study seeks to address the following research questions:

1. Are factor endowments—capital, labor, and land—significant in advancing bilateral trade between the Philippines and its leading trading partners?
2. How do economic and geographical variables, as framed by the Gravity Model, influence trade flows between the Philippines and its leading trading partners?
3. How do trade associations and preferential trade agreements correlate with the Philippines' trade with international counterparts?

1.3 Formulation of Hypothesis

The Heckscher-Ohlin (H-O) theory and the Tinbergen Gravity Model are simultaneously drawn to determine the relationship between factor endowments and trade flows in the Philippines' bilateral trade with its leading trading partners. The study employs a dataset spanning 2011 to 2018, examining bilateral trade volumes as the dependent variable, and seven (7) independent variables—GDP per capita, population, remoteness, capital endowment, labor endowment, land endowment, and trade association memberships. The following hypotheses are formulated:

Hypothesis 1: Are factor endowments (capital, labor, and land) significant in advancing bilateral trade between the Philippines and its leading trading partners?

H_0: Factor endowments (capital, labor, and land) do not significantly advance bilateral trade between the Philippines and its major trading partners.

H_1: Factor endowments (capital, labor, and land) significantly advance bilateral trade between the Philippines and its major trading partners.

Hypothesis 2: Do economic and geographical variables, as framed by the Gravity Model, influence trade flows between the Philippines and its leading trading partners?

H_0: Economic and geographical variables, as framed by the Gravity Model, do not significantly influence trade flows between the Philippines and its major trading partners.

H_2: Economic and geographical variables, as framed by the Gravity Model, significantly influence trade flows between the Philippines and its major trading partners.

Hypothesis 3: How do trade associations and preferential trade agreements correlate with the Philippines' trade with its international counterparts?

H_0: Trade associations and preferential trade agreements have no significant correlation with the Philippines' trade with its international counterparts.

H_3: Trade associations and preferential trade agreements significantly correlate with the Philippines' trade with its international counterparts.

1.4 Scope and Limitations of the Study

The study investigates the relationship between central economic variables and bilateral trade flows involving the Philippines and its principal trading partners from 2011 to 2018, applying both the

Heckscher-Ohlin theory and the Tinbergen Gravity Model. Nonetheless, several inherent limitations are acknowledged.

First, the analysis is bound to the Philippines' 25 leading trade partners—namely the United States, Japan, China, Singapore, Hong Kong, South Korea, Thailand, Malaysia, Indonesia, Germany, the Netherlands, Vietnam, Saudi Arabia, Australia, France, the United Kingdom, India, the United Arab Emirates, Canada, the Russian Federation, Belgium, Italy, Brazil, Switzerland and Ireland—based on trade volume and strategic relevance. While some emerging partners are excluded, this selection reflects the core of the country's bilateral trade activity during the study period.

Secondly, the study's reliance on available data from international databases may not capture more nuanced or emerging trends in global trade. However, the use of consistent and credible sources ensures methodological reliability and comparability across countries and time.

Furthermore, the study aims to establish correlations rather than causal relationships. While causality is ideal, the study identifies significant correlations that lay the groundwork for future causal inference studies, contributing to a deeper understanding of factors influencing bilateral trade.

1.5 Significance of the Study

The rationale for this study is rooted in addressing the gaps in understanding the factors that drive Philippine-involved bilateral trade flows. As the nation increasingly integrates into the global economy, it becomes critical to examine how factor endowments—capital, labor, and land—economic conditions, and trade agreements influence trade dynamics. Such an investigation is not only critical for targeting economic development but also for strategic positioning within the global trade framework.

Given the central role trade plays in Philippine economic growth, this subject warrants deeper investigation to inform trade policies that maximize the country's competitive advantage and strengthen its international trade relations. The findings of this study can be particularly beneficial for the following stakeholders:

For government trade and economic departments in the Philippines, the study provides indications into the relationships between fundamental economic variables and trade flows, enabling data-driven policymaking. By understanding the significance of factor endowments and trade agreements, officials can develop more targeted policies to enhance trade partnerships and improve the country's global competitiveness.

For regional and international trade organizations, such as ASEAN and the World Trade Organization (WTO), the study offers empirical evidence on how trade agreements influence bilateral trade. This knowledge can contribute to refining trade agreements and fostering better collaboration among countries within the region and beyond.

For business sectors involved in international trade, the study presents findings that may be used in identifying methods for heightening trade activities. In assessing trade-involved economic factors, businesses can make more informed decisions about investments, market expansion, and strategic partnerships.

For academia and future research, the study contributes to the broader body of knowledge in trade economics, particularly within the context of developing economies like the Philippines. Furthermore, the research lays the groundwork for contributory studies investigating the causal relationships between economic factors and trade flows, providing a foundation for deeper analysis into global trade dynamics.

1.6 Definitions of Terms

This section contains a table with detailed definitions of key terms used throughout the study.

Table 1. Definitions of Terms

Terminology	Definition	Source
Bilateral Trade	A system of exchange between two nations involving the reciprocal trading of goods, services, or payments, typically governed by mutually agreed-upon rules or agreements to foster balanced trade relations.	Swidrowski, 1968
Factor Endowment	The distribution of a country's productive resources, such as capital, labor, and land, which influence its economic output and comparative advantages in international trade.	Spilimbergo, Londoño, & Székely, 2024
Comparative Advantage	The ability of a country to produce a good or service at a lower opportunity cost than another, promoting specialization and beneficial trade even when one party is less efficient in producing all goods	Dev Gupta, 2015
Heckscher-Ohlin (H-O) Theory	A trade theory proposing that countries export goods requiring resources (factor endowments) they have in abundance and import goods that require resources in short supply.	Jones, 2008
Tinbergen Gravity Model of Trade	An economic model that predicts bilateral trade flows based on the economic size (measured by GDP) and distance between two countries; larger economies trade more with each other while greater distance, representing higher trade costs, reduces trade volume.	Shahriar, Qian, Kea, & Abdullahi, 2019

CHAPTER 2
REVIEW OF RELATED LITERATURE

2.1 Trade Flows and the Explanatory Variables

Section 2.1 reviews the existing literature that estimate the Heckscher-Ohlin theory and the gravity equation, particular to the relationship between trade flows and critical explanatory variables such as per capita GDP, population, remoteness, trade associations, and factor endowments—land, labor, and capital.

2.1.1 Trade Flows and GDP Per Capita

A majority of studies confirm a positive correlation between GDP per capita and trade flows, particularly in the initial phases of bilateral trade expansion. Research frequently demonstrates that higher per capita GDP strengthens a nation’s purchasing power, thereby increasing demand for imports and enhancing the capacity to produce exports. Kikerkova et al. (2021) found that a 1% increase in the GDP per capita differential between Macedonia and its EU trade partners—including Germany, the United Kingdom, and Italy—resulted in a 0.32% increase in bilateral trade.

In BRICS nations, Jabalameli and Rasoulinezhad (2018) applied a fixed-, random-, and fully modified ordinary least squares test (OLS) and found a strong positive correlation between per capita GDP and trade, with evidence of the H-O Theory. Similarly, Rahman et al. (2020) and Inançli and Haman (2019) found a long-run relationship between per capita GDP and trade in BRICS and ECCAS, with the former concluding that intra-BRICS trade follows both the Linder hypothesis and the Heckscher-Ohlin model, evidencing heterogeneous income levels and economic structures within BRICS countries. These findings

align with a broader trend observed in other countries such as Malaysia, Pakistan, and Brazil, where significant GDP per capita disparities support increased trade, consistent with gravity model predictions (Assim et al., 2022; Erdey and Pöstényi, 2017; Ganbaatar et al., 2021; Rai et al., 2021; Silva et al., 2015; Umair et al., 2022).

In contrast, some studies indicate context-specific results. Hoque and Yusop (2012) reported mixed results in Bangladesh: while long-run GDP growth correlated with a significant increase in exports, this relationship was statistically insignificant in the short term. Such discrepancies often arise from differences in methodological approaches. For instance, Rahnema (2024) reported contrasting results for the Philippines when using OLS versus Poisson regression models. While OLS indicated a significant positive association between GDP and trade with 183 partners, Poisson regression produced insignificant results, suggesting that economic modeling choices can substantially impact outcomes (Rahnema, 2024).

Further points in trade patterns are evident in regional trade studies, where GDP correlations differ. Noble et al. (2022) applied an augmented gravity model to intra-ASEAN trade and observed that the GDP of the host country did not significantly influence total trade, while the GDP of ASEAN trading partners positively affected bilateral exports. Choi et al. (2019) found that in China-Kazakhstan trade, there was a positive correlation found in the increase of either nation's per capita GDP. Yet, the overall impact in this trade relationship was statistically insignificant. These studies affirm the gravity model's utility in modeling regional trade dynamics and the importance of contextual economic factors that shape trade patterns.

2.1.2 Trade Flows and Population

A substantial body of literature has examined the correlation between population size and trade flows, frequently finding that larger populations positively correlate with increased trade activity. One explanation is that larger populations in trading nations create expanded markets and greater potential for trade. In a study of trade flows across 31 countries, Ramaswamy et al. (2020) found population size to be highly elastic and significantly correlated with trade volume, as larger populations foster both production and consumption scales conducive to increased trade. Similarly, Inançli and Haman (2019) observed that densely populated countries tend to have higher consumption capacity and greater labor supply, broadening their trade compatibility and range of exports, thereby expanding their trade flows.

In addition, studies suggest that population growth dictates traded goods, particularly in emerging economies with labor-abundant populations. For instance, Rahman et al. (2020) concluded that, by and large, population growth in labor-rich nations increases exports of labor-intensive goods, aligning with the Heckscher-Ohlin theory, which posits that countries export goods that intensively use their abundant factors. This effect is further magnified in countries with young populations, where high labor availability drives competitive pricing in global markets. These findings are consistent with Kikerkova et al. (2021), who noted that countries with large populations not only increase their export volumes but also expand their output to meet the demands of both domestic and international markets (Assim et al., 2022; Silva et al., 2015).

Although less common, some studies identify a negative correlation between population and trade, often where rapid population growth strains resources and limits export capacity. Ganbaatar et al. (2021) found a significantly negative relationship in China and Mongolia, where high population density has led to tighter trade policies in China to manage resource scarcity and production constraints. They argue that in economies with limited resources and infrastructure, trade may decline as domestic consumption reduces available goods. Similarly, Umair et al. (2022) observed that rapid population growth in low-income

countries can hinder trade by increasing domestic demand and prices, which raise production costs and reduce international competitiveness. Evidence from Pakistan suggests that a lack of state incentives may further discourage participation in trade activities (Umair et al., 2022).

Meanwhile, few studies report insignificant findings, suggesting that other economic factors may mediate this relationship. Erkekoğlu and Yilmaz (2019) found that population had no significant effect on Turkey-APEC trade, possibly due to Turkey's non-labor-intensive economy, which may benefit more from trade with similarly endowed countries. Erdey and Pöstényi (2017) corroborate this in a panel study of Hungary and 79 partners, observing that other factors—such as land area, shared borders, and trade agreements—often have more substantial effects on trade. These studies assert the context-dependent nature of the population-trade relationship, where population size alone may not sufficiently predict trade without accounting for broader economic conditions.

2.1.3 Trade Flows and Remoteness

A considerable amount of literature finds that remoteness, or geographical distance between trading partners, negatively impacts trade flows, consistent with the Gravity Model's assertion that greater distances increase transportation and logistical costs, thereby reducing trade volume. Studies by Assim et al. (2022) and Kikerkova et al. (2021), centered on Malaysia and Macedonia, respectively, confirm that high transportation costs significantly hinder trade. Similarly, Inançli and Haman (2019) note that landlocked countries face higher transport costs than coastal nations, which constrains their trade potential, while countries that share borders tend to experience higher trade flows. Silva et al. (2015) further observed that large-volume goods like cereals and perishable items such as meat are particularly affected, as the costs of storage and long-distance transportation remain prohibitive.

The effect of distance is compounded in regions with poor infrastructure, where logistical inefficiencies make trade even more demanding. Ramaswamy et al. (2020), in a panel study of 31 countries, concluded that distance consistently diminishes trade, particularly in regions with weak infrastructure, where transport inefficiencies create substantial geographical separation. Additional research corroborates these findings, with studies indicating that distance substantially restricts trade for nations with underdeveloped logistical capacities (Choi et al., 2019; Erdey and Pöstényi, 2017; Jabalameli and Rasoulinezhad, 2018; Noble et al., 2022; Rai et al., 2021; Rasoulinezhad, 2017).

Conversely, some research suggests that remoteness can positively impact trade in certain contexts, particularly through market exclusivity or specialization. Umair et al. (2022) found that Pakistan's strategic diplomatic relationships with critical trade partners mitigate the effects of distance by establishing well-supported trade routes and favorable policies, which sustain trade flows despite geographical separation. Similarly, Kalyuzhna (2017) observed that countries specializing in distinct goods with few global suppliers can benefit from reduced competitive pressures in distant markets, allowing them to maintain niche market segments despite higher transportation costs.

Meanwhile, several studies report mixed or insignificant effects of distance on trade flows, suggesting that other factors may moderate its impact. Rahnema (2024), in a panel study of 183 countries, found that distance yielded both significant and insignificant results depending on the analytical model used, indicating that the effect of distance on trade can vary with methodological approaches. Ganbaatar et al. (2021) argue that in highly liberalized economies, the effects of distance are less pronounced, as globalization and advancements in information and communication technology reduce the practical limitations of remoteness. Similarly, Rahman et al. (2020) observed that in the BRICS context, distance has diminished relevance due to shared borders and well-established trade channels among several

member nations. These findings suggest that distance may be less determinative of trade flows in regions with high connectivity, advanced infrastructure, or established trade agreements (Erkekoğlu and Yilmaz, 2019).

2.1.4 Trade Flows and Factor Endowments

Several studies support a positive relationship between trade flows and factor endowments, suggesting that countries tend to export goods that capitalize their abundant resources, in line with the Heckscher-Ohlin model. For example, Wahab (2024) found that Nigeria, with substantial capital endowments in transport and ICT, increased exports in capital-intensive industries by over 45% to their trade partners. In the same vein, Preciados and Zabala (2019) concluded that land-rich nations are more likely to export agricultural products by leveraging their comparative advantage in land-based resources. Umair et al. (2022) found a significant positive relationship across all three endowments—capital, labor, and land—in Pakistan, concluding that nations with heterogeneous resources and strong geographical connections can expand trade volumes when paired with policies that enhance factor intensities (Erkekoğlu and Yilmaz, 2019; Umair et al., 2022).

Conversely, some studies report a negative correlation, particularly when the abundance of one resource restricts the development of others. For instance, Bilas (2015) observed that in Croatia and other EU member states, labor abundance in lower-income countries sometimes hinder trade flows, as limited capital resources restrict these nations from fully developing export-oriented industries. In addition, Ramaswamy et al. (2020) found that land-abundant countries across 31 nations often rely heavily on natural resource exports, which limits expansion and leads to less stable trade patterns over time.

However, research frequently presents mixed results, with some findings indicating that the effects of endowments can vary depending on the combination of resources a country possesses. In their study of Macedonia and 40 trade partners, Kikerkova et al. (2021) found that while capital endowments positively impact trade in high-income countries, this effect is less pronounced in developing nations with abundant capital but limited labor and land resources. They argued that as a small, landlocked, and import-dependent country, Macedonia faces opposition in leveraging its endowments due to its dependency on raw material imports and a limited focus on finished goods production.

Erdey and Pöstényi (2017), in a study of Hungary and 79 other nations, observed that countries with balanced land and labor endowments undergo more stable trade flows. Whereas, those with an imbalance—such as an excess labor force but minimal capital—often struggle to expand trade due to inadequate capital investments. It was further suggested that in labor-rich countries, the benefits of capital endowment for trade are contingent on supportive infrastructure and policy measures (Mailom et al., 2023). While factor endowments significantly shape trade flows, their effects are non-linear and often moderated by each country's economic policies, infrastructure quality, and level of industrial diversification.

2.1.5 Trade Flows and Trade Associations

Trade associations, or formal trade agreements between nations, have been shown in studies to heighten trade by reducing tariffs, standardizing regulations, and fostering closer economic linkages. Research by Kikerkova et al. (2021) demonstrated that Macedonia's membership in the EU and CEFTA-2006 has substantially increased trade with European nations by acquiring access to larger markets and simplified trade regulations. Similarly, Rai et al. (2021) and Ganbaatar et al. (2021) found that trade agreements within Asia, such as those within BIMSTEC and the ASEAN trade bloc, have increased intra-regional trade by reducing transaction costs and promoting cooperative policies.

Other research corroborates the long-term effectiveness of trade associations in promoting economic integration and trade diversification (Assim et al., 2022; Rahman et al., 2020). Erdey and Pöstényi (2017), in their analysis of 79 countries, found that trade agreements consistently increase trade among members by reducing tariffs and aligning regulatory standards, thus streamlining trade processes. Additionally, Rasoulinezhad (2017) reported that participation in both the World Trade Organization (WTO) and the Organization of the Petroleum Exporting Countries (OPEC) led to a 17.92% increase in natural resource trade among member nations.

However, not all studies find a uniformly positive effect of trade associations on trade. Some reported mixed results due to differences in economic structures or levels of integration commitment among member countries. For example, Noble et al. (2022) observed that while ASEAN countries benefit from the ASEAN Free Trade Area (AFTA), trade gains under the WTO have been less consistent, likely due to infrastructural weakness and economic disparities within ASEAN. In their meta-analysis, Erkekoğlu and Yilmaz (2019) and Rahnema (2024) found that the impact of trade agreements fluctuates based on the size and economic compatibility of the member nations, leading to inconsistencies in trade outcomes across different regions.

Some studies even report insignificant results for certain trade agreements, particularly where the agreements are less robust or where economic disparities are substantial. For instance, Jabalameli and Rasoulinezhad (2018) found that trade agreements between developed and developing countries within the WTO often produce limited trade increases, as less developed economies may struggle to meet the regulatory standards necessary for full participation. In addition, the WTO membership has shown minimal impact on Russia's trade flows with the Asia-Pacific region due to Russia's relatively undiversified, resource-dependent trade structure, which does not require the specific trade frameworks facilitated by the WTO.

Table 2.1 summarizes the reviewed related literature on the relationships between trade [TRD] and the explanatory variables—per capita GDP [GDP], population [POP], remoteness [REM], factor endowments [FE], and trade associations [FTA].

Table 2.1 Summary of the Reviewed Related Literature

Study	Periods	Countries	Methodologies	Coeff.	Causality Relationship
Trade Flows and GDP Per Capita					
Assim et al. (2022)	2010-2020	Sarawak, Malaysia	OLS Regression, PPML	(+)	GDP → TRD (unidirectional)
Choi et al. (2019)	2006-2016	China and Kazakhstan	OLS Regression Estimation	Insig.	No causality found
Erdey & Pöstényi (2017)	1993-2014	Hungary and 79 Trade Partners	OLS Regression, Gravity Model	(+)	GDP → TRD
Ganbaatar et al. (2021)	1996-2019	Mongolia and China	ARDL Bounds Testing, Principal Component Analysis (PCA)	(+)	GDP → TRD
Hoque & Yusop (2012)	1972-1973,	Bangladesh	ARDL Bounds Testing	Mixed	GDP → TRD [(+) in the long

	2004-2005				run; insig. in the short run]
Inançli & Haman (2019)	2007-2016	17 Central African States (ECCAS)	Least Square Dummy Variable (LSDV) (FE)	(+)	GDP → TRD
Jabalameli & Rasoulinezhad (2018)	2001-2015	Brazil, Russia, India, China and South Africa	OLS (Fixed [FE], Random [RE], and Fully Modified [FMOLS])	(+)	GDP → TRD
Kikerkova et al. (2021)	2005-2019	Macedonia and 40 Trade Partners	OLS Regression without Effects	(+)	GDP → TRD
Noble et al. (2022)	1995-2019	Philippines and ASEAN	PPLM (Fixed), OLS (Fixed [FE])	Insig.	No causality found
Rahman et al. (2020)	2000-2017	BRICS and 20 Trade Partners	Pooled OLS, FE and RE	(+)	GDP → TRD
Rahnema (2024)	1980-2017	Philippines and 183 Trade partners	PPML, OLS (Random [RE])	Mixed	GDP → TRD
Rai et al. (2021)	1997-2019	Bangladesh, Bhutan, India, Myanmar, Sri Lanka, Thailand, Nepal	OLS Regression Estimation	(+)	GDP → TRD
Ramaswamy et al. (2020)	2007-2014	31 Countries	OLS (Fixed and Random), PPML	(+)	GDP → TRD [in the long run]
Rasoulinezhad (2017)	1998-2014	China and 13 OPEC Members	OLS (Fixed [FE], Random [RE], and Fully Modified [FMOLS])	(+)	GDP → TRD [in the long run and short run]
Silva et al. (2015)	2000-2012	Parana, Brazil	Pooled OLS Model	(+)	GDP → TRD
Umair et al. (2022)	2002-2019	Pakistan	ARDL Stationarity Model	(+)	GDP → TRD [in the long run]
Trade Flows and Population					
Assim et al. (2022)	2010-2020	Sarawak, Malaysia	OLS Regression, PPML	(+)	POP → TRD
Erdey & Pöstényi (2017)	1993-2014	Hungary and 79 Trade Partners	OLS Regression, Gravity Model	Insig.	No causality found
Erkekoğlu & Yilmaz (2019)	1997-2016	Turkey and 21 APEC Members	Panel EGLS Method	Insig.	No causality found
Ganbaatar et al. (2021)	1996-2019	Mongolia and China	ARDL Bounds Testing, (PCA)	(–)	POP → TRD

Inançli & Haman (2019)	2007-2016	17 Central African States (ECCAS)	Least Square Dummy Variable (LSDV) (FE)	(+)	POP → TRD
Kikerkova et al. (2021)	2005-2019	Macedonia and 40 Trade Partners	OLS Regression without Effects	(+)	POP → TRD
Rahman et al. (2020)	2000-2017	BRICS and 20 Trade Partners	Pooled OLS, FE and RE	(+)	POP → TRD [in the long run]
Ramaswamy et al. (2020)	2007-2014	31 Countries	OLS (Fixed and Random), PPML	(+)	POP → TRD
Silva et al. (2015)	2000-2012	Parana, Brazil	Pooled OLS Model	(+)	POP → TRD
Umair et al. (2022)	2002-2019	Pakistan	ARDL Stationarity Model	(–)	POP → TRD
Trade Flows and Remoteness					
Assim et al. (2022)	2010-2020	Sarawak, Malaysia	OLS Regression, PPML	(–)	REM → TRD
Choi et al. (2019)	2006-2016	China and Kazakhstan	OLS Regression Estimation	(–)	REM → TRD
Erdey & Pöstényi (2017)	1993-2014	Hungary and 79 Trade Partners	OLS Regression, Gravity Model	(–)	REM → TRD
Erkekoğlu & Yilmaz (2019)	1997-2016	Turkey and 21 APEC Members	Panel EGLS Method	Insig.	No causality found
Ganbaatar et al. (2021)	1996-2019	Mongolia and China	ARDL Bounds Testing, (PCA)	Insig.	No causality found
Inançli & Haman (2019)	2007-2016	17 Central African States (ECCAS)	Least Square Dummy Variable (LSDV) (FE)	(–)	REM → TRD
Jabalameli & Rasoulinezhad (2018)	2001-2015	Brazil, Russia, India, China and South Africa	OLS (Fixed [FE], Random [RE], and Fully Modified [FMOLS])	(–)	REM → TRD
Kalyuzhna (2017)	1992-2016	Ukraine	Generalized Classic Specifications of the Gravity Model	(+)	REM → TRD
Kikerkova et al. (2021)	2005-2019	Macedonia and 40 Trade Partners	OLS Regression without Effects	(–)	REM → TRD [in the long run]
Noble et al. (2022)	1995-2019	Philippines and ASEAN	PPLM (Fixed), OLS (Fixed [FE])	(–)	REM → TRD
Rahman et al. (2020)	2000-2017	BRICS and 20 Trade Partners	Pooled OLS, FE and RE	Insig.	No causality found
Ramaswamy et al.	2007-2014	31 Countries	OLS (Fixed and Random),	Mixed	REM → TRD

(2020)			PPML		
Rai et al. (2021)	1997-2019	Bangladesh, Bhutan, India, Myanmar, Sri Lanka, Thailand, Nepal	OLS Regression Estimation	(–)	REM → TRD
Ramaswamy et al. (2020)	2007-2014	31 Countries	OLS (Fixed and Random), PPML	(–)	REM → TRD
Rasoulinezhad (2017)	1998-2014	China and 13 OPEC Members	OLS (Fixed [FE], Random [RE], and Fully Modified [FMOLS])	(–)	REM → TRD
Silva et al. (2015)	2000-2012	Parana, Brazil	Pooled OLS Model	(–)	REM → TRD
Umair et al. (2022)	2002-2019	Pakistan	ARDL Stationarity Model	(+)	REM → TRD
Trade Flows and Factor Endowments					
Bilas (2015)	1995-2011	Croatia and 27 Other EU Countries	OLS Regression	(–)	FE → TRD
Erdey & Pöstényi (2017)	1993-2014	Hungary and 79 Trade Partners	OLS Regression, Gravity Model	Mixed	FE → TRD [CE (insig.); LBE (–); LE (–)]
Erkekoğlu & Yilmaz (2019)	1997-2016	Turkey and 21 APEC Members	Panel EGLS Method	(+)	FE → TRD
Kikerkova et al. (2021)	2005-2019	Macedonia and 40 Trade Partners	OLS Regression without Effects	Mixed	FE → TRD [CE (+); LBE (–); LE (–)]
Mailom et al. (2023)	2005, 2010, and 2015	US and the Philippines	Granger Causality Test; Input-Output (I-O) Analysis	Mixed	FE → TRD [CE (+); LBE (–)]
Preciados & Zabala (2019)	1995, 2005, and 2015	Japan and the Philippines	Vector Error Correction Model (VECM)	(+)	FE → TRD [CE (+); LBE (+)]
Ramaswamy et al. (2020)	2007-2014	31 Countries	OLS (Fixed and Random), PPML	(–)	FE → TRD [LBE (–)]
Umair et al. (2022)	2002-2019	Pakistan	ARDL Stationarity Model	(+)	FE → TRD [CE (+); LBE (+); LE (+)]
Wahab (2024)	2005-2021	Nigeria and 22 Major Trading	Panel Instrumental Variables, Pooled Two-	(+)	FE → TRD [CE (+); LBE

		Partners	Stage Least Squares (FE) (RE)		(+)]
Trade Flows and Trade Associations					
Assim et al. (2022)	2010-2020	Sarawak, Malaysia	OLS Regression, PPML	(+)	FTA → TRD
Erdey & Pöstényi (2017)	1993-2014	Hungary and 79 Trade Partners	OLS Regression, Gravity Model	(+)	FTA → TRD
Erkekoğlu & Yilmaz (2019)	1997-2016	Turkey and 21 APEC Members	Panel EGLS Method	Mixed	FTA → TRD [G-20 (+); APEC (–); OECD (–)]
Ganbaatar et al. (2021)	1996-2019	Mongolia and China	ARDL Bounds Testing, (PCA)	(+)	FTA → TR
Jabalameli & Rasoulinezhad (2018)	2001-2015	Brazil, Russia, India, China and South Africa	OLS (Fixed [FE], Random [RE], and Fully Modified [FMOLS])	Insig.	FTA → TRD [TCI (insig.); WTO (insig.); BRICS (+)]
Kikerkova et al. (2021)	2005-2019	Macedonia and 40 Trade Partners	OLS Regression without Effects	(+)	FTA → TRD
Noble et al. (2022)	1995-2019	Philippines and ASEAN	PPLM (Fixed), OLS (Fixed [FE])	Mixed	FTA → TRD [AFTA (+); WTO (–)]
Rahman et al. (2020)	2000-2017	BRICS and 20 Trade Partners	Pooled OLS, FE and RE	(+)	FTA → TRD
Rahnema (2024)	1980-2017	Philippines and 183 Trade partners	PPML, OLS (Random [RE])	Mixed	FTA → TRD [AFTA (insig.); ASEAN (+)]
Rai et al. (2021)	1997-2019	Bangladesh, Bhutan, India, Myanmar, Sri Lanka, Thailand, Nepal	OLS Regression Estimation	(+)	FTA → TRD [BIMSTEC (+)]
Ramaswamy et al. (2020)	2007-2014	31 Countries	OLS (Fixed and Random), PPML	Mixed	FTA → TRD [AFTA (+); APTA (+); SAFTA (–); GCC (insig.)]
Rasoulinezhad (2017)	1998-2014	China and 13 OPEC Members	OLS (Fixed [FE], Random [RE], and Fully Modified	(+)	FTA → TRD

			[FMOLS])		

2.2 Synthesis and Gaps

2.2.1 Synthesis

The literature on bilateral trade flows denote the crucial role of per capita GDP, population, and factor endowments in shaping international trade patterns. Studies consistently show that higher GDP per capita is positively associated with greater trade volumes, as wealthier nations can both produce and consume more goods, facilitating trade. This is particularly evident in countries like the United States and Japan. However, in developing economies such as the Philippines, the relationship between GDP and trade is influenced by additional factors, such as industrial development, policy, and access to global markets. Similarly, population size is generally linked to larger trade volumes, driven by higher domestic production and consumption. However, the impact of population on trade varies by country, influenced by economic structure and development levels.

Factor endowments, central to the Heckscher-Ohlin (H-O) theory, also significantly affect trade patterns. Nations tend to specialize in goods that make use of their abundant factors, such as labor, capital, or land. For example, labor-abundant countries like the Philippines export labor-intensive goods, while capital-rich nations like the U.S. focus on capital-intensive exports. However, some studies suggest that technological advancements and human capital can alter these traditional patterns, complicating the simple relationship proposed by the H-O model. Remoteness, or geographic distance, typically hinders trade by increasing transportation costs. Yet, the impact of remoteness is moderated by trade agreements and technological progress, which lower transaction costs and facilitate trade even over long distances.

Trade agreements are widely acknowledged to promote trade by reducing barriers, but their impact varies. While some studies emphasize their positive role in fostering economic ties, others argue that their benefits may be overstated, particularly when political and economic factors influence implementation. These findings show a gap in the literature, especially regarding the Philippines and emerging economies.

2.2.2 Gaps and Future Direction

Despite the breadth of research on bilateral trade, there are several important gaps that warrant further exploration. First, while studies have acknowledged the role of trade agreements, there is limited research on how these agreements interact with other variables like GDP per capita, population, and factor endowments to shape trade outcomes. Further studies could examine how regional trade agreements or preferential trade agreements influence the trade flows between the Philippines and its major trading partners.

Second, methodological differences across studies, such as the use of the Gravity Model versus other econometric models, often lead to inconsistencies in findings. There is a need for more robust and consistent methodological approaches to ensure comparability and reliability of results, especially in the case of developing economies like the Philippines.

Finally, the impact of technological advancements, infrastructure, and changing global supply chains has not been sufficiently integrated into trade models. Future research could explore how these modern developments interact with traditional factors, such as factor endowments, to influence trade flows, particularly for economies undergoing rapid technological growth. Addressing these gaps will deepen our understanding of bilateral trade, especially for emerging economies in Asia.

2.3 Theoretical Framework

2.3.1 The Heckscher-Ohlin Theory (1966)

The Heckscher-Ohlin (H-O) theory, pioneered by Eli Heckscher and Bertil Ohlin in the early 20th century, serves as a foundational principle in understanding the comparative advantage and the patterns of international trade (Ohlin, 1933; Flux et al., 1934). The theory asserts that disparities in factor endowments—capital, labor, and land—fundamentally define the comparative advantages of nations in their production of goods and services. The central idea states that countries gravitate towards specializing in and exporting goods that intensively use their abundant factors of production while importing goods that require factors in which they are relatively scarce (Stone et al., 2011).

For instance, a nation rich in capital resources will tend to specialize in and export capital-intensive products, whereas a labor-abundant country will prioritize and export labor-intensive goods. This strategic specialization, grounded in inherent factor endowments, enables countries to optimize production efficiency and allocate resources more efficiently, thus maximizing the benefits of international trade.

The H-O theory can be represented by the following equation, where the production of goods (X) based on factor endowments (L for labor, K for capital):

$$X_i = F(L_i, K_i) \quad (1)$$

Where X_i is the output of good i, L_i is the labor input in the production of good i, and K_i is the capital input. In the context of this study, the trade flow between countries i and j can be conceptualized as:

$$Tij = \alpha_0 + \beta_1 L_i + \beta_2 K_i + \epsilon_{ij} \quad (2)$$

Furthermore, the H-O theory predicts that over time, international trade will result in the equalization of factor prices across countries. As trade liberalization advances, it leads to a convergence in the returns to factors of production globally, facilitating economic development by reallocating resources to their most productive uses and contributing to a more efficient global economy (Ohlin, 1933; Stone et al., 2011).

2.3.2 The Tinbergen Gravity Model (1962)

The Tinbergen Gravity Model, introduced by Jan Tinbergen in the early 1960s, is critical in understanding the determinants of bilateral trade flows between nations. Central to the model is the assertion that the trade volume between two countries is directly influenced by their respective economic sizes—typically measured by Gross Domestic Product (GDP)—and inversely affected by the geographical distance between them (Tinbergen, 1962).

The Gravity Model can be represented by the following equation:

$$Tij = G \cdot \frac{(Yi \cdot Yj)}{Dij} \quad (3)$$

Where T_{ij} is the trade flow between countries i and j, Y_i and Y_j are the GDPs of countries i and j, D_{ij} is the distance between the two countries, and G is a constant that adjusts for other factors. In the context of this study, the trade volume can be modeled as follows:

$$Tij = \alpha_0 + \beta_1 GDP_i + \beta_2 GDP_i - \beta_2 D_{ij} + \epsilon_{ij} \quad (4)$$

Here, T_{ij} represents the trade flow between countries i and j, GDP_i and GDP_j denote the GDP of countries i and j, D_{ij} signifies the distance between the two countries, and ϵ_{ij} represents the error term.

According to the Gravity Model, countries with larger economies tend to engage in greater trade with each other, as their economic scale allows for the production and exchange of a wider variety of goods and services. Conversely, distance acts as a barrier to trade, with greater geographical separation increasing transportation costs and logistical challenges, thereby reducing trade volumes. This relationship between economic size and distance mirrors gravitational forces in physics, where mass pulls objects together, and

distance weakens that pull.

The model has been expanded to account for other factors that either facilitate or hinder trade, such as trade agreements, which will be factored into this study. These factors help explain variations in trade volumes beyond economic size and distance (Tinbergen, 1962).

2.3.3 Integration of the Gravity Model and the Heckscher-Ohlin Theory

The integration of the Gravity Model and the Heckscher-Ohlin (H-O) theory provides a comprehensive framework for analyzing both the composition and scale of trade. The H-O theory explains why nations export certain goods based on their abundant resources, while the Gravity Model addresses the volume of trade, asserting that trade flows increase with economic size and decrease with geographical distance. The interaction between these theories suggest that while factor endowments define the types of goods traded, it is economic scale and proximity that shape the intensity of trade interactions.

This integrated approach also accounts for additional elements such as trade agreements, technological advancements, and policy decisions, which further reduce distance-related barriers and reinforce economic ties between nations. The design of the study is thus able to present a more well-rounded understanding of global trade flows, considering how both spatial and economic factors interact with a nation's inherent endowments to shape international trade patterns.

2.4 Conceptual Framework

The conceptual framework of this study integrates the Heckscher-Ohlin (H-O) theory and the Gravity Model of Trade to investigate the relationship between factor endowments, trade determinants, and bilateral trade flows. The approach builds on the previous studies of Kikerkova et al. (2021) and Umair et al. (2022), which both employ the Gravity Model to analyze trade flows, incorporating variables like GDP, remoteness, and factor endowments (capital, labor, and land) as determinants of bilateral trade performance.

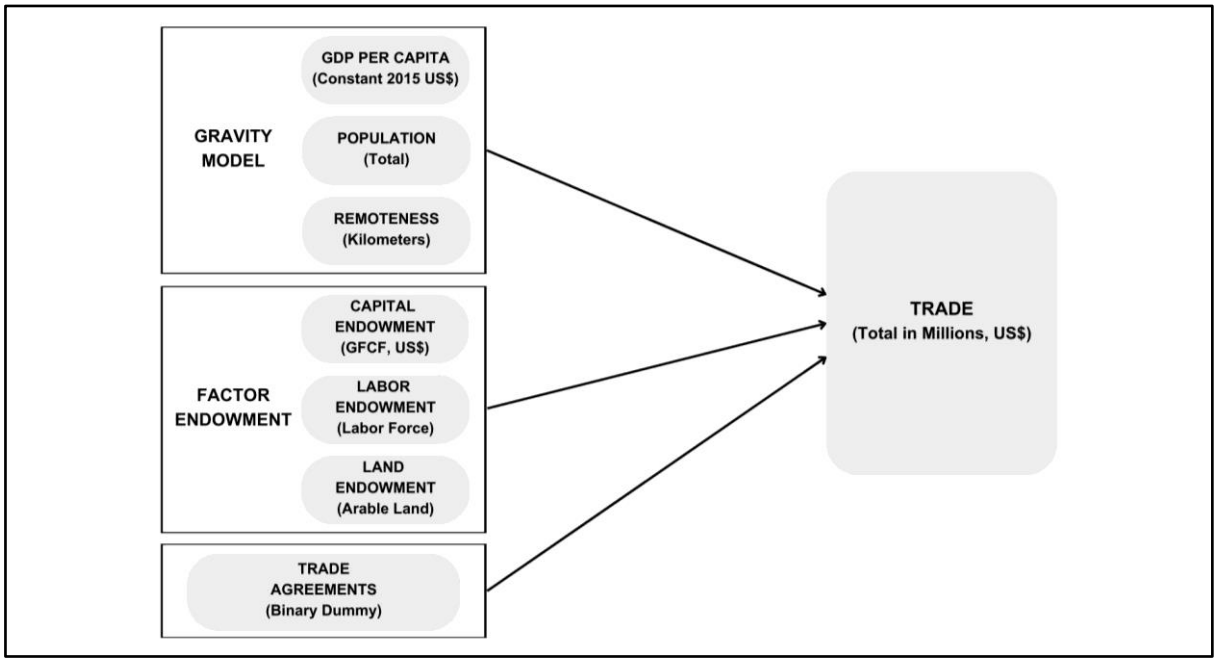

Figure 3. Conceptual Framework

The framework examines how the interaction between these variables shapes bilateral trade patterns between the Philippines and its leading trade partners. By incorporating both the Heckscher-Ohlin theory and the Gravity Model, this study aims to provide a deeper understanding of the mechanisms defining trade relationships and provide insights into how these dynamics can inform economic policy and strategic trade decisions, particularly in the context of the Philippines' engagement in global trade.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Research Design

This study employs the Pooled Ordinary Least Squares (Pooled OLS) regression model to investigate the applicability of the Heckscher-Ohlin (H-O) theory in the context of bilateral trade flows between the Philippines and its leading trade partners. Employing a quantitative-correlational research design, the pooled OLS approach enables the analysis of interactions effects of the independent variables—per capita GDP, population, capital endowment, labor endowment, land endowment, remoteness, and trade agreements—on trade flows, measured through imports and exports.

The panel data spans eight (8) consecutive years (2011–2018) and covers 26 countries: the Philippines and 25 of its bilateral trade partners, namely the United States, Japan, China, Singapore, Hong Kong, South Korea, Thailand, Malaysia, Indonesia, Germany, the Netherlands, Vietnam, Saudi Arabia, Australia, France, the United Kingdom, India, the United Arab Emirates, Canada, the Russian Federation, Belgium, Italy, Brazil, Switzerland and Ireland.

The study is grounded in the Heckscher-Ohlin (H-O) theory, with econometric analysis employed to test the model's validity in explaining trade flows among the 26 nations. In particular, the role of factor endowments—capital, labor, and land—will be examined to define their significance in shaping trade patterns. The study is further elevated by integrating a secondary framework, the Tinbergen Gravity Model—based on the analogy with the Newtonian theory of gravity—which suggests that trade volume between two countries is proportional to the product of their economic sizes and inversely proportional to the distance between them (Tinbergen 1962, Bergstrand 1985).

These frameworks account for macroeconomic and geographical variables in the context of bilateral trade. To further assess the correlation of factor endowments, the capital-labor ratio (K-L) for each country will be calculated using the formula derived from Clarnce and Karia (2020):

$$FE = \frac{TK}{TL} \quad (5)$$

Where TK represents gross fixed capital formation as a percentage of GDP, and TL denotes the total labor force participation rate as a percentage of the population aged 15-64. Apart from testing the overall relationship between trade and the explanatory variables, this study also elaborates on how the presence of trade associations and the factor endowments of each country affect the applicability of both the Heckscher-Ohlin and Gravity models, supporting the goal of the study to understand whether these frameworks function similarly across nations with different factor endowments and trade agreements.

3.2 Variable Selection

In line with the complexity of international trade dynamics, this study employs a range of variables. The primary focus is on economic indicators such as per capita GDP difference, reflecting development difference, and population, indicative of market size. Factor endowments, including gross fixed capital formation for capital, labor force for labor, and arable land for land, are also considered.

In addition, trade-related factors such as geographical distance and remoteness are incorporated to capture trade costs, while trade agreements are treated as a dummy variable. The selection of these variables is guided by existing literature on the Heckscher-Ohlin Theory and the Gravity Model, ensuring their relevance to the study's objectives while considering data availability and methodological constraints.

3.3 Data Collection and Measurement

Data collection for this study involved sourcing information from the World Bank, World Integrated Trade Solution (WITS), and CEPII datasets spanning the period from 2011 to 2018. The data for the explanatory variables—per capita GDP, population, and factor endowments—were all obtained from the World Bank database to ensure consistency and comparability across countries.

Trade data, particularly imports and exports, were sourced from WITS to measure total bilateral trade between the Philippines and its 25 selected trade partners: the United States, Japan, China, Singapore, Hong Kong, South Korea, Thailand, Malaysia, Indonesia, Germany, the Netherlands, Vietnam, and Saudi Arabia, Australia, France, Great Britain, United Arab Emirates, Canada, Russia, Belgium, Italy, Brazil, Switzerland, and Ireland..

Remoteness data, used to account for geographic and economic isolation, was obtained from the CEPII Gravity Database to enhance the robustness of spatial variables in the model. The use of standardized data from the World Bank, WITS, and CEPII ensures consistency in data collection methods across all countries, allowing for reliable cross-country comparisons and longitudinal analysis.

In addition, trade associations are interposed into the study as a dummy variable, coded as '1' if a bilateral trade agreement exists between the focal country and a given trading nation during the examined period, and '0' if no such agreement is in place.

Following the methodology of Kikerkova et al. (2021) and Umair et al. (2022), the data gathered from various sources were used to design the data needed for each of the variables in the model. Table 3 presents an overview of the variables employed in this study, including their operational definitions and corresponding data sources.

Table 3. Summary of the Variables

Variable	Measurement	Working Definition	Data Source
Trade [TRADE]	Current US $	Calculated as the sum of the import and export values between the Philippines and its trade partner.	World Integrated Trade Solutions (WITS), accessed 2024
GDP per Capita [GDPC]	Current US $	Calculated as the difference between the maximum and minimum per capita GDP values of the Philippines and its trade partner.	World Bank Indicators, accessed 2024
Population [POP]	Total	Sum of the total population values of the Philippines and the respective trade partner.	World Bank Indicators, accessed 2024
Remoteness [REM]	Kilometers	Calculated as geographical distance between capitals of the Philippines and its trade partner.	CEPII Gravity Database, accessed 2024

Capital Endowment [CAP]	Current US $	Ratio calculated as the maximum gross fixed capital formation (GFCF) to labor force ratio of the Philippines and its trade partner, divided by the minimum GFCF to labor force ratio of the Philippines and its trade partner.	World Bank Indicators, accessed 2024
Labor Endowment [LAB]	Current International $	Ratio calculated as the maximum GDP PPP per person employed of the Philippines and its trade partner, divided by the minimum GDP PPP per person employed of the Philippines and its trade partner.	World Bank Indicators, accessed 2024
Land Endowment [LAND]	Arable Land (hectares)	Ratio calculated as the maximum arable land to labor force ratio of the Philippines and its trade partner, divided by the minimum arable land to labor force ratio of the Philippines and its trade partner.	World Bank Indicators, accessed 2024
Trade Agreements [FTA]	Binary	Binary variable indicating the presence of free trade agreement between the Philippines and its trade partner, assigned a value of '1' if a trade agreement (e.g., ASEAN Free Trade Area) exists, and '0' if no such agreement is in place.	Dummy Variable

3.4 Econometric Model

A panel ordinary least squares (OLS) model is employed in this study to estimate the correlation of economic-geographical variables and factor endowments on the bilateral trade flows between the 26 subject nations. The OLS model method is appropriate due to its efficiency in estimating linear relationships, particularly in the context of panel data. By employing this method, we can evaluate the influence of both individual and combined factors on trade flows, denoting the advanced relationships between variables.

The general functional form of the model to estimate bilateral trade flows between countries *i* and *j* over time *t* can be defined as follows:

$$\ln T_{i,j,t} = \beta_0 + \beta_1 X_{i,j,t} + \varepsilon_{i,j,t} \quad (6)$$

Where:

lnTi, j,t is the natural logarithm of trade volume between country i and country j at time t.

Xi, j,t represents each independent variable X (e.g., GDP per capita difference, population, capital endowment, labor endowment, land endowment, remoteness, and trade agreements) between country i and country j at time t.

β0 is the intercept term.

εi, j,t is the error term.

To further specify the role of distinct factor endowments in bilateral trade flows, the model includes capital endowment ($CAP_{i,j,t}$), labor endowment ($LAB_{i,j,t}$), and land endowment ($LAND_{i,j,t}$) as separate variables. In addition, the gravity model elements—per capita GDP, population, and remoteness—are included, and a dummy variable indicates the presence of trade agreements. The expanded model is formulated as follows:

$$\ln T_{i,j,t} = \beta_0 + \beta_1 \ln GDP_{i,j,t} + \beta_2 \ln POP_{i,j,t} + \beta_3 CAP_{i,j,t} + \beta_4 LAB_{i,j,t} + \beta_5 LAND_{i,j,t} + \beta_6 \ln REM_{i,j,t} + \beta_7 \ln FTA_{i,j,t} + \varepsilon_{i,j,t} \quad (7)$$

Where:

lnGDPCi, j, t is the natural logarithm of GDP per capita difference.

lnPOPi, j, t is the natural logarithm of population.

CAPi, j, t is the capital endowment difference between country i and j.

LABi, j, t is the labor endowment difference between country i and j.

LANDi, j, t is land endowment difference between country i and j.

lnREMi, j, t is the natural logarithm of remoteness, representing the geographical distance between countries i and j.

lnFTAi, j, t is a trade agreement dummy variable, where FTA = 1 if a bilateral trade agreement exists, and FTA = 0 otherwise.

3.5 Statistical Tests

The study evaluates the correlation of factor endowments and economic-geographical variables to bilateral trade flows between the subject nations using the Pooled Ordinary Least Squares (OLS) method. This method is appropriate for estimating the relationship between the dependent and independent variables under the assumption of independently distributed errors with constant variance. All statistical analyses were carried out using Gretl, an open-source econometric software designed for time series and panel data analysis.

A. Tests for Individual Coefficients

The coefficients estimated in the OLS model quantify the change in bilateral trade flows associated with a one-unit change in each independent variable, holding other variables constant. These coefficients estimate the effects of GDP per capita difference, remoteness, population, capital endowment, labor endowment, land endowment, and trade agreements on trade flows. Significance levels of 1% and 5% are employed.

B. Goodness of Fit

To evaluate model fitness, R^2 and adjusted R^2 statistics are employed. R^2 measures the proportion of variance in bilateral trade flows explained by the independent variables, while adjusted R^2 accounts for the number of independent variables. In addition, the overall significance of the model is assessed using the F-statistic, which compares explained to unexplained variance. These metrics provide insights into the model's effectiveness in explaining variations in trade flows.

C. Diagnostic Tests

Diagnostic tests are conducted to ensure the model's validity, addressing potential issues in statistical assumptions:

a. Panel Unit Root Test: Tests the stationarity of variables over time; the Levin-Lin-Chu (LLC) test for the existence of a unit root.

b. Jarque-Bera Test for Normality of Error Terms: Assesses normal distribution of residuals, essential for reliable confidence intervals. A p-value above the significance level indicates a normal distribution of error terms.

c. Variance Inflation Factor (VIF): Tests multicollinearity, with values above 10 indicating potential high correlation among explanatory variables; crucial for coefficient estimation.

d. White's test: Detects heteroscedasticity with a p-value greater than the significance level, indicating acceptance of the null hypothesis of homoscedasticity.
e. Wooldridge Test for Serial Correlation: Detects autocorrelation, where a p-value greater than 0.05 indicates the absence of autocorrelation.
f. Ramsey RESET Test for Specification Bias: Assesses whether the model is correctly specified, with a p-value exceeding the significance level indicating correct model specification.

By conducting these tests, the study ensures that the model produces consistent, unbiased, and reliable estimates, presenting robust insights into the factors influencing bilateral trade flows.

3.6 Ethical Considerations

The study adheres to ethical standards in data collection and analysis by utilizing publicly available and credible data from source, including those from the World Bank, World Integrated Trade Solution (WITS), and the CEPII Gravity Database. As the research is based on aggregate economic indicators at the national level, it does not involve personal or sensitive data, ensuring compliance with data privacy and legal requirements. All sources, variable definitions, and methodological procedures are thoroughly documented to ensure transparency, reproducibility, and scholarly accountability.

The study also maintains academic integrity by accurately citing all references, theories, and existing literature, respecting the intellectual property of original authors. Limitations and potential biases are openly acknowledged to provide a balanced view of the findings. Data and results are analyzed and presented objectively. These ethical practices assert the study's commitment to credible and responsible research in international trade economics.

CHAPTER 4
DISCUSSION OF RESULTS

4.1 Descriptive Statistics

Descriptive statistics were computed to summarize the central tendency and variability of the variables used in the analysis. These figures provide a preliminary overview of the data distribution prior to regression testing. The results are presented as follows:

Table 4.1 Descriptive Statistics

Variable	n	Mean	Std. Dev.	Min.	Max.	Skewness
Bilateral Trade Flows [TRADE]	200	4.91945e+009	5.94307e+009	1.85010e+008	3.12780e+010	1.7955
Gross Domestic Product per Capita [GDPC]	200	31625.5	22338.6	72.5524	88045.6	0.1713
Population [POP]	200	278,849,020	354,655,344	100,917,997	1,511,328,836	3
Capital Endowment [CAP]	200	9.89694	6.92026	1.01465	35.8283	0.7652
Labor Endowment [LAB]	200	4.67987	2.28028	1.10272	9.92663	-0.1263
Land Endowment [LAND]	200	41.7635	152.372	1.0018	806.979	4.4272
Remoteness [REM]	200	7408.98	4591.09	1114.39	18832.3	0.400399

The descriptive statistics offer an initial overview of the distribution and variation of the variables used in the regression analysis. With 200 observations per variable, the data spans a balanced panel across the

study period (2011–2018) and country pairs. The mean TRADE is approximately PHP 4.92 billion, with a standard deviation of PHP 5.94 billion, indicating considerable variation in bilateral trade volumes. The skewness value of 1.7955 suggests a moderate right-skew, meaning a few high trade values pull the distribution rightward.

GDPC has a mean of 31,625.5, with relatively low skewness (0.1713), implying a more symmetric distribution. POP, on the other hand, shows significant dispersion [mean = 278 million, std. dev. = 354 million] and a high positive skew (3.0), reflecting substantial variation in country size among trade partners. Capital endowment and labor endowment exhibit lower means (9.90 and 4.68, respectively) and moderate variability, with CAP showing a right-skew (0.7652) and LAB close to normal distribution (-0.1263). Land endowment (LAND) stands out with a large range and the highest skewness (4.4272), suggesting the presence of extreme values or outliers, which may be attributed to a few countries with vast land resources.

4.2 Prerequisite Diagnostic Test

As a prerequisite to confirm the validity of the data for panel regression analysis, the Levin-Lin-Chu (LLC) unit root test was conducted to assess the stationarity of variables. The test assumes a common unit root across all panels and yielded the following results:

Table 4.2 Results of Levin-Lin-Chu Stationarity Test

Variables	Level	First Difference
ln_TRADE	0.8282	0.0000***
ln_GDPC	0.3453	0.0000***
ln_POP	0.8736	0.0000***
CAP	0.0000***	0.0000***
LAB	0.0000***	0.0000***
LAND	0.0000***	0.0001***

Table 4.2 presents the results of the LLC stationarity test. At level, the variables ln_TRADE, ln_GDPC, and ln_POP have p-values greater than 0.05, indicating the presence of a unit root and thus non-stationarity in their original form. In contrast, the variables CAP, LAB, and LAND are stationary at level, as evidenced by p-values less than 0.01

However, after taking the first difference, all variables become stationary at the 1% significance level. The p-values for all variables drop to 0.0000 (except for LAND at 0.0001), confirming the rejection of the null hypothesis of a unit root. This indicates that the variables ln_TRADE, ln_GDPC, and ln_POP are integrated of order one, I(1), while CAP, LAB, and LAND are stationary at both level and first difference. These results justify the transformation of non-stationary variables through differencing to avoid spurious regression outcomes. Consequently, the stationarity of the dataset is established, fulfilling a necessary precondition for reliable estimation using the Pooled Ordinary Least Squares (Pooled OLS) method.

4.3 Regression Results

Using panel data from the Philippines' top 25 trading partners between 2011 and 2018, the study constructed a regression model to estimate the relationships of underlying economic and geographical variables with bilateral trade flows. The analysis applied the Pooled Ordinary Least Squares (OLS) method

to assess both the individual significance of each variable and the model's overall explanatory power. The resulting estimates are discussed as follows:

Table 4.3 Pooled OLS Estimates

Variables	Coefficients	T-Statistic	P-Value	Interpretation
ln_GDPC	0.5509	7.4300	3.51e-012***	Passed at 1% significance
ln_REM	-1.2121	-11.6800	3.63e-024***	Passed at 1% significance
ln_POP	0.8455	8.0100	1.11e-013***	Passed at 1% significance
CAP	-.04473	-3.3700	0.0009***	Passed at 1% significance
LAB	0.1285	2.3600	0.0192**	Passed at 5% significance
LAND	-0.0009	-1.9100	0.0570*	Passed at 10% significance
TA	0.6497	3.0900	0.0023***	Passed at 1% significance
R-Squared		63.95%		
Adjusted R-Squared		62.64%		

The Pooled Ordinary Least Squares (OLS) regression model explains 63.95% of the variation in bilateral trade flows, as indicated by the R-squared value. The adjusted R-squared of 62.64% reinforces the model's explanatory strength, suggesting that a substantial portion of the variation in trade flows is captured by the included variables. These results support the robustness and reliability of the model specification within the Pooled OLS framework.

The explanatory variable ln_GDPC produced a positive coefficient of 0.5509 and is statistically significant at the 1% level [p = 0.000***], indicating a strong and robust relationship between per capita income differentials and bilateral trade flows. Particularly, a 1% increase in the disparity in GDP per capita between the Philippines and its trading partners is associated with a 0.55% increase in trade flows. This finding aligns with the core proposition of the Heckscher-Ohlin theory, which contends that differences in factor endowments and development levels stimulate more intensive trade, as these differences create opportunities for specialization and mutual benefit.

This result is consistent with the evidence presented by Kikerkova et al. (2021) and Umair et al. (2022), who observed that greater income disparities between nations facilitate inter-industry trade by enabling countries to export goods that intensively utilize their abundant resources. In the case of the Philippines, this supports its comparative advantage in labor-intensive production and its reliance on importing capital-intensive goods. Rai et al. (2021) further reinforce these arguments in Southeast Asia, demonstrating how structural asymmetries expand regional trade flows. In contrast, studies like Choi et al. (2019) and Jabalemeli and Rasoulinezhad (2018) identified negative associations under the Linder Hypothesis, which emphasizes trade among countries with similar income levels; however, this framework is less applicable in the Philippine context given its trade structure and export profile.

The explanatory variable ln_REM produced a coefficient of -1.2121, negatively significant at the 1% level [p = 0.000***], indicating that a 1% increase in economic distance between the Philippines and a trading partner is linked to a 1.21% decrease in trade volume. This result is in line with the traditional Gravity

Model of Trade, which asserts that geographic distance weakens trade due to higher transportation costs, longer delivery times, and increased uncertainty.

The finding is consistent with Assim et al. (2022), Kikerkova et al. (2021), and Rai et al. (2021), who all confirmed the persistent trade-reducing effects of spatial separation—particularly within Southeast Asia, where inadequate infrastructure and inefficient customs procedures continue to hinder regional integration. Silva et al. (2015) add that bulk commodities and time-sensitive goods are particularly affected by these distance-related frictions. In contrast, Umair et al. (2022) identified cases where strong diplomatic relations and enduring trade partnerships mitigated the effects of remoteness; however, such mitigating conditions appear less applicable in the Philippine context.

The explanatory variable ln_POP has a positive coefficient of 0.8455 and is statistically significant at the 1% level [p = 0.000***], indicating that a 1% increase in population is associated with an estimated 0.85% rise in trade flows. This reinforces the view that larger populations expand market size and aggregate demand, thereby fostering trade. This finding supports the demand-side logic embedded in the Gravity Model, where population serves as a proxy for market potential and scale economies.

The result echoes those of Assim et al. (2022), Kikerkova et al. (2021), and Rahman et al. (2020), who assert that population growth enhances import demand—particularly for consumer goods—and stimulates export supply through increased labor. However, Umair et al. (2022) and Ganbaatar et al. (2021) caution that in some cases, rapid population growth may depress per capita income or raise domestic prices, increasing production costs and undermining export competitiveness. Fortunately, such concerns do not appear to manifest significantly in the Philippine context.

The regression results for factor endowments yielded varying results across the three variables. CAP, representing differences in capital endowment, yields a negative coefficient of -0.04473, which is statistically significant at the 1% level [p = 0.000***]. This suggests that a widening gap in capital endowments between the Philippines and its trading partners is associated with a decrease in bilateral trade flows. While the Heckscher-Ohlin theory generally predicts that trade arises from differences in factor endowments, this result implies that excessive disparities in capital intensity may hinder productive complementarities and limit the mutual benefits of trade.

This outcome aligns with the findings of Bilas (2015) and Kikerkova et al. (2021), who found that imbalances in capital between trade partners—particularly when not offset by complementary labor or technological capacity—can suppress trade, especially for developing countries lacking sufficient industrial infrastructure. In these contexts, the ability to participate in capital-intensive global value chains becomes constrained. Mailom et al. (2023) similarly argue that in labor-abundant economies like the Philippines, capital-based trade benefits depend heavily on supportive institutions and infrastructure. Thus, the negative coefficient on capital endowment indicates structural limitations and that capital disparity may function more as a constraint than a comparative advantage in the Philippine trade context.

The explanatory variable LAB, representing differences in labor endowment, has a positive coefficient of 0.1285 and is statistically significant at the 5% level [p = 0.017**], suggesting that greater disparities in labor endowment between the Philippines and its trading partners are associated with higher bilateral trade flows. Specifically, a one-unit increase in labor differential corresponds to a 12.85% rise in trade volume. This result supports the Heckscher-Ohlin theory, indicating that, as a labor-rich economy, the Philippines appears to benefit from exporting labor-intensive goods to more capital-intensive countries.

This result is strongly supported by Kikerkova et al. (2021) and Umair et al. (2022), who found that labor endowment is crucial in significant trade enhancement, particularly in developing countries engaged in

manufacturing and services. Erkekoğlu (2019) further emphasizes labor abundance as a source of comparative advantage, while Bilas and Bošnjak (2015) confirm its role in sustaining trade performance. Mailom et al. (2023) add that labor's effectiveness in trade depends not only on abundance but also on policies that enable workforce participation and productivity. In the case of the Philippines, the positive and significant result for LAB affirms labor endowment as a comparative strength, reinforcing its position in global trade.

The explanatory variable LAND, representing land endowment differentials, yields a negative coefficient of -0.0009, statistically significant at the 10% level (p = 0.0570). This suggests that greater disparities in land endowment between the Philippines and its trade partners are associated with a slight decrease in bilateral trade flows. While this appears to contrast with the predictions of the H-O theory, it demonstrates the decreasing role of land in shaping trade in non-agricultural economies. In the Philippines, trade is largely concentrated in manufacturing and services, where land is a less critical input, weakening the expected theoretical relationship.

This conclusion agrees with the empirical findings of Kikerkova et al. (2021), who also reported a negative association between land endowment differentials and trade, particularly in countries where land is no longer a dominant factor of production. Furthermore, Mailom et al. (2023) note that the influence of land on trade has diminished over time, especially as economies shift toward industry- and service-based structures. While Umair et al. (2022) observed a positive relationship in contexts where agriculture and natural resources remain central to trade, such conditions are less representative of the Philippine trade landscape. Thus, the negative coefficient, though modest, is both theoretically and contextually justifiable.

Lastly, the explanatory variable TA, representing the presence of a trade agreement, is associated with a substantial positive coefficient of 0.6497, statistically significant at the 1% level [p = 0.000***]. The result indicates a substantial trade-enhancing effect of institutional arrangements. It affirms the expectations of trade theory, where agreements facilitate the flow of goods by minimizing frictions related to tariffs, customs procedures, and policy uncertainty.

Empirical evidence from Kikerkova et al. (2021), Umair et al. (2022), and Erdey and Pöstényi (2016) support this finding, each demonstrating a significant positive relationship between free trade agreements and bilateral trade flows. These studies argue that FTAs reduce transaction costs, simplify customs procedures, and foster deeper economic integration among member countries. Although Ramaswamy et al. (2020) present a more nuanced perspective—acknowledging the effects of FTAs may vary based on their scope and enforcement—the Philippine case manifests trade-enhancing outcomes commonly associated with well-established agreements such as AFTA and JPEPA.

In summary, the regression results provide strong support for the applicability of the Gravity Model of Trade and partial support for the Heckscher-Ohlin theory in explaining the Philippines' bilateral trade flows. The significant and expected relationships for GDP per capita, labor endowment, and population align with the H-O framework, affirming that certain factor endowment differences continue to influence trade specialization. However, the negative coefficients observed for capital and land endowment contradict traditional H-O expectations and are more consistent with the Linder Hypothesis, which suggests that trade may also be driven by similarity in economic structure or demand patterns.

At the same time, the significant negative effect of remoteness and the positive effect of trade agreements validate the core propositions of the Gravity Model, emphasizing the importance of geographic proximity and institutional mechanisms in facilitating trade. Together, these findings reveal the layered nature of trade determinants in the Philippine context and form a solid basis for the recommendations presented in

the following chapter.

4.4 Summary of Additional Diagnostic Tests

To further the robustness and validity of the regression model, several diagnostic tests were conducted to assess econometric assumptions. The results of these tests are summarized as follows:

Table 4.4 Summary of Additional Diagnostic Test Results

Test	Results	Conclusion
Jarque-Bera Test	0.2703	Error is normally distributed.
Variance Inflation Factor (VIF)	GDPC = 4.5500	No Multicollinearity
	REM = 2.2710	No Multicollinearity
	POP = 1.9740	No Multicollinearity
	CAP = 3.0320	No Multicollinearity
	LAB = 5.5120	No Multicollinearity
	LAND = 1.9200	No Multicollinearity
	TA = 3.4860	No Multicollinearity
White's Test	3.3654e-17	Heteroskedasticity is present.
Wooldridge test	2.8704e-22	Serial correlation is present.
Ramsey RESET Test	0.1048	Specification is adequate.

The diagnostic tests conducted confirm that the regression model meets several key econometric assumptions. The Jarque-Bera Test returned a value of 0.2703, indicating that the residuals are normally distributed—a necessary condition for valid inference in OLS estimation. The Variance Inflation Factor (VIF) values for all independent variables are below the commonly accepted threshold of 10, with most values falling below 5, suggesting the absence of multicollinearity among the regressors.

However, the White's Test produced a highly significant result [$p < 0.01$], indicating the presence of heteroskedasticity. The Wooldridge Test for autocorrelation also produced a significant result. Although no correction was applied in this study, future research may consider using robust or clustered standard errors to address these issues and enhance the reliability of inferential results.

Despite these, the Ramsey RESET Test returned a non-significant result [$p = 0.1048$], indicating that the model is correctly specified and free from major functional form misspecification. Overall, the diagnostics support the credibility of the model, with minor adjustments needed to account for heteroskedasticity and autocorrelation.

CHAPTER 5
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study strived to investigate the determinants of the Philippines' bilateral trade flows through the lens of two foundational international trade theories: the Heckscher-Ohlin (H-O) theory and the Gravity Model of Trade. Using panel data from the country's top 25 trading partners spanning the period 2011 to 2018,

the analysis employed Pooled Ordinary Least Squares (OLS) to estimate the correlation of factor endowments and geographic-economic variables on bilateral trade performance.

The empirical analyses validate the central claims of the Gravity Model, as remoteness was negatively correlated with trade, while the presence of trade agreements was positively associated—supporting the idea that proximity and institutional arrangements are closely linked with higher trade volumes. The findings also indicate partial support for the Heckscher-Ohlin theory, with GDP per capita, labor endowment, and population demonstrating relationships consistent with the model's expectations regarding comparative advantage. However, the negative correlations observed for capital and land endowments deviate from the theory's predictions. While not formally tested, this evidence may open the discussion for the Linder Hypothesis, which suggests that countries with similar levels of development may trade more due to overlapping demand structures.

Collectively, these findings present the elaborate nature of trade relationships and the varying degrees to which classical trade theories apply within the Philippine context. While the Gravity Model is strongly supported, the partial alignment with the Heckscher-Ohlin framework suggests that structural, sectoral, and institutional factors must also be considered when interpreting trade behavior. The study's results not only provide a clearer lens of the Philippine-involved bilateral trade but also establish a foundation for evidence-based policy strategies aimed at enhancing the nation's global trade position.

5.2 Policy Recommendations

Grounded in the findings of this study and supported by existing literature, the following policy recommendations are proposed to enhance the Philippines' bilateral trade performance.

First, the government should prioritize stronger institutional support for Filipino laborers. This includes providing better labor protections, employment services, and social safety nets. As noted by Kikerkova et al. (2021) and Mailom et al. (2023), labor endowment contributes to trade only when backed by policies that enable workforce participation and ensure fair conditions.

Second, while the Philippines has benefitted from participation in AFTA, there is a need to enhance the implementation of existing agreements by addressing non-tariff barriers, streamlining customs procedures, and improving regulatory alignment. Umair et al. (2022) and Erdey and Pöstényi (2016) emphasize that FTAs yield greater gains when member countries actively harmonize standards and reduce administrative frictions. Strengthening institutional capacity for trade governance can further ensure that agreement terms translate into tangible trade outcomes.

Third, as an archipelago, improving ports, transport connectivity, and digital infrastructure is critical to lowering transaction costs and expanding the country's effective trade reach. Assim et al. (2022) and Rai et al. (2021) point out that poor infrastructure continues to limit trade in Southeast Asia, especially for archipelagic countries like the Philippines. Addressing these constraints will allow the country to trade more effectively with distant partners and improve its participation in global value chains.

5.3 Directions for Future Research

Future research may consider using alternative estimation methods, such as fixed effects or dynamic panel models, to address potential issues of unobserved heterogeneity or time-related dynamics not captured by pooled OLS. It may also be valuable to disaggregate trade data by sector to examine whether factor endowments influence trade differently across industries. Including institutional or regulatory variables could help explain deviations from classical theories, especially in the case of capital and land. Lastly, expanding the study to include more recent data or additional trade partners could provide insights into how Philippine trade has evolved in response to global events.

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