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| RESEARCH ARTICLE

The Relationship between Philippine Population, Remittances, Foreign Direct Investment, and Trade Openness on its Gross Domestic Product

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| ABSTRACT
The Philippine economy is regarded as one of the leading emerging markets, although many issues remain unsettled. The country experienced ups and downs in its economic growth through different administrations and policies that affected its various determinants. In the past decades, the Philippines has focused on changing the country's economic standing. Policymakers and researchers are interested in improving the country's economic performance by identifying leading driving forces. This study will analyze the relationship between Population, Remittances, Foreign Direct Investment, and Trade Openness on Gross Domestic Product. It would specifically investigate the nature of the relationship between the variables to guide policymakers in prioritizing indicators that would generate the most growth. This paper aims to understand these relationships in the Philippine context from 2005-2020. The results of the adjusted regression model show that GDP has a relationship with TO and Remittances, which rejects the null hypothesis. Remittances accept the null hypothesis, making it an insignificant variable in the model. It also shows that FDI positively correlates with GDP, while Population and TO affect GDP negatively. In the four assumptions mentioned in the methodologies, only one stayed true in the variables used in a Philippine setting: As remittances increase, GDP also increases. Furthermore, these observations confirm that Population and TO affect the economic growth of the Philippines negatively. The researchers recommend that the Philippine government create policies to improve the FDI attractiveness of the Philippines, encourage employment for OFWs, and create more economic opportunities for the growing population.

| KEYWORDS
Gross Domestic Product, Economic development, Trade Openness, Foreign Direct Investment, Remittances, Population.

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1. Introduction

1.1. Background of the Study

This paper will specifically investigate the nature of the relationship between the variables to guide policymakers in prioritizing indicators that would generate the most growth. This paper identified four factors that the country can focus more on. In particular, this paper analyzes the relationship between Population, Remittances, Foreign Direct Investment (FDI), and Trade Openness (TO) on Gross Domestic Product (GDP).

Gross Domestic Product is one of the leading indicators for measuring a country's economic performance. The OECD (2001) defined GDP as the "aggregate measure of production equal to the sum of the gross values added of all resident institutional units engaged in production. According to the ADB (2022), most developed Asia will see consistent economic growth from 2023 onwards. Furthermore, they forecast that Economies in the Caucasus and Central Asia are forecast to grow 3.6% on average this year and 4.0% next year. The trade-dependent economies of Southeast Asia are forecast to grow collectively by 4.9% this year and 5.2% in 2023. The Philippines' GDP has shown an increasing trend over the years. From 2005 to 2018, the Philippines experienced

average GDP growth of 5.75 percent, with the highest GDP of over 346 billion USD in 2018. The population has also significantly grown in the Philippines, as it reached over 100 million in 2014. Developed countries produce, consume, and invest in different sectors than developing countries regarding their economic growth, and how determinants affect their economic development may also vary. In India and Bangladesh, empirical evidence shows that remittances positively correlate with GDP growth (Ale et al., 2018). Furthermore, in Malaysia, FDI shows a significant relationship and positively affects GDP growth (Aziz & Anmi, 2018). FDI has steadily increased in the Philippines over the years, making it one of the leading FDI destinations in Southeast Asia. The country is now focusing on increasing FDI by amending three laws -- the Foreign Investments Act, the Retail Trade Liberalization Act, and the Public Services Act, which would loosen restrictions. Findings from other Asian countries show that FDI and Trade Openness affect economic growth and that trade relations positively affect a country's economic growth. (Yang & Shafiq, 2020). Using Trade Openness, however, has a decreasing trend but is recently increasing again. Trade is a factor for countries to grow faster, innovate, and improve productivity, but it does come with its faults (World Bank Group, 2018). Factors such as Employment Rate, Remittances, Foreign Direct Investment, and Trade Openness can potentially impact economic growth. The growth rate, however, has been continuously decreasing over the years. With a growing population, the increasing number of Overseas Filipino Workers (OFW) has significantly improved the total remittances sent, which were 31.4 billion USD as of 2021 (Venzon, 2022). Remittances are a vital determinant of economic growth as it generates capital inflow and supports household consumption (Meyer & Shera, 2017).

The Philippine economy is regarded as one of the leading emerging markets, although many issues remain unresolved. The country experienced ups and downs in its economic growth through different administrations and policies that affected its various determinants. Nevertheless, the Philippines remain one of the fastest-growing economies in Asia. With its increasing urbanization, growing middle class, and large young population, the Philippines has one of the most vibrant economies in the East Asia Pacific region (The World Bank, 2022). In the past decades, the Philippines has focused on changing the country's economic standing. Policymakers and researchers are interested in improving the country's economic performance by identifying leading driving forces. Therefore, examining these determinants for economic growth is necessary for every economy (Parjiono, 2009). This paper aims to understand these relationships in the Philippines in the period of 2005-2020.

1.2. Statement of the Problem

Numerous studies assess the impact of Remittances, Population, FDI, and TO on GDP. Remittances as a factor of GDP contribution to the home country's investment by being procyclical since senders often give because of either altruism or self-interest (De et al., 2016). Usually, remittances are more beneficial than detrimental to the home economy. Population, inversely, can negatively impact a country when the country's resources cannot sustain the growing population. Theories such as the Malthusian Growth Model and Optimum Theory of Population further support the negative impact of overpopulation on economic growth. Studies on FDI and Trade Openness impacting GDP have shown different results depending on the country and time studied. FDIs, which are supposed to boost output and generate growth (Tan & Tang, 2016), can negatively affect local businesses and investors (Chua, 2016). Aldaba & Aldaba (2010) found that FDI spillover limits domestic firms if these firms are incapable of absorbing the transferred technology and knowledge. Trade openness has similarly increased due to economic integration and globalization increasing. Likewise, the negative impact of Trade Openness comes when local industries fail to adjust to international productivity levels (Silajdzic & Mehic, 2018).

Numerous works of literature discuss the relationship between said variables, but despite all the theories, research shows mixed results. Therefore, this paper seeks to answer the following questions:

1. Is there a significant relationship between Population and GDP?
2. Is there a significant relationship between the Philippines' GDP with the country's' Remittances, Population, FDI, and TO?

1.3. Formulation of Hypothesis

This study considers the following Hypothesis:

Hypothesis 1:
H_0: Population does not have a significant relationship with GDP.

Hypothesis 2:
H_0: Population, Remittances, FDI and TO does not have a significant relationship with GDP.

1.4. Scope and Limitations

This study will analyze the relationship between Population, Remittances, Foreign Direct Investment, and Trade Openness on Gross Domestic Product. It would specifically investigate the nature of the relationship between the variables to guide policymakers in prioritizing indicators that would generate the most growth. This paper uses the 15-year Philippines quarterly Population, Remittances, TO, FDI, and GDP data from the Bangko Sentral ng Pilipinas (BSP) Online Statistical Database and Philippine Statistical Authority (PSA) OpenSTAT database from 2005 to 2020. The study's time frame is limited to 2005 to 2020 because data for some of the variables from 2021 are missing from the respective databases.

1.5. Significance of the Study

Multiple studies attempt to examine the individual relationship between Population, Remittances, FDI, and TO on GDP; however, there have been contrasting results. This paper aims to understand these relationships in the Philippine context during 2005-2020, wherein the country faced an increasing Population and Remittances and prioritized improving trade and FDI.

- **Philippine Government**. This study would be a reference for governments and other policy-making bodies to implement their policies or base their decisions on research and models to perceive their implications.
- **National Economic and Development Authority (NEDA)**, **Department of Trade and Industries (DTI)**, **Department of Labor and Employment (DOLE)**, and **Bangko Sentral ng Pilipinas (BSP)**. Public and private institutions could use the study's results as a reference in policy creation in managing the population, improving local and international job opportunities, FDI attractiveness, and trade liberalization. Identifying the relationship between the variables would allow economists to predict and prepare for the future.
- **Future Researchers.** Researchers can also gain insights from the results of this study and use this as material for more comprehensive research.

2. Review of Related Literature

This section discusses the various literature and studies related to the variables: Gross Domestic Product (GDP), Population, Remittances, Foreign Direct Investment (FDI), and Trade Openness (TO) and their relationship with economic growth. The theoretical and operational framework would include the theories behind the concepts discussed. Additionally, the definition of terms would state the official definition of the variables used for this research. The discussion will serve as the researcher's basis for further study on the topic.

2.1. Gross Domestic Product

Economic growth drivers are a common theme for research as their significance in policymaking has grown over time. The Gross Domestic Product (GDP) is one of the most used indicators in measuring the economy's health (Liu, 2018; Capulla, Dionisio, & Pascual, 2020). It is necessary to analyze various variables and factors that influence growth (Brueckner & Hansl, 2018) as it is convenient for creating policies that would potentially boost the economy. Capulla, Dionisio, and Pascual (2020), Caballos and Pujeda (2019), and Ocampo and Solina (2020) conducted studies on various economic indicators in the Philippines, allowing researchers to better understand the relationship between the indicators and growth.

2.2. Population

Population refers to the sum of all residents residing in a specific country, which is from the national censuses. Population growth can have a positive or negative influence on economic growth. Various studies found that the effect of population growth on overall economic growth may vary in low-income countries compared to higher-income countries due to different constraints in each country. Even though Ethiopia is a low-income country, the results show that population growth positively impacts economic growth (Degu, 2019). Likewise, Rizuan et al. (2018) study found that most ASEAN-5 countries show a positive relationship between population and GDP. Lubbock, Merin, and Gonzalez (2022) oppositely found that population growth harms economic growth in the Philippines. According to the findings of Furouka's (2016) research, the causation between population and economic growth can have a detrimental impact on China's economic growth. While Mahmoudinia, Hosseini, and Jafari (2020) discovered bidirectional causation between population and economic growth in Organization of Islamic Cooperation (OIC) countries. Economic problems may occur because of the rising population and the lack of resources in a country (Peterson, 2017); therefore, it is necessary to analyze how different variables affect the relationship. Empirical results indicate that aging is a factor in population

growth (Rahman et al., 2020). Pham and Vo (2019) said that having a young population can negatively impact GDP in the long run. Similarly, the study of Lee and Shin (2019) indicates that an older populace leads to lower economic growth. Thus, results may vary from country to country based on the literature present. Such as the study of Jones (2020), which discusses that a declining population will lead to stagnated economic growth. While the cross-country panel data analysis study by Yang, Zheng, and Zhao (2021) shows an inverted U-shape relationship between population and GDP. Population growth also affects supply chain performance, which is an indicator of growth (Haseeb et al., 2019). The quality of the growing population and the resources invested in them is also a factor considered in evaluating the relationship between population and economic growth. Bucci and Raurich (2019) and Taasim (2020) emphasize the importance of human capital development and education in an increasing population. Various literature has different results because the topic of population and economic growth will always vary in each country and the resources available in the country.

2.3. Remittances

Remittances refer to the sum of money sent by foreign workers to their home country. Remittances hold a significant source of financing, especially for those in developing countries. Studies show that remittances serve as a substantial source of foreign exchange earnings, indicating a positive relationship between remittances and GDP (Meyer & Shera, 2018). Cazachevici et al. (2020) said that remittances have a positive effect on economic growth, but it is small. In contrast with their studies, Naidu et al. (2017) and Sutradhar (2019) point out that there is a negative relationship between remittances in selected countries. Studies vary on how remittances affect economic growth. Results from Sobiech (2019), Peprah et al. (2019), and Rehman and Hysa (2021) indicate that financial development is a factor that affects the relationship between remittances and economic growth. The emphasis is that a country with the proper financial development will be able to have better economic growth (Eggoh et al., 2017). Government policies, likewise, are vital in financial development that will lead to a more significant impact on economic growth (Tangtipongkul & Khiev, 2019). Policies on trade openness can boost the influence of remittances on economic growth (Dastidar, 2017). Nevertheless, it still can be seen that, without remittances, it will be difficult for most developing countries. With remittances, receivers can use it to invest in themselves, especially since senders often send because of either altruism or self-interest. Abduvaliev and Bustillo (2017) indicate that remittances reduce poverty while increasing GDP per capita evidenced by Commonwealth of Independent States (CIS) countries. Evidence from Asian countries shows that remittances can be reliable funding for reducing poverty (Yoshino et al., 2017). Remittances do influence economic growth; nevertheless, it is necessary to look at other determinants that would be a better generator of economic growth. Empirical results from Comes et al. (2018) and Depken et al. (2021) similarly found that remittances enhance growth, but FDI and Gross Capital Formation are better determinants of economic growth. Empirical studies have different results that vary from each country, but it can be that remittances do affect economic growth.

2.4. Foreign Direct Investment

Foreign Direct Investment (FDI) refers to investments in physical capital by a foreign owner or entity. FDI is not necessarily part of the GDP equation; instead, it only appears when the investments start to create any form of economic activity, such as sales, construction costs, employment, etc... FDI is a significant factor in generating economic growth in the long run (Ridzuan et al., 2018) since physical capital usually becomes more valuable in the long run. Empirical results from Tan and Tang (2016), Cahn et al. (2019), and Dinh et al. (2019) similarly found that FDI negatively impacts GDP in the short run while it positively impacts in the long run for both developed and developing countries. A long-term causal relationship between FDI and GDP also exists in most Asian developing countries (Ahmed et al., 2016; Ali & Mingque, 2018). Duarte et al. (2017) used an ECM Granger-causality Test to find a positive bi-directional causality between FDI and GDP for the case of Cabo Verde. Other variables such as human capital (Fatima et al., 2019), technology (Ekananda and Parlinggoman, 2017), and natural resources (Hayat, 2018) can potentially affect the relationship between FDI on GDP. Human capital and technology positively influence FDI, while natural resources negatively impact FDI. Saini and Singhania (2018) likewise found that FDI investors often look for policy-related determinants, which is in contrast with Segupta and Puri's (2018) results that FDI is an instrumental factor in enhancing growth despite the differences in economic policies. Developing countries are considering the increasing global levels of FDI as both an opportunity and challenge for host countries and the whole global economy (Alfaro & Chauvin, 2020). FDI's ability to enhance growth (Alfaro, 2017), generate financing (Jaiblai & Shenai, 2017), reduce poverty (Magombeyi & Odhiambo, 2018), and improve financial institutions (Sabir et al., 2019) attracts a lot of attention from developing countries. Vogiatzoglou (2016) considers ASEAN countries, in particular, attractive for FDI investors. As such, the Philippines is greatly interested in improving its attractiveness to increase FDI. The past and current administrations in the Philippines have tried to boost FDI as its future value would greatly influence economic growth.

2.5. Trade Openness

Trade Openness is a direct measure of a country's total trade over its GDP. Most theories suggest a strong positive relationship with economic growth since openness often creates economic opportunities. Halijee and Niroomand (2019) found that openness can lead to better income distribution and poverty reduction, while Brahim and Sare (2018) discovered it as a substitute for human capital accumulation. Trade liberalization allows multiple economies to develop as barriers are lowered for trade to grow (Ho et al., 2021). Open economies usually generate more growth since closed economies fail to find alternatives for select imports. Keho (2017) further supported this by emphasizing the theory of comparative advantage, wherein countries would focus on producing specialized products and services and trade with other countries. It allows the country to boost its exports, thus also improving GDP. Trade liberalization further improves the comparative advantage theory since it promotes efficiency and productivity in the global economy (Keho, 2017). The endogenous theory wherein increased openness leads to higher growth was proven true by Idris, Habibullah, and Yusop (2017) from 87 countries during 1977 - 2011. The empirical results from Semankovâ (2016), Keho (2017), Rahman et al. (2017), Malefene & Odhiambo (2018), and Ho et al. (2021) similarly confirm the endogenous theory. Lal (2017), Alan and Sumon (2019), and Raghutla (2020) also validated the possibility of a causal relationship existing between the variables. Beinta (2019) and Ma et al. (2019), on the other hand, stated that outside variables could influence the relationship and cause endogeneity problems. Trade openness does not always benefit a country or economy. In such cases, Siddiqui (2016) reminds us that although developing countries would benefit from trade openness and liberalization, such policies would also make them more reliant on international finance capital.

2.6. Research Gap and Synthesis

The literature on GDP elaborates that it is one of the leading indicators of a nation's economic standing. It is most commonly used to measure a nation's economy. Understanding how a country's GDP is affected by different variables is essential for economists to see which variable has a positive or a negative effect on GDP. Numerous literature shows that various economic variables have different relationships with the GDP, which may differ from country to country. Increasing a country's GDP is one of their most important goals as a nation, and knowing which economic variable they should consider. Furthermore, different constraints can affect each country, and it is essential to accurately identify these to recognize how it affects a country's GDP.

Various literature on Population states that population growth's effect on economic growth may vary between countries due to different constraints per country. Studies also show that the impact of population growth will vary due to their different economic standing. A growing population can be seen as a potentially growing workforce, especially if accompanied by human capital development. Nevertheless, that is only sometimes the case due to the resources needed to sustain the Population of each country, as seen in other literature. Thus, the literature strongly shows that population growth will have contrasting results in each country.

Studies vary on how remittances affect economic growth. Results from various studies indicate that financial development is a factor that affects the relationship between remittances and economic growth. Remittances are more commonly seen in developing nations such as the Philippines, with its high number of oversea workers. It is seen in different results from multiple studies that remittances do positively affect economic growth. Nevertheless, there are better indicators for economic growth, with the effect of remittances varying per country. Nonetheless, remittances still influence economic growth, but studies show that changes due to remittances and the country's financial development will affect the economy.

Increasing global levels of foreign direct investment (FDI) have created challenges and opportunities for both developed and developing countries. Studies state that developing countries consider the increasing international levels of FDI as both an opportunity and a challenge for the global economy. As most nations open their economies, it has created a more significant chance for developed nations to invest in developing countries. Thus, the opportunity for foreign investment has been more attractive; it has challenged governments to reduce their foreign trade restrictions to increase their investor attractiveness. Developing countries such as the Philippines are focusing on improving their FDI attractiveness as, with their limited resources, additional investment from foreign investors will enhance economic growth. The increase in foreign investment can create new opportunities for the invested nation to develop the different sectors of their economy.

Trade liberalization allows multiple economies to develop as barriers are lowered for trade to grow. The Philippines is now focusing on increasing trade openness and FDI by amending three laws the Foreign Investments Act, the Retail Trade Liberalization Act, and the Public Services Act, which would loosen restrictions. Open economies usually generate more growth since closed economies fail to find alternatives for specific products. Trade openness allows the country to boost its exports, thus also improving its GDP.

Studies show that trade openness does not always benefit a country or economy. Increasing imports could hurt local producers, and the reliance on imports will increase; thus, local production and employment will decline. The results of increasing trade liberalization will vary due to the different constraints of each country.

Numerous studies investigate the individual relationships of Population, Remittances, Foreign Direct Investment, and Trade Openness on GDP for various countries and time series. However, there is still a significant difference in the studies on how the independent variables affect economic growth, especially the differences in developing countries. Furthermore, the need for published research in the Philippines during the 2005 - 2020 period regarding the variables and recommendations to adopt to create changes for better economic growth. Very few studies were found on which of these variables of positive or negative effects in the Philippines. Therefore, this paper aims to question whether there is a relationship between the independent variables (Population, Remittances, FDI, and Trade Openness) and the dependent variable (GDP) and recommend possible policies that the government can use for economic development.

2.7. Theoretical Framework

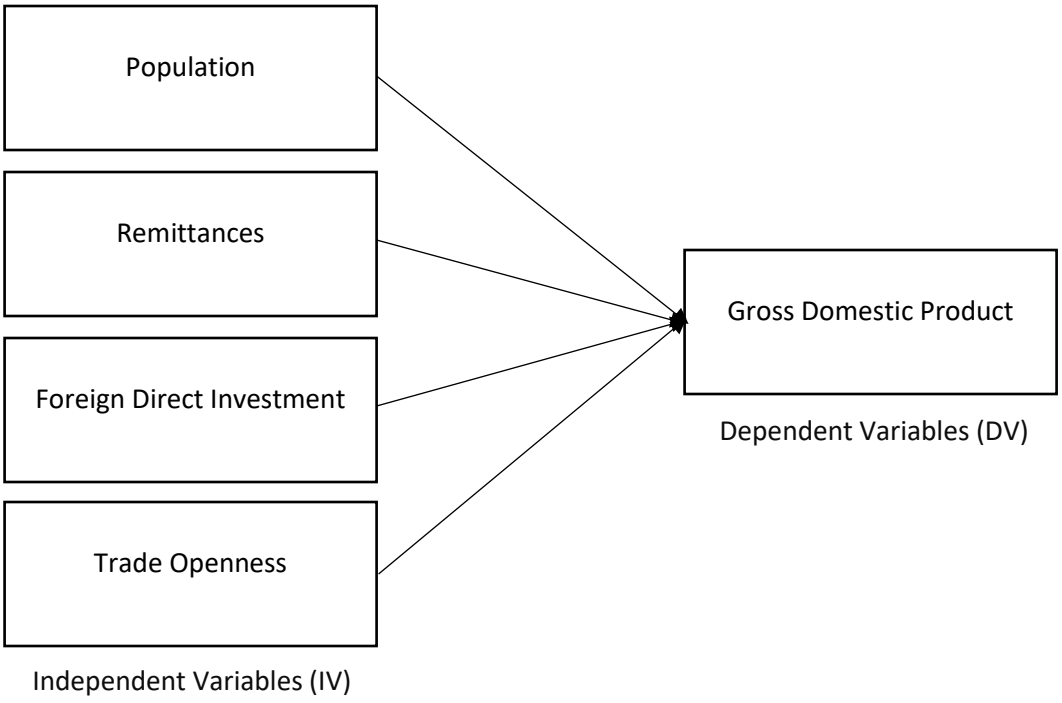

Figure 1. Theoretical Framework

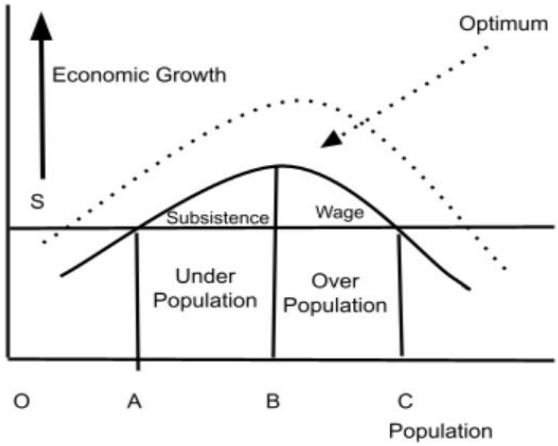

Figure 2. Illustration for Optimum Theory of Population

This paper uses two different theories to support the assumptions with the relationship of the variables. The first theory to explain the individual relationships with the variable is the Optimum Theory of Population (See Figure 2.). In 1924, economist Edwin Cannan proposed the idea of the theory in his book *Wealth*. The theory states that there is an optimum level of population that would yield the highest income per capita in a country, given the limited resources it possesses. Underpopulation would lead to underutilization of available resources, which means that income per capita would not reach its maximum. Overpopulation, on the other hand, would mean that the available resources would not be sufficient for the growing population. In this case, both income per capita and standard of living would decrease. The problem now is whether the Philippines has already reached or surpassed its optimum population.

The Exogenous Growth Theory is the second theory used that revolves around economic growth as a result of capital accumulation, labor or production, increased trade liberalization, and technological advancement. Remittances have the potential to boost capital accumulation in home countries while increasing labor and production in host countries (Khraiche & Boudreau, 2020), making them a variable component of the exogenous growth model. FDI, aside from boosting capital (Freckleton et al., 2012), creates opportunities to improve technology, human and physical capital, and practices (Ahmed et al., 2016) that, thus, increase productivity and generate growth for the host countries. Trade Openness, similarly, allows countries with higher openness to grow more compared to those with a lower degree due to the international diffusion of advanced technology (Romer, 1994, as cited in Keho, 2017). As a result, trade liberalization improves productivity from the comparative advantage of host countries. FDI, Remittances, and Trade Openness prove to be vital for the Philippines' investment and consumption opportunities.

2.8. Conceptual Framework

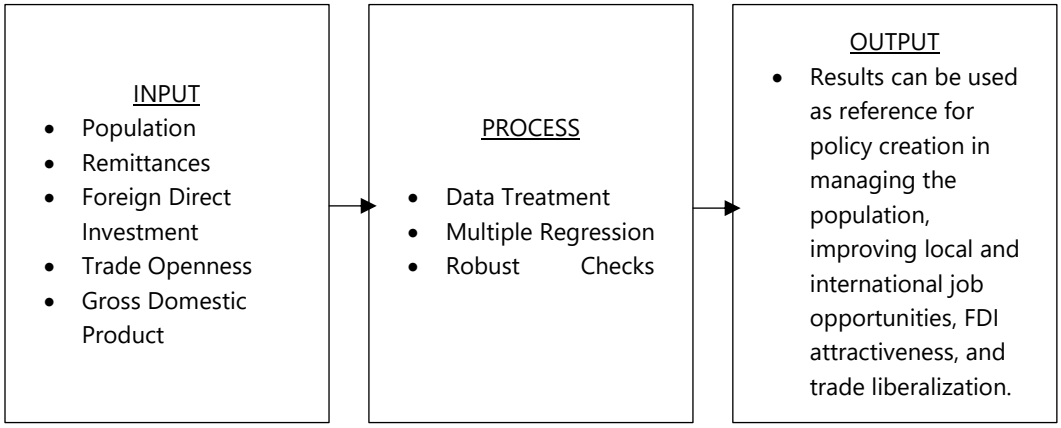

Figure 3. IPO Model

The input for this research includes all four variables for testing. The independent variables, Remittances, Population, FDI, and Trade Openness, and the dependent variable, Gross Domestic Product, are the focus of research. The process contains the research's various statistical tests. The tests are needed to reach the desired output of the research. Lastly, the output consists of the general objectives this paper aims to fulfill.

2.9. Definition of Terms

- Gross Domestic Product – is the aggregate measure of production equal to the sum of the gross values added of all resident institutional units engaged in production.
- Population – is the number of alive individuals residing within a country in the given time of measurement.
- Remittances – refer to the personal remittances made by the sender. Cash remittances is when senders send cash instead of any other form of money to whoever would receive in the home country.
- Foreign Direct Investment – is a type of investment where a resident of one country has control or a significant degree of influence on the management of an enterprise or investment located in another country.
- Trade Openness – is the degree of context a country is open to trade. It is a direct measure of a country's total trade over its GDP.

3. **Methodology**

This section discusses the methodology used to interpret and analyze the data presented in the study. It discusses the statistical tools and methods used to better describe and understand the relationship of the variables. It would also include the assumptions made based on a priori knowledge and the econometric model that would be the basis for testing.

3.1. Research Design

This paper used a quantitative research design since it analyzes the relationship between the independent variables (Population, Remittances, FDI, and TO) and the dependent variable (GDP). The correlational design determines the strength and direction of the relationship between the variables. The Ordinary Least Squares served as the main statistical test to determine the said relationship. The regression results were tested through different robustness tests to determine their validity of the results.

3.2. Data Gathering Procedure

Most of the data used for this paper comes from the BSP (Bangko Sentral ng Pilipinas) Online Statistical Database. The BSP's database system provides easily accessible historical accounts of key economic and financial indicators in the Philippines. Among the data included in the database are the quarterly accounts of Remittances, FDI, and TO from 2005 to 2020. The Population and GDP variable came from the OpenSTAT website, which is the open data platform of the Philippine Statistics Authority (PSA). The variable taken was from quarterly periods during the same years from 2005 to 2020. The total observations covered by the period is equal to 64.

3.3. Variable Description

Variable	Label	Description	Measurement
Gross Domestic Product	GDP	Real GDP based on 2018 prices	In millions USD
Population	POP	GDP divided by Per Capita GDP	In Million Persons
Remittances	REM	Overseas Filipinos' Personal Remittances	In millions USD
Foreign Direct Investments	FDI	Non-Resident Investments in the Philippines	In millions USD
Trade Openness	TO	Trade to GDP	In Percent, Current

Table 1. List of Variable Description

3.4. Assumptions

- As Population increases, GDP decreases. (-)
- As Remittances increases, GDP also increases. (+)
- As FDI increases, GDP also increases. (+)
- As TO increases, GDP also increases. (+)

3.5. Econometric Models

$$\boldsymbol{GDP = \beta_0 + \beta_1 POP + \mu}$$

$$\boldsymbol{GDP = \beta_0 + \beta_1 POP + \beta_2 REM + \beta_3 FDI + \beta_4 TO + \mu}$$

Where:

GDP = Gross Domestic Product
POP = Population
REM = Remittances

FDI = Foreign Direct Investment
TO = Trade Openness
β_0 = Intercept
$\beta_1, \beta_2, \beta_3, \beta_4$ = Coefficients for the variables
μ = Error Term

Econometric Model 1 would examine the simple relationship between GDP and Population in the Philippines, which is based on the Optimum Theory of Population. The 2nd Econometric model would analyze all the variables into one model. This would combine the 1st theory and the Exogenous Growth Theory.

3.6. Statistical Tools

This paper uses the EViews 12 Student Version software as its main statistical tool to analyze the data using the various statistical tests. All graphs and figures presenting the data also comes from the same software.

3.7. Statistical Tests

3.7.1 Ordinary Least Squares (OLS) Multiple Regression

OLS is for estimating the coefficients of a linear regression model that describes the relationship between the variables. The coefficients come with their corresponding t-values and p-values, which indicate whether an independent variable has a significant relationship with the dependent variable. The OLS would also specify the F-statistic, which shows whether at least one of the independent variables is significant. Moreover, the OLS also reveals the Goodness of Fit of the model through the R^2. The R^2 represents the proportion of variance of the dependent variable explained by the independent variables.

3.7.2 Augmented Dickey-Fuller (ADF) Test

$$\boldsymbol{\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \delta_1 \Delta Y_{t-1} + \delta_2 \Delta Y_{t-2} + \cdots}$$

Where:

α = constant
β = coefficient
Y_t = data

The ADF test is a unit root test for stationarity. The test determines whether a given time series is stationary or not since this could lead to unpredictable results. The stationary test is conducted so that the statistical properties of a time series do not change over time. The null hypothesis of the ADF test is that the time series is not stationary; therefore, the p-value must be lower than the level of significance for the data to be stationary.

3.7.3 Jarque-Bera test for Normality

$$JB = n[\frac{S^2}{6} + \frac{(K-3)^2}{24}]$$

Where:

S = Skewness coefficient
K = kurtosis coefficient
n = sample size

The Jarque-Bera is used to test for normality of the residuals because one of the assumptions of the Classical Linear Regression Model (CLRM) is to have a normally distributed residual. It is also used for testing whether the variables are normally distributed; however, it is not part of the assumptions of the CLRM. The null hypothesis of the Jarque-Bera test for normality is that the variables are normally distributed; hence, the p-value should be greater than the level of significance so that it is normally distributed.

3.7.4 Variance Inflation Factor (VIF)

$$VIF_i = \frac{1}{1 - R_i^2}$$

Where:

R_i^2 = Coefficient of Determination

The VIF is a test of multicollinearity used to identify which independent variables are correlated with one or more other independent variables. The VIF is a necessary test since it would violate one of the assumptions of CLRM of no multicollinearity among independent variables. Multicollinearity can lead to insignificant t-values and larger variances, which, in turn makes the regression results inaccurate. The tolerance level of VIF must not exceed ten since this would indicate multicollinearity among the variables.

3.7.5 Breusch-Godfrey Serial Correlation LM Test

$$LM = (n-p)R^2 \sim X_p^2$$

Where:

R^2 = Coefficient of Determination
X_p^2 = Chi-Square
n = sample size
p = first order serial correlation coefficient

The Breusch-Godfrey test is used for finding serial correlation in the regression model. Serial correlation is the correlation between members of a series of observations ordered in time. The serial correlation becomes problematic since it violates one of the assumptions of CLRM, and it makes the results of the T, F, and Chi tests invalid. Furthermore, the R2 is overestimated while the regression model is no longer efficient. The null hypothesis of the Breusch-Godfrey Serial Correlation LM Test is that there is no serial correlation in any order, which means that the p-value must be higher than the level of significance.

3.7.6 Durbin-Watson Statistic

$$DW = \frac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2}$$

Where:

e_t = Residuals from OLS

Similar to the Breusch-Godfrey test, the Durbin-Watson statistic indicates whether there is serial correlation in a model. The Durbin-Watson statistic has a fixed range of 0 to 4. When the statistic is within the range of 1.5 to 2.5, there is no serial correlation in the model. There is a positive serial correlation when the value is between 0 and 1.49, and a negative serial correlation when the value is between 2.51 and 4. The difference between the Durbin-Watson statistic and the Breusch-Godfrey Serial Correlation LM Test is that the Durbin-Watson uses only one lag when testing.

3.7.7 Breusch-Pagan-Godfrey Heteroskedasticity Test

$$\boldsymbol{\theta = \frac{1}{2}(ESS) \sim \mathcal{X}^2_{m-1}}$$

Where:

ESS = Explained Sum of Squares

The Breusch-Pagan-Godfrey test is a type of heteroskedasticity test that measures how errors grow farther apart as the dependent variable increases. Homoskedasticity is a crucial assumption of the CLRM since it makes the T and F test results inaccurate while also making the model inefficient. The null hypothesis for the Breusch-Pagan-Godfrey Test is that the model is homoscedastic; therefore, the p-value should be greater than the level of significance.

3.7.8 Ramsey RESET Test

$$\boldsymbol{F = \frac{(R^2_{new} - R^2_{old})/number\ of\ new\ regressors}{(1 - R^2_{new})/(n - number\ of\ parameters\ in\ new\ model)}}$$

The Ramsey RESET Test is a type of test for specification errors. Specification error refers to possible irregularities within the model. Its common effects are that the results are inaccurate, the forecasts are unreliable, the variables are irrelevant, and the assumptions for CLRM are not met. The null hypothesis for the Ramsey RESET test is that the model is correctly specified; hence, the p-value should be more than the level of significance.

3.8. Process of Statistical Tests

The tests would start by testing the variables using the ADF and the Jarque-Bera test to check for the Stationarity and Normality of the variables, respectively. If the variables meet the conditions to pass the tests, then the variables can proceed for the OLS. If not, the variables would be adjusted using Log transformations or First and Second differences. The descriptive statistics and correlation matrix will also be added to the paper to provide a better overview of the variables. After checking for Stationarity and Normality, the OLS for the two models would start. The researchers would use the Robustness Checks to verify the results of the OLS. If there are any errors in the Robustness Checks, the model will be adjusted and re-tested to pass all the checks. Once the model completes the Robustness Checks, the tests will be over, and the results will be final.

4. Results and Discussion

This chapter discusses the results of the various statistical tools used for identifying the relationship between the variables. It would have the unadjusted econometric model based on the original model.

4.1. OLS Model 1

Table 2. Simple Regression Results

Dependent Variable:	GDP		Observations:	64
Sample:	2005Q1 - 2020Q4			
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	-148016.9	7866.857	-18.81525	0.0000
POP	2194.402	81.01793	27.08539	0.0000
R-squared	0.922073		Mean dep. var.	64462.32
Adjusted R-squared	0.920816		S.D. dep. var.	16739.20
F-statistic	733.6183		D-W stat	1.968372
Prob(F-statistic)	0.000000		S.E of regression	4710.344

Table 2 presents the simple regression results between the unadjusted GDP and Population, which show that the model has an R^2 value of 0.92, indicating that the data does fit the model. The independent variable does explain 92.08% of the variation in the dependent variable. Furthermore, this implies that Population does correlate with GDP, which affirms the results of the individual

correlations discussed in Appendix B. The p-value of POP is less than 0.05, which accepts the null hypothesis that there is no significant relationship between the variables. The t-Statistic also supports this relationship. The robustness checks (see Appendix I.) show that the model has serial correlation and heteroskedasticity issues. The model needs further adjustments to pass the robustness checks.

4.2. OLS for Model 2

Table 3. Multiple Regression Results

Dependent Variable:	GDP		Observations:	64
Sample:	2005Q1 - 2020Q4			
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	-26814.80	30402.79	-0.881985	0.3814
FDI	2.292569	0.920798	2.489764	0.0156
REM	6.946777	1.927983	2.603192	0.0006
POP	440.6887	429.6322	1.025735	0.3092
TO	57.5683	66.11636	0.870712	0.3874
R-squared	0.945040		Mean dep. var.	64462.32
Adjusted R-squared	0.941314		S.D. dep. var.	16739.20
F-statistic	253.6259		D-W stat	2.348920
Prob(F-statistic)	0.000000		S.E of regression	9.70E+.08

Table 3 shows the unadjusted multiple regression results, which convey that the model has an R2 value of 0.94, indicating that the data fits the model. The independent variable explains 94.13% of the variation in the dependent variable. Furthermore, this implies that the variables have a high positive overall correlation. The F-statistic also conveys that at least one of the independent variables is related to GDP. The p-value of FDI and REM are all less than 0.05, which rejects the null hypothesis that there is no significant relationship between the variables. POP and TO, however, have a p-value greater than 0.05, indicating that it is an insignificant variables. FDI and REM appear to have a positive relationship with GDP, while POP and TO also have a positive relationship despite being insignificant. The robustness checks (see Appendix I.) show that the model has serial correlation and heteroskedasticity issues. The model needs further adjustments to pass the robustness checks.

4.3. Ending Discussion

The initial result, without any adjustments in the model, shows that Population and GDP have a significant positive relationship in the simple regression. The Population's coefficient does not match the assumptions made before the analysis, indicating that, based on the Optimum Population Theory, the Philippines has not yet reached overpopulation. The results concur with the works of Degu (2019) and Rizuan et al. (2018), where Population is a significant positive variable of economic growth. Given that the model is still unadjusted and corrected based on the assumptions of CNLRM, the model required further modifications.

Likewise, the second model is also unadjusted and corrected based on the assumption of CNLRM. The results convey that only two independent variables are significant, but all four independent variables have positive coefficients. Population is now an insignificant variable in this model, along with TO. Remittances and FDI are positively significant variables, with Remittances having the higher coefficient value. FDI is one of the variables that positively affects GDP, which concurs with the initial assumption and the results of Tan and Tang (2016), Cahn et al. (2019), and Dinh et al. (2019). Remittances also follow the initial assumption while supporting the studies of Meyer and Shera (2018) and Cazachevici et al. (2020). TO contrasts with the initial assumption and the Exogenous Growth Theory, similar to the results of Keho (2017) and Idris et al. (2017). Lastly, the results for Population agree with Lubbock et al.'s (2022) results and the initial assumption that Population negatively affects GDP. A possible explanation for this is the overpopulation leading to decreased income from the Optimum Population Theory.

5. Summary, Conclusions, and Recommendations

As mentioned in Chapter 4, Ending Discussions, the results only used the unadjusted version of the model that did not correct for any of the assumptions of CNLRM. The summary section would also include the model adjustments to correct the assumptions and the overall summary of the study. Conclusions and Recommendations based on the results will complete in this section.

5.1. Adjusted OLS for Model 1

Table 4. Adjusted Simple Regression Results

Dependent Variable:	GDP2		Observations:	62
Sample:	2005Q3 - 2020Q4		After Adjustments	
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	1615.175	17066.33	0.094641	0.9249
LNPOP1	-353305.5	4169650	-0.084733	0.9328
R-squared	0.00012		Mean dep. var.	175.5174
Adjusted R-squared	-0.016545		S.D. dep. var.	12543.09
F-statistic	0.00718		D-W stat	3.834042
Prob(F-statistic)	0.932756		S.E of regression	12646.43

Table 4 presents the simple regression results between GDP and Population, which show that the model has an R^2 value of 0.00, indicating that the data does not fit the model. The independent variable does not explain any variation in the dependent variable. Furthermore, this implies that Population does not correlate with GDP, which confirms the results of the individual correlations discussed in Appendix H. The p-value of POP is more than 0.05, which accepts the null hypothesis that there is no significant relationship between the variables. The robustness checks (see Appendix I.) show that the model has serial correlation and heteroskedasticity issues. The model needs further adjustments to pass the robustness checks.

5.2. Adjusted Model 1 Equation

$$\boldsymbol{LNGDP2 = \beta_0 + \beta_1 LNPOP1 + \beta_2 LLNGDP2 + \mu}$$

Where:

LNGDP2 = Second Difference of the Log of Gross Domestic Product
LLNGDP2 = Lagged LNGDP2
LNPOP1 = First Difference of the Log of Population
β_0 = Intercept
β_1, β_2 = Coefficients for the variables
μ = Error Term

The Second Difference of the Log of GDP addresses the issue of heteroskedasticity, while the Lagged Second Difference of the Log of GDP answers the serial correlation issue.

5.3. Final Adjusted OLS for Model 1

Table 5. Final Adjusted Simple Regression Results

Dependent Variable:	LNGDP2		Observations:	61
Sample:	2005Q4 - 2020Q4		After Adjustments	
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	0.042232	0.081382	0.518936	0.6058

LNPOP1	-9.856940	19.94203	-0.494280	0.6230
LLNGDP2	-0.954536	0.040918	-23.32801	0.0000
R-squared	0.903700		Mean dep. var.	0.003118
Adjusted R-squared	0.900379		S.D. dep. var.	0.186383
F-statistic	272.1417		D-W stat	1.571216
Prob(F-statistic)	0.000000		S.E of regression	0.058828

Table 5 presents the adjusted simple regression results between GDP and Population, which show that the model has an R^2 value of 0.86, indicating that the data does fit the model. The independent variable explains 85.50% of the variation in the dependent variable. Furthermore, this implies that Population does have a strong positive correlation with GDP, which contrasts with the results of the individual correlations discussed earlier. The p-value of POP is more than 0.05, which accepts the null hypothesis that there is no significant relationship between the variables. The robustness checks show that the adjusted model solved the issues on serial correlation and heteroskedasticity; however, there is now a problem with the non-normality of residuals (see appendix I). The model would no longer be adjusted since the issue could arise primarily due to outliers in the data. As such, the t-statistic is unreliable.

5.4. Adjusted OLS for Model 2

Table 6. Adjusted Multiple Regression Results

Dependent Variable:	GDP2		Observations:	62
Sample:	2005Q3 - 2020Q4		After Adjustments	
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	5842.334	5919.909	0.986896	0.3279
FDI1	2.351860	0.710810	3.308705	0.0016
REM1	7.740285	1.608788	4.811252	0.0000
TO2	-549.2862	32.15454	-17.08270	0.0000
LNPOP1	-1592170	1447197	-1.100175	0.2759
R-squared	0.886046		Mean dep. var.	175.5174
Adjusted R-squared	0.878050		S.D. dep. var.	12543.09
F-statistic	110.8009		D-W stat	2.657971
Prob(F-statistic)	0.000000		S.E of regression	1.09E+09

Table 6 presents the regression results, which show that the model has an R^2 value of 0.89, indicating that the data fits the model. The independent variable explains 88.60% of the variation in the dependent variable. Furthermore, this implies that the variables have a high positive overall correlation, which contrasts with the results of the individual correlations discussed earlier (see Appendix H.). The F-statistic also conveys that at least one of the independent variables is related to GDP. The p-value of FDI, REM, and TO are all less than 0.05, which rejects the null hypothesis that there is no significant relationship between the variables. POP, however, has a p-value greater than 0.05, indicating that it is an insignificant variable. FDI and REM appear to have a positive relationship with GDP, while POP and TO have a negative relationship. The robustness checks (see Appendix I.) show that the model has serial correlation and heteroskedasticity issues. The model needs further adjustments to pass the robustness checks.

5.5. Adjusted Model 2 Equation

$$\boldsymbol{LNGDP2 = \beta_0 + \beta_1 LNPOP1 + \beta_2 REM1 + \beta_3 FDI1 + \beta_4 TO2 + \beta_5 LLNGDP2 + \mu}$$

Where:

LNGDP2 = Second Difference of the Log of Gross Domestic Product
LLNGDP2 = Lagged LNGDP2
LNPOP1 = First Difference of the Log of Population
REM1 = First Difference of the Remittances
FDI = First Difference of the Foreign Direct Investment
TO = Second Difference of the Trade Openness
β_0 = Intercept
$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ = Coefficients for the variables
μ = Error Term

The Second Difference of the Log of GDP addresses the issue of heteroskedasticity, while the Lagged Second Difference of the Log of GDP answers the serial correlation issue. The other variables did not require to be adjusted.

5.6. Final Adjusted OLS for Model 2

Table 7. Final Adjusted Multiple Regression Results

Dependent Variable:	LNGDP2		Observations:	61
Sample:	2005Q4 - 2020Q4		After Adjustments	
Variable	Coefficient	Standard Error	t-Statistic	Probability
C	0.048	0.058271	0.828794	0.4108
FDI1	0.000006	0.000007	0.809551	0.4217
REM1	9.74E-05	1.60E-05	6.094294	0.0000
TO2	-0.003016	0.000622	-4.84944	0.0000
LNPOP1	-13.61734	14.28556	-0.963224	0.3446
LLNGDP2	-0.59451	0.065486	-9.078401	0.0000
R-squared	0.953300		Mean dep. var.	0.003118
Adjusted R-squared	0.949054		S.D. dep. var.	0.186383
F-statistic	224.5449		D-W stat	1.865453
Prob(F-statistic)	0.000000		S.E of regression	4.21E-02

Table 7 presents the regression results, which show that the model has an R^2 value of 0.95, indicating that the data fits the model. The independent variable explains 95.33% of the variation in the dependent variable. Furthermore, this implies that the variables have a highly positive overall correlation, which contrasts with the results of the individual correlations discussed earlier (see Appendix H.). The F-statistic also conveys that at least one of the independent variables is related to GDP. The p-value of REM and TO remains less than 0.05, which rejects the null hypothesis that there is no significant relationship between the variables. Likewise, POP still has a p-value greater than 0.05, indicating that it is an insignificant variable. FDI, however, is now a negligible variable since the adjustments in the model changed its p-value to below 0.5 and its t-statistic to 0.8. FDI and REM remain positive with GDP, while POP and TO have a negative relationship. The variables' coefficients all decreased. The robustness checks (see Appendix I.) show that the model has no issues, as it has passing marks on all regression assumptions. The model does not need any further adjustments, and the results are final.

5.7. Ending Discussion on Adjusted Models

The models are now valid since all robustness checks were passed, and no additional treatments are needed for both models. Based on the results of the first model, Population and GDP do not have any significant relationship. The Population's coefficient matches the initial assumption of a negative impact. The results for Population agree with Lubbock et al.'s (2022) results and the

initial assumption that Population negatively affects GDP. A possible explanation for this is the overpopulation leading to decreased income from the Optimum Population Theory.

The results of the second model show that two of the four independent variables are significant, with only two positively affecting GDP. Population continues to be negative and insignificant, further supporting the results of the first model. FDI is one of the variables that positively affects GDP, which concurs with the initial assumption and the results of Tan and Tang (2016), Cahn et al. (2019), and Dinh et al. (2019). However, FDI is an insignificant variable. Remittance is the only positively affecting significant variable, which supports the studies of Meyer and Shera (2018) and Cazachevici et al. (2020). The results of both FDI and Remittance agree with the initial assumptions and the Exogenous Growth Theory. Lastly, TO contrasts with the initial assumption and the Exogenous Growth Theory, similar to the results of Keho (2017) and Idris et al. (2017). TO is the only significant variable with a negative impact.

5.8. Summary

As the Philippines is still a developing country, it faces an increasing Population and Remittances and prioritized improving Trade and FDI. As mentioned in the previous chapters, no research is available using the dependent (GDP) and independent (Remittances, Population, FDI, and Trade Openness) variables during the quarterly periods of 2005 to 2020 for the Philippines. Cleansing and adjusting the data is necessary to provide clearer and more precise results compared to having an unadjusted model. The adjustments are from standard techniques to satisfy the assumptions of CNLRM. After transforming the initial variables, they are now stationary and normally distributed. The adjusted simple regression model shows that Population does not have a significant relationship with GDP. The second adjusted regression model indicates that GDP is related to TO and Remittances, which rejects the null hypothesis presented earlier. FDI and Population accept the null hypothesis, making them an insignificant variable in the model. It also shows that FDI and Remittances positively impact GDP, while Population and TO affect GDP negatively. Remittances have the highest positive impact, while Population has the highest negative impact. The initial unadjusted results in Chapter 4 differ from those in Chapter 5, wherein there is a relationship between Population and GDP in the simple regression. Likewise, the initial unadjusted multiple regression results vary since FDI and Remittances are the only significant variables.

5.9. Conclusion

In the four assumptions mentioned in the methodologies, only one stayed true in the variables used in a Philippine setting: As remittances increase, GDP also increases. Furthermore, these observations confirm that Population and TO affect the economic growth of the Philippines negatively. The Philippines being a developing nation can justify why an increasing population can negatively affect economic growth. The resources of a country are limited and insufficient for a growing population, as mentioned in Cannan's Optimum Theory of Population. For TO, on the other hand, its negative relationship to GDP contrasts with the results of other studies. Different variables could cause a negative relationship, which is not in the study. This indicates that the Philippines is not ready to expand trade liberalization further. The results regarding FDI contrast with multiple studies that FDI has a positive relationship with GDP. The insignificance of FDI in the model can be attributed to outliers found in the data. External events from 2005-2020 have significantly reduced FDI in the Philippines. Furthermore, different factors can explain why FDI has a weak positive relationship with Philippine economic growth. Such as mismanagement of the projects or the inflows of FDI are not enough to notably influence GDP, which is why the government is creating policies that will attract more foreign investors to the country and increase investor confidence in the country. Lastly, Remittance remains a strong indicator of GDP growth since it has continuously served as a source of financing for households in the Philippines. The results for Remittances confirm most of the results from the studies in the RRL. In conclusion, only Remittances positively correlate with GDP, while TO negatively affects GDP.

5.10. Recommendations

The findings of this study allowed the researchers to create recommendations based on sectors that need further investment to improve economic growth in the Philippines. First, the country has a rising Population, and it is hard for a developing country to sustain the needs of everyone, thus, leading to the decline of economic growth. Improving the FDI attractiveness of the Philippines creates more economic opportunities for the growing population. Increasing FDI inflows can cancel out the negative effect on the people by improving income distribution and capital accumulation. The Philippine government, NEDA, and DTI should prioritize creating policies that boost FDI attractiveness in the Philippines. The second is that the Philippines can slow down increasing trade liberalization in the Philippines, as it may be harming local businesses. The Philippine government and agencies should develop better local business conditions rather than concentrating on imports. Lastly is the development of the financial sector. The financial sector along with the BSP must help its citizens invest, grow, and use their money in productive ways, which will help increase economic growth. As the Philippines have a considerable number of overseas workers, educating the recipients on how to use their money efficiently will improve the flow of the economy. Furthermore, improving job conditions overseas can help attract and

motivate more Filipinos to work, consequently increasing remittances. Lastly, the authors recommend using annual data, a longer time span, and a causality method for future researchers. Adjustments to the model used in this study are recommended for those using a similar approach—these adjustments in the model address critical assumptions in the CNLRM.

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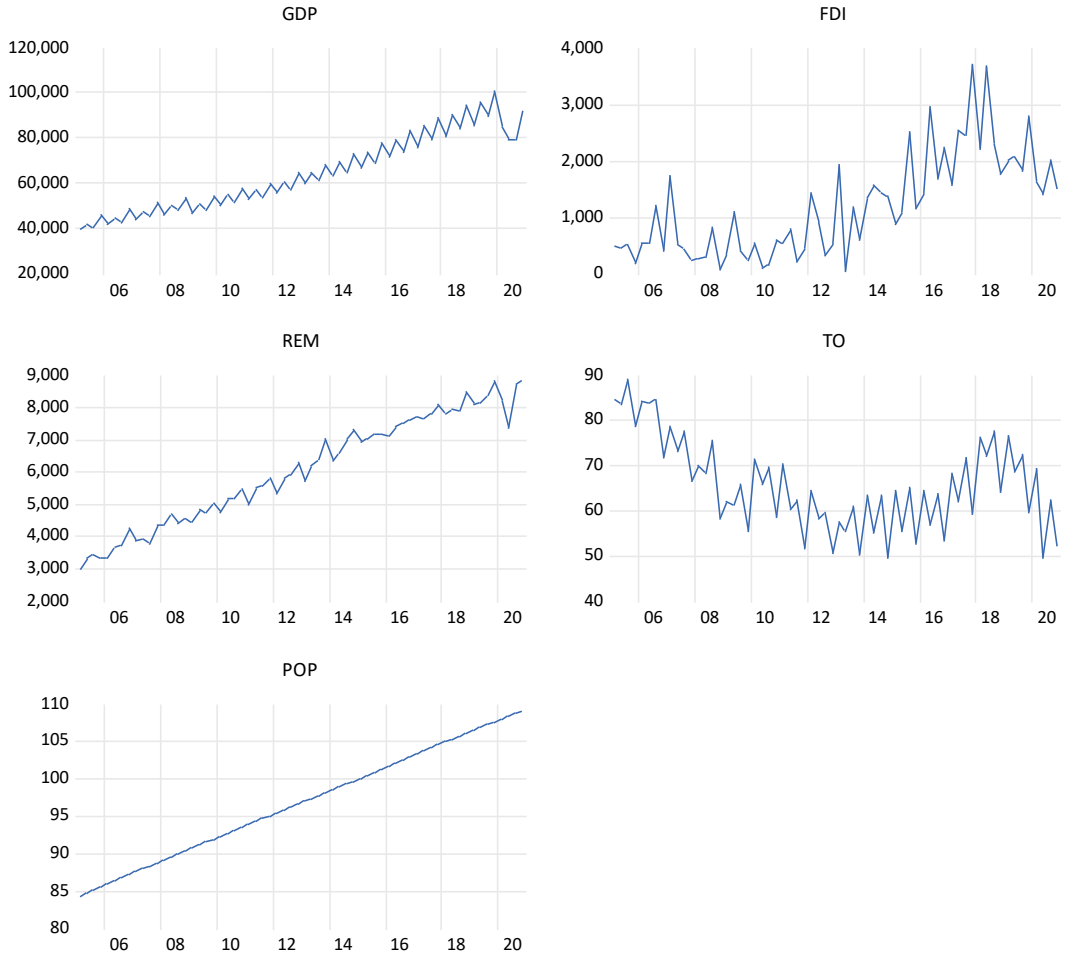
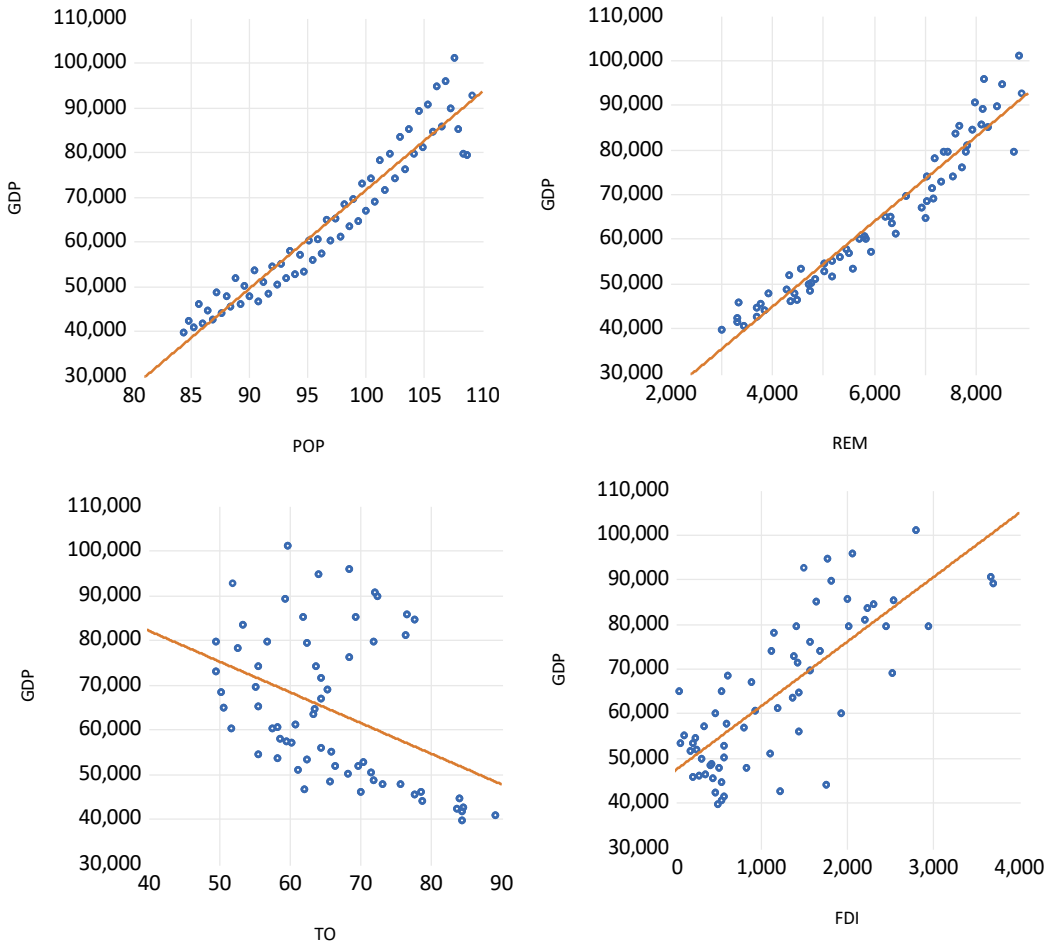
Appendices

Appendix A. Trend Line



Appendix B. Scatter Plot



Appendix B above shows that GDP has a very high positive relationship with FDI, POP, and REM. On the other hand, GDP and TO have a low negative relationship. GDP to POP and GDP to REM have less scattered data, while GDP to TO and GDP to FDI is more spread out.

Appendix C. Initial Descriptive Statistics

Table 8. Initial Descriptive Statistics

	GDP	FDI	REM	POP	TO
Mean	64462.32	1191.307	6058.329	96.82785	65.82031
Median	60856.33	1099.735	6071.760	96.82462	64.50000
Maximum	101117.2	3699.083	8891.489	109.1316	89.20000
Minimum	39829.61	30.88230	3004.756	84.36206	49.60000
Std. Dev.	16739.20	897.4336	1694.566	7.324893	9.962217
Skewness	0.372308	0.818353	-0.088518	-0.000597	0.377765
Kurtosis	1.960064	3.080987	1.758976	1.808149	2.411569
Jarque-Bera	4.362460	7.160969	4.190618	3.788025	2.445540
Probability	0.112903	0.027862	0.123032	0.150467	0.294414
Sum	4125589.	76243.67	387733.1	6196.983	4212.500
Sum Sq. Dev.	1.77E+10	50739385	1.81E+08	3380.205	6252.484
Observations	64	64	64	64	64

Table 8 above presents the descriptive statistics of GDP, FDI, POP, REM, and TO in the Philippines during the quarters of 2005 to 2020. Gross Domestic Product and Trade Openness is moderately skewed to the right, while Foreign Direct Investment is highly skewed to the right. Remittances and Population, on the other hand, is moderately skewed to the left. Furthermore, there is a relatively considerable difference between the maximum and minimum values of all the variables.

Appendix D. Stationary Test

Table 9. Augmented Dickey-Fuller Test

Variables	No Trend, Level	With Trend, Level
GDP	0.468	0.5944
FDI	0.5604	0
POP	0.6496	0.4192
REM	0.3627	0.9864
TO	0.0924	0.2507
GDP2	0	0
FDI1	0	0
LNPOP1	0.0073	0.002
REM1	0	0
TO1	0	0

Note: Max lag 10 (default)

The Augmented Dickey-Fuller Test (ADFT) is a Unit Root test that checks whether a time series is stationary or not to account for statistical changes in the data. The at level with the trend is used since the graphs of the variables in the Appendix A show that all the variables have a constant trend. The test rejects the null hypothesis that the series is not stationary when P-value < 0.05. Furthermore, the test also uses a lag value of ten based on the default of ADFT with the number of observations used. Table 9 shows that GDP, POP, REM, and TO are not stationary with or without trends. FDI, on the other hand, is only stationary at a level with a trend. Therefore, the data is transformed to match the results where the data would pass both stationary and normality test. The new results indicate that all variables are now stationary; hence, it is possible to proceed.

Appendix E. Normality Test of Variables

Table 10. Jarque-Bera Test for Normality of Variables

Variables	Jarque-Bera Value	Probability
GDP	4.36246	0.112903
FDI	7.160969	0.027862
POP	3.788025	0.150467
REM	4.190618	0.123032
TO	2.44554	0.294414
GDP2	5.63717	0.05969
FDI1	0.321042	0.8517
LNPOP1	1.158233	0.560393
REM1	4.873165	0.087459
TO2	6.065528	0.548182

The Jarque-Bera test is for identifying whether the variables are normally distributed. The test accepts the null hypothesis that the variable is normally distributed when P-value > 0.05. As seen in Table 10, FDI is normally distributed, but because it is not stationary, the variable must be transformed. GDP, POP, REM, and TO are not normally distributed; therefore, they would also be transformed despite being stationary earlier. GDP1, FDI1, LNPOP1, REM2, and TO1 are the results of transforming the variables to pass both stationary and normality test.

Appendix F. Graphs

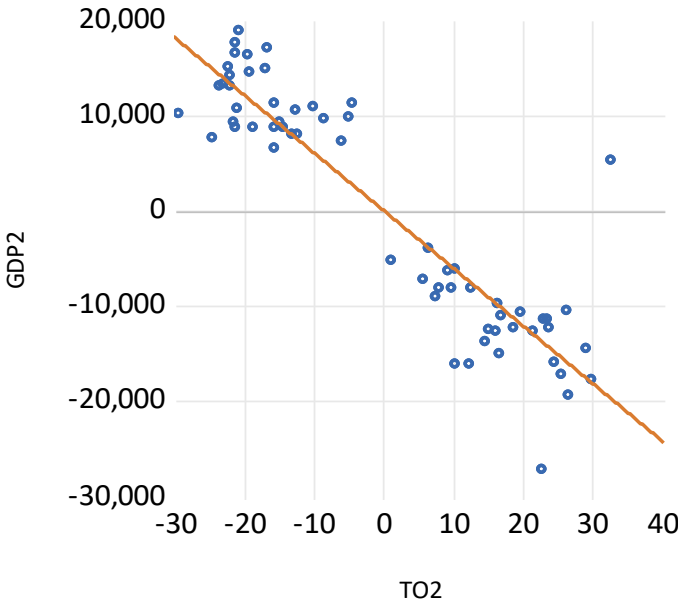


Figure 4. GDP2 to TO2 Scatter Plot

Figure 3 above presents the relationship between the transformed GDP2 and TO2 in the Philippines from 2005 to 2020. It can be seen that the line in the graph shows a downward sloping trend, meaning that there is a strong direct negative relationship between the adjusted GDP and Trade Openness.

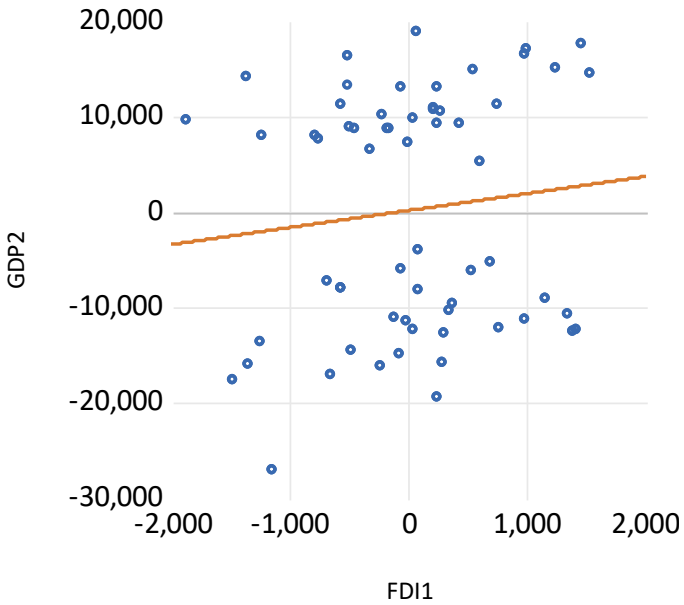


Figure 5. GDP2 to FDI1 Scatter Plot

As seen in Figure 5, GDP1 and FDI have a weak negative relationship with one another. The slightly flat trend line shows the weak relationship between the two.

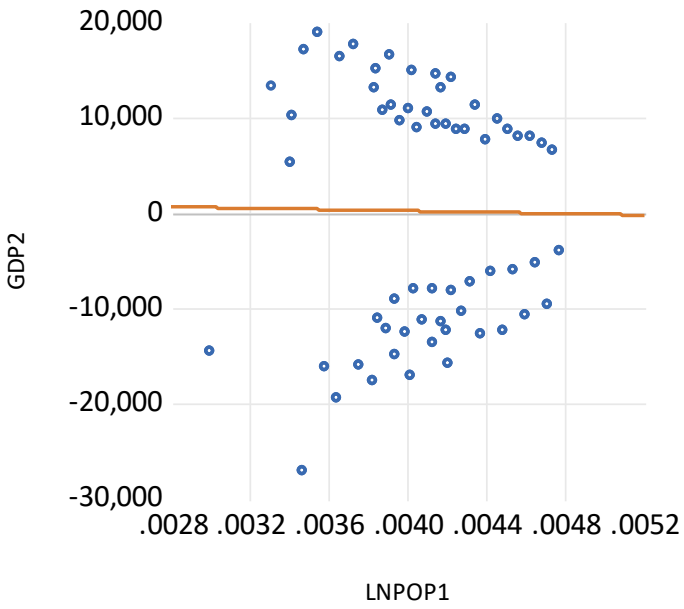


Figure 6. GDP2 to LNPO1 Scatter Plo

Similar to FDI, Figure 6 shows another near-flat trend line but downward sloping. This indicates that GDP1 and LNPOP1 have a weak negative relationship.

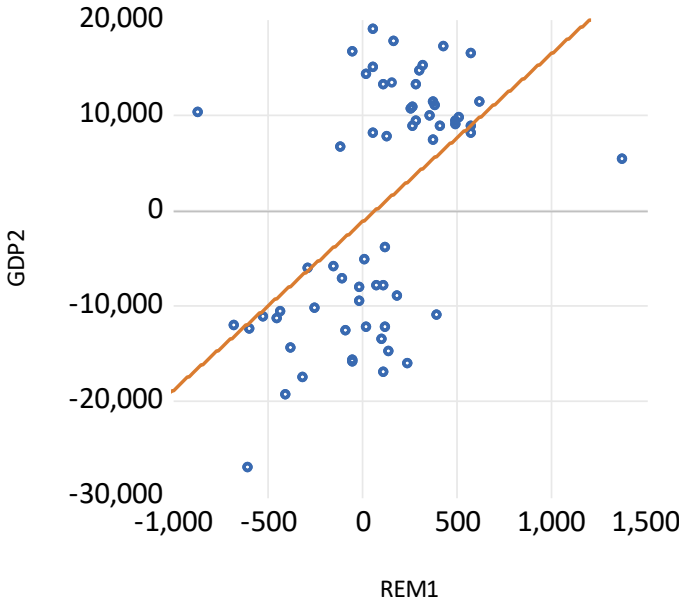


Figure 7. GDP2 to REM1 Scatter Plot

Presented in Figure 7 above is the relationship between the transformed GDP and REM, and a steep upward trend can be seen. It can be interpreted that GDP2and REM1 have a strong positive direct relationship.

Appendix G. Adjusted Descriptive Statistics

Table 11. Adjusted Descriptive Statistics

	GDP2	FDI1	REM1	LNPOP1	TO2
Mean	175.5174	16.62538	89.91356	0.004075	-0.156452
Median	6083.156	32.69700	115.1770	0.004107	-1.900000
Maximum	19068.10	1522.089	1375.328	0.004767	32.60000
Minimum	-27054.66	-1890.649	-864.2477	0.002992	-29.50000
Std. Dev.	12543.09	791.4088	376.5777	0.000388	18.80759
Skewness	-0.166633	-0.093766	0.043625	-0.355125	0.120388
Kurtosis	1.560881	2.659568	4.340341	2.850719	1.486734
Jarque-Bera	5.637170	0.390243	4.660661	1.360742	6.065528
Probability	0.059690	0.822734	0.097264	0.506429	0.048182
Sum	10882.08	1030.774	5574.641	0.252639	-9.700000
Sum Sq. Dev.	9.60E+09	38205997	8650456.	9.20E-06	21577.25
Observations	62	62	62	62	62

Table 11 above presents the descriptive statistics of the transformed variables GDP, FDI, Population, Remittances, and TO. GDP2, TO2, and LNPOP1 have a to the left distribution, while REM1 and TO2 are moderately skewed to the right. Furthermore, there is a relatively great difference between the maximum and minimum values of all the variables.

Appendix H. Correlation Matrix

Table 12 and 13 shows the correlation coefficient between the variables in their base and transformed forms. Using the Pearson Correlation, GDP and FDI have a 0.77 coefficient, indicating a moderately strong relationship. The positive relationship remains true with the results of Ekananda and Parlinggoman (2017) and Chua (2016). Both REM and POP also show a very strong positive relationship with GDP as their coefficients are 0.96. The results are similar to Meyer and Shera's (2018) and Degu's (2019) works. TO, on the other hand, has a low negative relationship with GDP, which is contrary to results from the related literature. Once the data is transformed, GDP to FDI changes to a very low positive relationship, and REM decreases to a moderately strong positive relationship. POP to GDP turns into a negative relationship, while GDP to TO becomes a much stronger negative relationship.

Table 12. Initial Correlation Coefficient

	GDP	FDI	REM	POP	TO
GDP	1.000000	0.770096	0.965824	0.960246	-0.408602
FDI		1.000000	0.725140	0.727743	-0.090614
REM			1.000000	0.986282	-0.488725
POP				1.000000	-0.456501
TO					1.000000

Table 13. Adjusted Correlation Coefficient

	GDP2	FDI1	REM1	LNPOP1	TO2
GDP2	1.000000	0.112015	0.529762	-0.010938	-0.905486
FDI1		1.000000	-0.058969	0.048677	0.024615
REM1			1.000000	0.036204	-0.373853
LNPOP1				1.000000	-0.027584
TO2					1.000000

Appendix I. Regression Results (OLS)

Dependent Variable: GDP2
Method: Least Squares
Date: 11/02/22 Time: 15:35
Sample (adjusted): 2005Q3 2020Q4
Included observations: 62 after adjustments

Variable	Coeffici...	Std. Error	t-Statistic	Prob.
C	1615.175	17066.33	0.094641	0.9249
LNPOP1	-353305.5	4169650.	-0.084733	0.9328

R-squared	0.000120	Mean dependent var	175.5174
Adjusted R-squared	-0.016545	S.D. dependent var	12543.09
S.E. of regression	12646.43	Akaike info criterion	21.75986
Sum squared resid	9.60E+09	Schwarz criterion	21.82848
Log likelihood	-672.5558	Hannan-Quinn criter.	21.78680
F-statistic	0.007180	Durbin-Watson stat	3.834042
Prob(F-statistic)	0.932756		

Dependent Variable: LNGDP2
Method: Least Squares
Date: 11/13/22 Time: 20:04
Sample (adjusted): 2005Q4 2020Q4
Included observations: 61 after adjustments

Variable	Coeffici...	Std. Error	t-Statistic	Prob.
C	0.042232	0.081382	0.518936	0.6058
LNPOP1	-9.856940	19.94203	-0.494280	0.6230
LLNGDP2	-0.954536	0.040918	-23.32801	0.0000

R-squared	0.903700	Mean dependent var	0.003118
Adjusted R-squared	0.900379	S.D. dependent var	0.186383
S.E. of regression	0.058828	Akaike info criterion	-2.780481
Sum squared resid	0.200720	Schwarz criterion	-2.676668
Log likelihood	87.80468	Hannan-Quinn criter.	-2.739796
F-statistic	272.1417	Durbin-Watson stat	1.571216
Prob(F-statistic)	0.000000		

Dependent Variable: LNGDP2
Method: Least Squares
Date: 11/02/22 Time: 16:43
Sample (adjusted): 2005Q4 2020Q4
Included observations: 61 after adjustments

Variable	Coeffici...	Std. Error	t-Statistic	Prob.
C	0.048294	0.058271	0.828794	0.4108
FDI1	5.55E-06	6.85E-06	0.809551	0.4217
REM1	9.74E-05	1.60E-05	6.094294	0.0000
TO2	-0.003016	0.000622	-4.849438	0.0000
LNPOP1	-13.61734	14.28556	-0.953224	0.3446
LNGDP2(-1)	-0.594510	0.065486	-9.078401	0.0000

R-squared	0.953300	Mean dependent var	0.003118
Adjusted R-squared	0.949054	S.D. dependent var	0.186383
S.E. of regression	0.042069	Akaike info criterion	-3.405842
Sum squared resid	0.097338	Schwarz criterion	-3.198215
Log likelihood	109.8782	Hannan-Quinn criter.	-3.324471
F-statistic	224.5449	Durbin-Watson stat	1.865453
Prob(F-statistic)	0.000000		

Appendix J. Robustness Checks

Table 14. Robustness Checks for Model 1

Jarque-Bera Normality test for Residuals			
Jarque-Bera	5.61665	Probability	0.060306
Breusch-Pagan-Godfrey Heteroskedasticity Test			
F-Statistic	27.93161	Prob. F(4,49)	0
Obs *R-Squared	19.69439	Prob. Chi-Square (4)	0
Scaled explained SS	5.260467	Prob. Chi-Square (4)	0.0218
Breusch-Godfrey Serial Correlation LM Test			
F-Statistic	410.2114	Prob. F(4,49)	0
Obs *R-Squared	54.20394	Prob. Chi-Square (4)	0
Durbin-Watson Statistic			
Durbin-Watson stat	3.834042	P-value	1

Table 15. Final Robustness Checks for Model 1

Jarque-Bera Normality test for Residuals			
Jarque-Bera	29.11881	Probability	0
Breusch-Pagan-Godfrey Heteroskedasticity Test			
F-Statistic	3.499943	Prob. F(4,49)	0.0567
Obs *R-Squared	6.569135	Prob. Chi-Square (4)	0.0575
Scaled explained SS	15.67005	Prob. Chi-Square (4)	0.004
Breusch-Godfrey Serial Correlation LM Test (1 Lag)			
F-Statistic	0.700403	Prob. F(4,49)	0.4061
Obs *R-Squared	0.740455	Prob. Chi-Square (4)	0.3895
Durbin-Watson Statistic			
Durbin-Watson stat	1.571216	P-value	0.0449312

Table 16. Robustness Checks for Model 2

Variance Inflation Factor			
Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	35045322	113.2478	NA
FDI1	0.055251	1.006564	1.006112
REM1	2.59E+00	1.234546	1.16693
TO2	1033.914	1.162838	1.162756
LNPOP1	2.09E+12	113.3798	1.004152
Jarque-Bera Normality test for Residuals			
Jarque-Bera	0.098241	Probability	0.952067
Breusch-Pagan-Godfrey Heteroskedasticity Test			
F-Statistic	6.393705	Prob. F(4,49)	0.0003
Obs *R-Squared	19.20245	Prob. Chi-Square (4)	0.0007
Scaled explained SS	15.3536	Prob. Chi-Square (4)	0.004
Breusch-Godfrey Serial Correlation LM Test			

F-Statistic	7.041252	Prob. F(1,56)	0.0103
Obs *R-Squared	6.924952	Prob. Chi-Square (1)	0.0085

Durbin-Watson Statistic			
Durbin-Watson stat	2.657971	P-value	0.997431

Ramsey RESET Test			
	Value	df	Probability
t-statitic	0.797109	56	0.4288
F-Statistic	0.635383	(1,56)	0.4288
Likelihood ratio	0.699499	1	0.403

Table 17. Final Robustness Checks for Model 2

Variance Inflation Factor			
Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.003395	117.0335	NA
FDI1	4.69E-11	1.013538	1.013138
REM1	2.55E-10	1.317208	1.247061
TO2	3.87E-07	4.707332	4.706415
LNPOP1	204.0771	117.1495	1.004607
LNGDP2(-1)	0.004288	5.014456	5.014313

Jarque-Bera Normality test for Residuals			
Jarque-Bera	0.267644	Probability	0.874746

Breusch-Pagan-Godfrey Heteroskedasticity Test			
F-Statistic	0.718581	Prob. F(4,49)	0.6122
Obs *R-Squared	3.740508	Prob. Chi-Square (4)	0.5873
Scaled explained SS	3.093864	Prob. Chi-Square (4)	0.6855

Breusch-Godfrey Serial Correlation LM Test (1 Lag)			
F-Statistic	0.062801	Prob. F(4,49)	0.8031
Obs *R-Squared	0.07086	Prob. Chi-Square (4)	0.7901

Durbin-Watson Statistic

Durbin-Watson stat	1.865453	P-value	0.361238

Ramsey RESET Test

	Value	df	Probability
t-statistic	1.940291	54	0.0576
F-Statistic	3.76473	(1,54)	0.0576
Likelihood ratio	4.111064	1	0.0426

Appendix K. Data

Year	REM	TO	FDI	POP	GDP
2005Q1	3,004.7557000000	84.50	491.6093	84.3620595700	39,829.6129492229
2005Q2	3,316.8481000000	83.70	454.5761	84.7677646425	42,218.6286201891
2005Q3	3,443.8192000000	89.20	526.1073	85.1728096667	40,730.4749799218
2005Q4	3,329.3863000000	78.70	191.7073	85.5771946425	45,958.2951344273
2006Q1	3,314.0961000000	84.40	554.2648	85.9809195700	41,622.7156814721
2006Q2	3,691.2140000000	84.00	533.8089	86.3839844492	44,717.5787384045
2006Q3	3,703.7682000000	84.60	1,211.5220	86.7863892800	42,646.0131155409
2006Q4	4,279.2248000000	71.90	407.8192	87.1881340625	48,721.4670227336
2007Q1	3,849.5912000000	78.80	1,749.8067	87.5892187967	44,188.4012424204
2007Q2	3,911.2692000000	73.20	505.5755	87.9896434825	47,777.2503061308
2007Q3	3,756.9685000000	77.70	428.3107	88.3894081200	45,437.9472150395
2007Q4	4,334.8094000000	66.40	235.0319	88.7885127092	51,889.4637256817
2008Q1	4,357.1293000000	70.00	266.4795	89.1869572500	46,030.9094111406

2008Q2	4,718.2390000000	68.30	300.4259	89.5847417425	50,057.6796729979
2008Q3	4,428.2160000000	75.70	828.8062	89.9818661867	47,907.6084543236
2008Q4	4,560.0620000000	58.20	55.6841	90.3783305825	53,520.6780196817
2009Q1	4,472.4346000000	62.10	345.7179	90.7741349300	46,545.1934094337
2009Q2	4,846.4676000000	61.20	1,093.0734	91.1692792292	51,004.8362901943
2009Q3	4,743.8240000000	65.70	398.9611	91.5637634800	48,352.1308266479
2009Q4	5,014.9874000000	55.60	226.8683	91.9575876825	54,475.3974935573
2010Q1	4,762.4610000000	71.50	554.8029	92.3507518367	50,324.8254618720
2010Q2	5,178.5987000000	65.90	90.3741	92.7432559425	55,072.4345407426
2010Q3	5,168.3608000000	69.80	165.1217	93.1351000000	51,770.2219158378
2010Q4	5,453.4599000000	58.70	590.3317	93.5262840092	57,906.7680150306
2011Q1	5,006.3606000000	70.40	554.3122	93.9168079700	52,754.0134258521
2011Q2	5,500.6091000000	60.30	789.0243	94.3066718825	57,033.1919746555
2011Q3	5,578.8163000000	62.50	202.3041	94.6958757467	53,341.8510233897
2011Q4	5,836.4236000000	51.80	461.5101	95.0844195625	60,243.2588239726
2012Q1	5,317.8347000000	64.50	1,432.0422	95.4723033300	55,940.3669266956
2012Q2	5,808.7872000000	58.20	916.4346	95.8595270492	60,580.2777738861
2012Q3	5,921.7680000000	59.60	332.7825	96.2460907200	57,288.8898639533
2012Q4	6,303.8193000000	50.60	534.1558	96.6319943425	64,968.6614007720

2013Q1	5,709.3364000000	57.50	1,921.5310	97.0172379167	60,187.9913477858
2013Q2	6,221.7510000000	55.60	30.8823	97.4018214425	65,131.3263510788
2013Q3	6,409.4804000000	60.90	1,184.8038	97.7857449200	61,132.3794045722
2013Q4	7,028.2732000000	50.30	600.1546	98.1690083492	68,445.2957223309
2014Q1	6,347.3991000000	63.30	1,361.0764	98.5516117300	63,618.0003703532
2014Q2	6,612.8094000000	55.10	1,570.7878	98.9335550625	69,649.1516543607
2014Q3	7,011.8472000000	63.50	1,438.3248	99.3148383467	64,760.6433892173
2014Q4	7,300.6556000000	49.60	1,369.3849	99.6954615825	73,050.0266096910
2015Q1	6,920.2223000000	64.50	876.3818	99.9941750000	66,957.6244197147
2015Q2	7,037.5956000000	55.60	1,106.3956	100.4115050000	74,105.8462903206
2015Q3	7,164.1856000000	65.30	2,516.3765	100.8333710000	69,026.6861640314
2015Q4	7,186.4861000000	52.70	1,140.0020	101.2598820000	78,196.5248649554
2016Q1	7,134.1426000000	64.50	1,423.4531	101.6863680000	71,590.1592504634
2016Q2	7,434.6785000000	56.90	2,945.5417	102.1082910000	79,618.9615161270
2016Q3	7,539.5282000000	63.70	1,685.0075	102.5301960000	74,086.2050242339
2016Q4	7,597.6530000000	53.40	2,225.5460	102.9433300000	83,602.2875739808
2017Q1	7,708.7952000000	68.40	1,562.0075	103.3564100000	76,153.4109550411
2017Q2	7,655.4751000000	61.90	2,539.1403	103.7606040000	85,333.2935066421
2017Q3	7,799.9205000000	71.90	2,456.2121	104.1692300000	79,666.0789633029

2017Q4	8,124.1771000000	59.30	3,699.0826	104.5689630000	89,154.4874610063
2018Q1	7,809.3103000000	76.40	2,207.1164	104.9687060000	81,068.7784874331
2018Q2	7,978.0394000000	72.00	3,667.3416	105.3597930000	90,776.6147421191
2018Q3	7,925.7186000000	77.80	2,299.7759	105.7551800000	84,562.3331759354
2018Q4	8,500.3933000000	64.00	1,774.3649	106.1415750000	94,845.9324053152
2019Q1	8,098.1243000000	76.70	2,000.3034	106.5279730000	85,830.4984735137
2019Q2	8,154.0071000000	68.50	2,057.4677	106.9059340000	95,883.1611429747
2019Q3	8,391.1827000000	72.50	1,808.6989	107.2881500000	89,914.3116387830
2019Q4	8,823.9342000000	59.70	2,804.8958	107.6611010000	101,117.2328105600
2020Q1	8,218.4020000000	69.40	1,638.1098	108.0340910000	85,265.4901420001
2020Q2	7,354.1543000000	49.60	1,410.8304	108.4030680000	79,671.9878366838
2020Q3	8,729.4819089248	62.40	2,007.9720	108.7719780000	79,528.8232676999
2020Q4	8,891.4888884084	51.90	1,485.3496	109.1315880000	92,799.9156646416