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**| RESEARCH ARTICLE**

# Applicability of Harrod-Domar Model in Explaining Economic Growth in the Philippines

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**| ABSTRACT**
This paper ought to determine and examine whether the Harrod-Domar model is applicable in explaining the economic growth in the Philippine setting from 1981 to 2021, whereas the variables are Gross Savings and Gross Capital Formation. Using the multivariate Ordinary Least Squares (OLS) regression, the results showed that all independent variables are shown to be positively significant parameters of GDP growth. Furthermore, several tests employed in the study, including the Variance Inflation Factor, the Breusch-Godfrey test, Breusch-Pagan-Godfrey, have no evidence of multicollinearity or autocorrelation and heteroscedasticity in the regression model. The Harrod-Domar Model economic growth that is focused on in this study was popular among developed countries, yet considering the Philippines is one of the developing countries in the world, the researchers aim to understand whether the Harrod-Domar Model is applicable in the Philippine settings.

**| KEYWORDS**

Harrod-Domar model, GDP Growth, Gross Saving, Gross Capital Formation.

**| ARTICLE INFORMATION**

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## 1. Introduction

### *1.1 Background of the Study*

The Philippines is considered one of the most economically developing countries in the world. The study of economics is always best determined to be a social science that studies how human beings interact in the economy. Economics has been part of the lives of the people. It is not just about how money flows in the economy but also how people make different choices. Every situation may involve economics, whether in a household, community, school, or workplace. In particular, people opt to deal with the production of the economy, distribution, and consumption of goods and services. Achieving economic stability is one of the most desired objectives. However, various factors hinder the aim of achieving such economic growth. For over a decade, the Philippines has been considered one country with a dynamic economy.

Given that the Philippines is considered a developing country and is experiencing problems and difficulties, major factors occurred during the Japanese occupation in the 1940s. Issues in terms of the high inflation rate of the economy have been discerned. Regardless of the problems arising, the Philippines is still trying to outstretch the growth of the economy.

Filipino people are facing difficulties in terms of their salary. Every year the minimum wage value in the Philippines is not raised. Hence, the inflation rate in the country is continuously increasing, which can affect Filipinos' daily consumption and gross savings. According to Mapa (2022), amidst the pandemic, the economy of the Philippines is primarily driven by consumer spending. Consumption represents approximately 72.8% of total economic activity, and considering its amount, it is not a stretch to say that the economy will expand as far as consumption allows. While the savings in the Philippine economy, as predicted, poverty and lack of access to wages forced households to turn into the savings of the Filipinos. The decrease in savings has been marked for those earning Php10,000 to Php 29,000 per month, perhaps even more than those earning Php10,000 or less per month. During the lockdowns, lower-income households received government cash allowances, while those who did not receive cash assistance

were forced to dip deeper into their savings. Moreover, one of the Filipino traits is to love going out of town, eating expensive foods, and buying all things when people get a salary and act like a one-day millionaire instead of investing it into a small business.

According to the World Bank (2022), the Philippine economy is the most dynamic in the East Asia Pacific region. Between 2010 and 2019, average annual growth increased to 6.4%, up from 4.5% on average between 2000 and 2009. The economic development of the Philippines is centered on high consumer demand, supported by a lively labor market and wage growth due to increasing urbanization, a growing middle class, and a large young population. Moreover, the Philippine economy made strides toward inclusive growth, as illustrated by decreased poverty rates and the Gini coefficient. Poverty dropped from 23.3% in 2015 to 16.6% in 2018, while the Gini coefficient slumped from 44.9 to 42.7 during the same period.

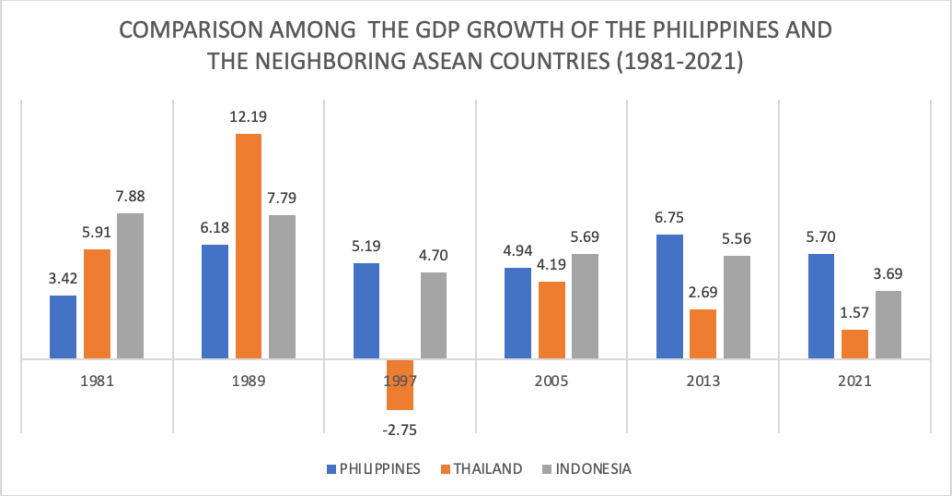


Figure 1. Comparison among the GDP growth of the Philippines and the neighboring ASEAN countries (1981-2021) | *Source: World Bank national accounts data and OECD National Accounts data files*

The figure above shows the comparison of the GDP growth of the Philippines between the two neighboring countries - Thailand and Indonesia, which were also included in the Association of Southeast Asian Nations countries. In 1981, the GDP growth rate of the Philippines was 3.42%, which went up to 5.70% in 2021. This indicates that the country has improved to an extent. The massive decline in GDP growth of Thailand and Indonesia has continuously decreased for 40 years. Throughout the years, the GDP growth rate of the Philippines is fluctuating. The figure above shows that the Philippines experienced an economic downturn for two consecutive years, from 1984 to 1985. According to Malin (1985), a massive economic and political stability challenge was experienced in 1984. This has been spawned yet concealed during the decade when martial law was declared. Also, this continued to burst during the wake of Benigno Aquino Jr. The Harrod-Domar economic growth model used in this study was popular among developed countries. The Harrod-Domar economic growth model was utilized to determine profit, saving, and investment strategies, which were critical in developing the preparation of the economy. The Harrod-Domar economic growth model has proven to be remarkably versatile, showing the rate at which the industry can develop to utilize the ability generated by new equities entirely, as well as the required investments and costs of capital for income to achieve a specific target growth rate. The Philippines is considered low in terms of savings rate due to the standard of living; this also shows that the country only administers a small percentage of current output for doctor accumulation. Compared to other countries in Southeast Asia, the Philippines is quite different regarding working-age population growth, which is considered relatively high.

### *1.2 Statement of the Problem*

The Philippines is a developing country that faces issues and problems regarding the determinants of the Harrod-Domar economic growth model. Specifically, the paper aims to determine whether the model is applicable in the Philippine setting.

Hence, at the end of the research study, the paper aims to consider answering the following questions:

1. What changes have occurred in the following variables from 1981 to 2021 in the Philippines?

    A. GDP growth

B. Gross savings

C. Gross capital formation

2. Is there a long run relationship between the dependent and independent variables in the Philippines?
3. Is there any significant relationship between GDP growth, gross savings, and gross capital formation?

### *1.3 Formulation of Hypothesis*

To have an in-depth understanding of the relationship between gross savings, gross capital formation, and GDP growth from 1981 to 2021, the null hypothesis of the study is as follows:

Ho1: There is no significant relationship between GDP growth and gross savings.

Ho2: There is no significant relationship between GDP growth and gross capital formation.

Ho3: There is no long-run relationship between GDP growth and gross savings, GDP growth and gross capital formation.

### *1.4 Scope and Limitation*

The study focused on the econometric analysis of several indicators of economic growth in the Philippines. Also, the study determined the growth of an economy, in which the GDP growth rate served as the model of the dependent variable that is measured by employing GDP growth in annual percentage growth.

The following independent variables that aim to determine the relationship towards GDP growth are gross savings and gross capital formation. That said, the current local currency unit determines gross savings since some indicators are very limited in the number of data. Gross capital formation is also determined by using constant local currency units.

The researchers collected and used annual data since time-series analysis was utilized. The time-series data collected from the World Bank World Development Indicators database (WDI) are only limited to a total of 41 years of observations from 1981-2021 since one of the independent variables shows to be limited in the number of data available.

In addition, the researchers considered determining if there are significant relationships among the said variables to estimate the Ordinary Least Squares (OLS) through multiple linear regression models for the GDP growth in the Philippines. To see what changes have occurred for each variable based on the given annual time-series, the researchers used Microsoft Excel for the trendline of the variables. The statistical software for the econometric analysis that the researchers used was EViews 12 (Student Version) in conducting the required econometric tests to find out if the model employed is coherent and credible. Apart from that, this study also employed other econometric tests such as the Augmented Dickey-Fuller test to see if there is a unit-root, Variance Inflation Factor (VIF) to measure and detect the multicollinearity among the independent variables, Breusch-Godfrey Serial Correlation LM test to detect if there is autocorrelation, Breusch-Pagan test to see if the regression model has detected heteroscedasticity, Ramsey RESET test for detecting misspecification among the data, Jarque-Bera for the normality of the residuals, and as well as Cointegration test.

### *1.5 Significance of the Study*

The paper seeks to determine and analyze the determinants of GDP growth in the Philippines. In addition, the researchers hope that the study be very beneficial to many people and significant to the following:

**Local Government Units.** The study is also beneficial to the local government units, which signified as guidance in knowing the condition of their subordinates on saving aspects.

**Households**. The findings of this study are also beneficial to the households since the study includes determinants that contain information with regard to savings. Also, this allows them to be aware of how the growth of the Philippines has been changing throughout the years.

**Future Researchers**. The study helps future researchers of Philippine GDP growth to gain new knowledge about the study and serve as a reference for further studies. Also, this helps them provide and come up with new findings and solutions that enable them to formulate solutions to the problem experienced by the country related to the topic.

**Economics students**. Although the study is not primarily focused on all economic terms and discussions, it enables them to understand how the GDP growth in the Philippines relates to several indicators.

## 2. Review of Related Literature

### *2.1. Review of Related Literature*

#### *2.1.1 GDP growth*

The global Coronavirus pandemic had a massive impact on the economy; this slowed the economic state of most of the developing countries in the world even more. In the study of West (2021), Guatemala and Libya are considered developing countries; The Harrod-Domar economic growth model was a good representation in explaining the economic growth of both mentioned countries. However, given that instance, Guatemala and Libya should increase necessary indicators to improve welfare.

According to Dragoi (2019), the theory of the Harrod-Domar economic growth model has received massive criticism. Many developing countries are struggling and having a difficult time saving, which is why efforts made by the people in saving were not recognized better in the savings ratio of a particular country. An increased poverty rate in developing countries has negatively influenced savings. Also, the author mentioned that savings and investments should work together to achieve a higher economic growth rate. However, despite having no improvement in savings, Thailand attained fast-paced economic growth rates.

#### *2.1.2 The Relationship between GDP Growth and Gross Savings*

This part provides numerous literature and studies on GDP growth, particularly the relationship between GDP growth and gross savings, along with the findings of the research and the data that was collected and used in the study.

Gross Savings plays an important role in affecting the economic growth of society. It deals with the portion of gross national income that is not used for final consumption. In accordance with GDP growth, there is always an impact of the indicators in affecting the movement of the GDP rate in the economy. The literature collected is more on the long-run effect of gross savings in different countries.

##### *2.1.2.1 Country-Specific Studies*

Misztal (2017) states that their findings of the study on the relationship between savings and economic growth are generally consistent in advanced economies and emerging and developing economies with theories of economic growth from the standpoint of a standard economic theory of domestic savings and economic growth, positive cause and effect relationship may appear in advanced economies with relatively high domestic savings. An essential source of financing domestic investment and an economic growth factor without foreign investment is required. For the same reason, there should not be any relation between domestic savings and economic growth in the poorest countries in the world. These countries use mostly foreign savings to finance their investments because domestic savings are limited and very scarce.

Sabe (2017) investigated the domestic saving trends in Indonesia, Malaysia, Singapore, Thailand, Vietnam, and the Philippines. In the ASEAN community, these countries' domestic saving rates have steadily increased. Using fixed effect models, the paper investigates the economic determinants underlying the saving trends of the group from 2000 to 2015. According to the findings, the highest contributors to the rise in the saving rate are GDP per capita and inflation. Another striking finding is that lowering the young dependency ratio increases the saving rate during the observed period. Domestic savings are highly perceived as one of the primary drivers of economic growth; the purpose of this paper was to investigate the reasons behind the various saving patterns of selected ASEAN countries.

Most of the studies postulate that higher savings mean higher investment; however, Ihimbazwe (2018) states that an increase in savings does not necessarily mean increased investment. The authors have studied whether savings shows to have an effect on the economic growth in Rwanda. Regardless of all the government implementation and improvement for the savings, this still remains at a lower rate. In comparison for both long-run and short-run periods, the latter indicates that savings induce an increase of about 17.51% towards the GDP, while the former is said to be positively related. Still, in both long and short-run periods, savings have a positive impact towards economic growth. However, given that result, there still should be policies to be implemented to maintain steady growth.

In the study of Akter (2018), savings are found to be a major factor that affects long-term economic growth. The study contributes to the macroeconomic effects of monetary policy by conducting a comparison analysis of Bangladesh, India, and the Philippines. The use of the Johansen cointegration test suggested that domestic savings and foreign aid have a long-run relation to gross savings. The study results indicate that domestic savings have a positive effect on gross savings in Bangladesh and the Philippines, whereas, in India, there is an insignificant negative effect. The policy should prioritize introducing money transfers in order to encourage savings and investment for economic growth.

In the study conducted by Reddy and Ramaiah (2020), they examined the relationship and effect of gross capital formation towards GDP growth for four years, which are 1970 to 1971 and 2018 to 2019, which are two different timeframes. Analyzing if there are unit roots shows that gross domestic savings were integrated at first difference. Also, concerning that, gross savings are not considered to be a significant variable in explaining the GDP growth in India. The authors have emphasized that the possibility of recommending a Monetary-Fiscal Policy mix formulation must be done in the upcoming years to address the issue of the economic downturn of the country.

Sellami, Bentafat, and Rahmane (2020) have utilized the Autoregressive Distributed Lag (ARDL) model in order to measure if the domestic savings had an impact towards the economic growth in Algeria from 1980-2018. In that case, it shows that there is a long-run equilibrium relationship, meaning if the rate of savings increases, the policies should be directed in aiming for a higher rate of investment so as to achieve a higher economic growth rate as well.

Ribaj and Mexhuani (2021) have examined the case of Kosovo when it comes to the economic transformation that happened in the last 17 years, as mentioned in their study. Although this study has focused on Southeast Europe, Kosovo has been considered to have good economic growth for five years. A higher rate of savings seems to be one of the determinants that cause the growth of an economy to be fast, unlike having lower rates which will definitely lead to lower economic growth as well. Increasing savings in a country is a sign of achieving higher GDP growth; that is why the authors have expounded that the developing countries which save more could lead them to consume less, which could result in larger capital and investment.

In understanding the economic dynamics, it is vital to consider the relationship between savings and income. Rahman and Pabon (2021) have analyzed the gross savings and GDP of Bangladesh, which implies that the mentioned country is similar to the Philippines, which has a low savings rate. For instance, gross national savings seems to increase investment rather than gross domestic savings. In the short-run period, the causality between savings and economic growth resulted in a unidirectional relationship, which is economic growth to savings. On the other hand, in the long-run period, the causality in either direction shows to have no evidence at all in employing the tests. This simply means that the relationship between savings and economic growth in Bangladesh from 1980 to 2018 is not consistent with the neoclassical growth theory and endogenous growth theory. Previously, Aslam (2017) concluded that consumption expenditure induces economic growth, but Rahman and Pabon (2021) had a different direction, wherein economic growth has induced savings.

Eshetu (2021) states that in developing countries, savings and investment are considered to be considered indicators of promoting economic growth. However, as the study is focused on Ethiopia, which is located in Africa faces several challenges in terms of investment. In the time series of 1981 to 2019, the study resulted in a long-run cointegration existence in employing the ARDL bound test. On the one hand, given that Ethiopia is a developing country that suffers from increasing investment, the causality test indicates that there is a positive and significant causality relationship.

Economic growth is a necessary component of economic development. Chakraborty and Abraham (2021) gross savings explained a significant portion of total financial inclusion, which explained a significant portion of GDP per capita growth. Ownership of a financial institution improved gross savings positively, whereas ownership of a savings account increased GDP per capita in upcoming sections. Responsibility of a verifying account distinguished countries with the highest 5% of gross savings, whereas ownership of a debit card distinguished countries with the highest GDP per capita growth.

### *2.1.3 The Relationship between GDP Growth and Gross Capital Formation*

This section discusses a variety of literature and studies on GDP growth, particularly the relationship between GDP growth and gross capital formation, In which previous research and data that was collected and used in the study.

The relationship between GDP growth and gross capital formation has a huge impact in affecting the growth of the economy. It serves that the indicators are used to examine whether the variables have a positive impact in developing countries. The literature on Gross capital formation state that there is a bidirectional relationship between GDP and gross capital formation.

#### *2.1.3.1 Country-Specific Studies*

The contribution of capital formation is considered to be one of the determinants to be examined for the growth of an economy. Onyinye, Idenyi, and Ifeyinwa (2017) studied that capital formation in Nigeria definitely determines the growth of an economy. However, in testing and analyzing the data gathered by the authors, utilizing several tests, it implies that the Harrod-Domar model is not applicable in Nigeria since it shows in the results that there is an insignificant relationship between capital formation and GDP growth.

Fetai et al. (2017) have studied several determinants affecting the GDP growth in the Western Balkans; however, focusing only on gross capital formation shows that in their study, a negative correlation has been detected. This simply means that whenever the government increases expenditure, a negative impact towards the growth of an economy is observed.

Meyer and Sanusi (2019) state that, according to theory, gross capital formation is recognized as a necessary component for economic growth. The empirical data outcomes discovered a positive relationship between gross fixed capital formation and economic growth in both the short and long run and as evidence that the relationship between gross capital formation and economic growth is bidirectional. In this study, the Harrod-Domar model is relevant in which gross capital formation and GDP growth have a positive impact on each other.

Masengesho and Ntamwiza (2022) state that gross capital formation has a big role in economic growth. It is one of the important determinants in developing the economic growth of the society. From 1990 to 2017, the study looked at the factors that influenced Rwanda's economic growth. Long-run results show that capital formation and foreign direct investment have a positive and significant impact on aggregate income. Moreover, the long-run and short-run models revealed that capital formation, foreign direct investment, inflation rate, and exchange rate all have a significant short-run and long-run impact on GDP growth.

Gross Capital formation, in the long run, affects the GDP growth in the Economy. In the study of Dahal and Luitel (2021), In Nepal, gross capital formation and savings are one of the biggest impacts in increasing the GDP growth of the country in terms of the long run. Moreover, in the short run, the Gross capital formation and gross national savings damage the GDP growth in the economy.

Gross Capital Formation is considered to improve employment and the GDP growth of the Society. In the study of Pasara and Garidzirai (2020), gross capital formation has a positive impact on unemployment and GDP growth in South Africa. As a result, the study suggests that the government in South Africa implements fiscal policy to boost the economy, investment, and labor in society. The government must invest more in capital goods in order to create jobs and improve the economy.

Capital goods are one of the main tools in driving economic activity, which funds a significant portion of the total final demand for goods and services, together with relationships between financial revenue and embodied properties. In the study of Wood and Hertwich (2017), gross capital formation has an effect associated with a global scale, and it is used as a tool in measuring development. In the research of Pasara and Gadzirai (2020), Gross capital formation analytically supports that there is a long run relationship in the GDP economic growth in Indonesia. Additionally, the gross capital formation between unemployment has a positive and significant relationship together. The result of the study is that the gathered data among 124 countries shows a unidirectional causality between gross capital formation and GDP growth in different countries.

Gross capital formation has a huge impact on economic growth. It plays an important role in supporting the economic growth in ASEAN countries, according to the research of Sriyana and Afandi (2020). Singapore studies it implies that these economies' capital structure should be encouraged. Similarly, human capital, as measured by the life expectancy rate, influences economic growth. It concludes that the findings of the study are consistent with neoclassical theory, which states that market factors such as investment, human capital, and international trade dictate the rate of economic growth.

According to the study of Ay & Kursunel & Baoua (2017), there is a two-way connection between GDP growth and capital formation. In a similar situation, there is a connection between capital formation and trade openness. According to the study, African countries should boost their Marketing of investment in order to enhance capital formation and trade openness and thus encourage economic growth. Moreover, A tax increase may entice capital formation to avoid it in order to serve the community market. Elements placed in these scenarios perform poorly or lose competitiveness.

#### *2.1.3.2 Local Studies*

The study of Urrutia and Tampis (2017) discussed that in the Philippines, during the fourth year of 1999, the decrease in gross capital formation was documented due to the decrease in foreign direct investment. As recorded, the highest capital formation was in the year 2015. Gross capital formation found variable is important for analysts in the GDP growth of the Philippines. Develop a mathematical model for predicting GDP in the Philippines and identify some factors of capital formation that are one of the indicators in applying the factors that can explain GDP at a 93 percent level and have significant factors in the GDP growth of the society**.**

### *2.2 Synthesis of Literature*

Gross Domestic Product plays a vital role in the economy, which is influenced or individually influenced by other factors in the economy, such as the mentioned independent variables of the study, including gross savings and gross capital formation. With the gathered review of related literature, here are the research gaps and synthesis among the authors of several research studies

and literature. Several research literature and studies showed how each independent variable, namely, gross savings and gross capital formation, individually affects and has a relationship with GDP growth. Most of the studies collected and reviewed were from other countries—moreover, research literature and studies in the Philippines lack, which could probably be more helpful in analyzing how the indicators and economic growth model are applicable in the country.

Regarding the related literature and studies of the relationship between GDP growth and gross savings, there have been many different results and implications. Gross savings are also considered a vital driving force of GDP growth. Savings are more consistent in most advanced or developed economies, which could increase investment and boost GDP growth over time. Also, gross savings is more lenient in affecting long-term economic growth. However, some studies imply to be insignificant in explaining the variability of the GDP growth; most of these cases are mainly observed in developing countries with difficulties in increasing the level of savings due to economic problems and issues such as corruption and poverty. Thus, this shows to have different results from each of the countries mentioned in the related literature and studies. Studies show that gross capital formation serves a significant role in determining the GDP growth of a country, mainly in funding the demand for goods and services of the economy. However, gross capital formation only sometimes shows a significant relationship with GDP growth, as it damages the growth of an economy in the short run.

### *2.3 Theoretical Framework*

This section contains relevant economic theories that deal with the variables of economic growth and have significant contributions to the conceptual and econometric models developed for the study.

#### *2.3.1 The Theory of the Harrod-Domar economic growth model*

The Harrod-Domar growth model was independently Formulated by Roy F. Harrod in 1939 and Evsey Domar in 1946, despite the fact that a similar model had been proposed by Gustav Cassel in 1924. According to Onyinye, N. & et al. (2017) states that the basic model assumes that the economy is closed, that there is no government, that there is no depreciation of existing capital, that all investment is a net investment, and that all investment (I) comes from savings (S). The theory describes the economic method by which increased investment leads to increased growth. To develop and grow, a country must divert some of its resources away from immediate consumption purposes and invest them in capital formation. Saving is the diversion of resources from current consumption. Even as saving is not the only factor that influences growth, the Harrod-Domar model assumes that it is a critical component. Its statement is that all economies have to save a certain percentage of their economic output, even if it is only to substitute worn-out capital goods. According to the model, growth is directly related to saving and indirectly related to the capital output ratio.

The Harrod-Domar Growth Model is based on G (actual growth rate) and Gn (natural growth rate) (Jhingan, 2007). As a result, the growth model is expressed as a series of equations. The actual growth rate is written as G=S, and the warranted growth rate is written as Gw = S. Meanwhile, the natural growth rate is denoted by Gn = S. G, Gw, and Gn denotes the rate of output growth over a given time period, while (S) denotes the saving-to-income ratio. Harrod's theory is investigated through long-run and constant equilibrium growth. The warranted growth rate defines the full capacity growth for economic development, and (Gn) of actual capital must be consistent in the proposition of fixed assets in order to accomplish the welfare optimum.

#### *2.3.2 The Theory of Solow's Growth Model*

The Harrod-Domar growth model is the primary model applied in the research paper. Solow's growth model is a related theory that can be used in accordance with the primary model. Solow's growth model was released as a presentation paper on economic growth in 1956. development under the title "A Contribution to Economic Growth Theory." Solow was victorious. In 1987, he was awarded the Nobel Prize in Economics for his significant contribution to understanding economic expansion. Solow investigates the effects of increased saving and investment. Long-term economic development In the short run, increased savings and investment raise the national income and product growth rate. In contrast, higher growth rates are predicted by the Solow growth model. Saving and investing do not affect the economic growth rate in the long run.

### 2.4 Conceptual Framework

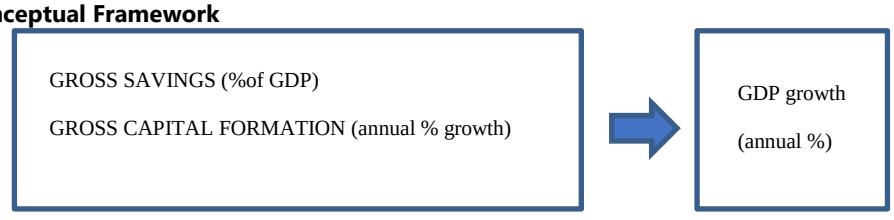

Figure 2. The Effects of Gross Savings and Gross Capital Formation on the GDP Growth in the Philippines

The paradigm above shows the Criterion-Predictor (CP) model to illustrate the relationship and changes in the GDP growth determined by the gross savings and gross capital formation in the Philippines during the time period of 1981-2021. The model above will help in assessing the impact and relationships of the independent variables towards the dependent variable that will be used in the study.

### *2.5 Definition of Terms*

In order for the readers to fully understand the study, the researchers have allocated the definition of terms based on their use throughout the whole study.

● **Capital –** Capital is defined as cash or liquid assets held or obtained for the purpose of spending. In a general context, the term can refer to all of the monetary assets of the country, such as its equipment, real estate, and inventory.

● **Economic growth –** defined as an increase in the quantity and quality of the economic goods and services produced by a society.

● **GDP growth rate -** GDP Growth Rate determines the change in the GDP of the country in comparison to a previous period.

● **Gross Capital Formation -** The total value of a unit or sector gross fixed capital formation and shifts in inventories is used to calculate gross capital formation.

## 3. Methodology

### *3.1.1 Illustration Model*

In order to illustrate and estimate the relationship between the dependent variable and independent variables, this research study adopts the multivariate Ordinary Least Squares (OLS) regression which is presented below:

$$Y = \alpha + \beta 1\ X1 + \beta 2\ X2 + \beta n\ Xn + \varepsilon$$

The econometric model shown below describes how the GDP growth is affected by the independent variables, namely, gross savings and gross capital formation; the econometric model was utilized and specified below:

$$GDP = \beta 0 + \beta 1\ GSV + \beta 2\ GCF + \varepsilon$$

Whereas:
***GDP*** = GDP growth rate
***GSV*** = gross savings
***GCF*** = gross capital formation
***ε*** = error term

### *3.1.2 A-Priori Expectations*

*Table 1. A-Priori Expectations of the Variables*

| **Independent Variables** | **Assumption** | **Expected Sign** |
|---|---|---|
| Gross savings | As the gross savings increase, the GDP growth also increases, and vice versa. | **(+)** |
| Gross capital formation | As the gross capital formation increases, the GDP growth also increases, and vice versa. | **(+)** |

The table above shows the assumptions of each of the independent variables, namely, gross savings and gross capital formation, towards the dependent variable, namely GDP growth.

### *3.2 Research Design*

The study intended to examine the relationship between the different determinants of GDP growth. For instance, a quantitative-correlational research design approach was utilized. This will enable the researchers to assess the relationship between the

dependent variable, which is GDP growth, and the following independent variable - which are gross savings and gross capital formation.

In accordance with Bhandari (2022), a correlational research design is primarily used to investigate how the variables turn out to have a relationship without having any control or manipulation made by the researchers. Additionally, this is designed to test and investigate the association and changes of the variables towards each other.

### *3.3 Research Procedure*

The researchers collected and used annual data, namely, GDP growth, gross savings, and gross capital formation, since time-series analysis was utilized. The time-series data collected from the World Bank World Development Indicators database (WDI) are only limited to a total of 41 years of observations from 1981-2021 since one of the independent variables shows to be limited in the number of data available.

### *3.4 Data Sources and Instruments*

This section shows the list of variables and their sources, and in conducting the required tests for this study, the researchers used EViews 12 (Student Version) software; the following tests were utilized are the following:

#### *3.4.1 Variable List*

*Table 2. Variable List and its description, units, and sources*

| Variables | Description | Units | Sources |
|---|---|---|---|
| Dependent Variable | | | |
| **GDP_growth** | GDP growth | Percentage | (The World Bank, 2022) |
| Independent Variable | | | |
| **GSV** | Gross Savings | Percentage to GDP | (The World Bank, 2022) |
| **GCF** | Gross capital formation | Percentage | (The World Bank, 2022) |

The table above shows all the lists of variables collected from the World Bank World Development Indicators database (WDI) in 2022. All of the dependent and independent variables are measured in percentage.

#### *3.4.2 Statistical Tool*

The researchers used Microsoft Excel to illustrate the figures and trendline and EViews 12 (Student Version) software as a statistical tool for testing and analyzing all the statistical tests required in determining the relationship between GDP growth, gross savings, and gross capital formation.

#### 3.4.3 Statistical Test

The following tests that were used to analyze the study are the following:

##### *3.4.3.1 Augmented Dickey-Fuller Test (ADF)t*

$\Delta Yt=\alpha+\beta t+\gamma Yt-1+\delta 1\Delta Yt-1+\delta 2\Delta Yt-2+\ldots$

Whereas:

$\alpha$ = constant

$\beta$ = coefficient

Yt = data

**t** = time

Employing the unit root tests, the researchers analyzed and tested the results if there were stationary or nonstationary in the time series. If no trend is detected in the time series, this leads to a stationary series. It is essential to determine this kind of test before proceeding to other tests; for some reason that if the unit root test appears to be nonstationary, there is a possibility that the regression results will be spurious. The Augmented Dickey-Fuller test was chosen to analyze both level and first difference in conducting the unit-root test. Given that the null hypothesis has a unit root and implies nonstationary, the decision rule is to reject the null hypothesis if the p-values are less than the significant level, which is 5%; otherwise, it is not rejected.
Ho: There is a unit root (series is non-stationary)
H1: There is no unit root (series is stationary)

***3.4.3.2 Test for Regression Output***

$$R^2 = 1 - \frac{RSS}{TSS} = 1 - \frac{\sum e_i^2}{\sum (Y_i - \underline{Y})^2}$$

This study aims to determine if the independent variables have a relationship with the dependent variable. An Ordinary Least Squares (OLS) regression will be used to test this. First, the R-Squared should be greater than 0.75 or 75% to state that at a certain percentage, this shows that the independent variables well explain the variability in the dependent variable. Also, the Adjusted R-Squared should be lower than the R-Squared value. Apart from that, the p-values of the beta coefficients or the intercepts of the independent variables should be less than 0.05 or 5% to be considered statistically significant to tell if there is a direct relationship between the dependent variable and each independent variable.

This study sought to determine if the independent variables have a relationship with the dependent variable. An Ordinary Least Squares (OLS) multiple regression was used to test this. First, the R-Squared shows the Goodness of Fit of the model and shows that the independent variables are well explained by the variability in the dependent variable. Also, the Adjusted R-Squared should be lower than the R-Squared value. Apart from that, the p-values of the beta coefficients or the intercepts of the independent variables should be less than 0.05 or 5% to be considered statistically significant to tell if there is a direct relationship between the dependent variable and each independent variable.

On the one hand, T-statistics was used to test each variable to determine if its regression coefficient shows to be significantly different from the value of zero and if it showed a significant impact on the dependent variable. For the t-statistics or t-ratio, its value should exceed the t-tabulated at a 5% level of significance to reject the null hypothesis that there is no difference between means. For the F-statistic, in examining the importance of the model, the researchers will reject the null hypothesis if the value for the F-statistic exceeds the F-tabulated value to show a significant relationship. In short, to reject the null hypothesis of the R-Squared, which is not equal to zero, the value of the F-statistic should be less than the level of significance.

***3.4.3.3 Test for Multicollinearity***

$$\textbf{VIF=} \frac{1}{1-R^2}$$

One of the Classical Linear Regression Model (CLRM) assumptions is to assess that there is no multicollinearity among the independent variables. The econometric model is considered to be biased whenever there is multicollinearity or an exact linear relationship among all or some of the independent variables. The researchers employed the Variance Inflation Factor (VIF) to test whether the study model has multicollinearity. In connection with that, the results for the Centered VIF value should not exceed 10 to interpret that there is no multicollinearity detected in the model. However, if that exceeds a particular independent variable, this occurs to have a linearly biased model. With that said, dropping, transforming, or remedying should be done for that variable from the model. As mentioned, the VIF should not exceed 10 in order not to reject the null hypothesis, which has no multicollinearity.
Ho: There is multicollinearity detected.
H1: There is no multicollinearity detected.

***3.4.3.4 Test for Serial Correlation***

One of the tests in figuring out whether there is a serial correlation in the model is assessing the Breusch-Godfrey Serial Correlation LM test. If the probability does not exceed the 5% level of significance, the null hypothesis fails to be rejected.

Ho: There is no autocorrelation detected.
H1: There is autocorrelation detected.

#### *3.4.3.5 Test for Normality of the Residual*

The assumptions that are regularly distributed are known as residual normality. The null hypothesis states that the residuals are normally distributed, which is in contrast to their alternative hypothesis, which states that the residuals are not normally distributed. If the test p-value is less than the preset significance level, it may reject the null hypothesis and infer that the residuals are not from a normal distribution. If the p-value is greater than the predefined significance level, the null hypothesis cannot be rejected.

#### *3.4.3.6 Heteroscedasticity Test*

Heteroscedasticity happens when the residuals or the error terms are calculated from an inconstant variance distribution, which also contradicts one of the classical Linear Regression Model assumptions. To see if the residuals of the model have changed the Breusch-Pagan-Godfrey Test, the test was used to see if a regression model has any heteroscedasticity. The probability of the product of observations and r-squared in the auxiliary regression. When the regressors of p-values are higher than the level of significance

H0: Homoscedasticity exists.
H1: Homoscedasticity does not exist.

#### *3.4.3.7 Specification Test*

Comparison of two different estimators is a means of constructing misspecification tests that will apply to the number of conditions in the previous data. The test that was used was the Ramsey RESET Test which is based on the concepts in running the regression. In the given equation, the forecast y value is controlled between 0 and 1 before the rules are calculated. The coefficients on all powers of the anticipated Y should be jointly insignificant if the regression is properly defined.

#### *3.4.3.8 Cointegration Test*

The Johansen Cointegration test was used to test the validity of there are cointegrating long-run relationships in the study and model. The decision was to reject the null hypothesis of having no cointegration if there is no long-run relationship detected between the variables whenever the p-value is less than the 5% level of significance. An estimation of the Vector Autoregressive Model (VAR) has also been utilized, whereas the variables were stationary at first difference.

H0: There is no cointegration.
H1: There is cointegration.

## 4. Results and Discussions

This chapter presents the results and discusses the relationship between GDP growth as the dependent variable and gross savings and gross capital formation as the independent variables. The results show the interpreted data to fully understand and acquire the methods mentioned in the previous chapter.

### *4.1.1 Trends of the Variables*

The figures below show and illustrate the trendline of each variable from 1981 to 2021:

#### *4.1.1.1 Trendline of GDP Growth*

Figure 3: **GDP growth rate**

As shown in Figure 3 above, the GDP growth of the Philippines from 1981 to 2021 shows a fluctuating trend. Moreover, the movement from 1983 to 1985 declined because the inflation rate had increased, leading to economic collapse. In 1990-1991, it is evident that the trendline decreased immensely due to the Gulf War crisis, which also led to an oil price shock. In 2020, the COVID-19 pandemic started to cause economic collapse severely.

### *4.1.1. Trendline of Gross Savings*

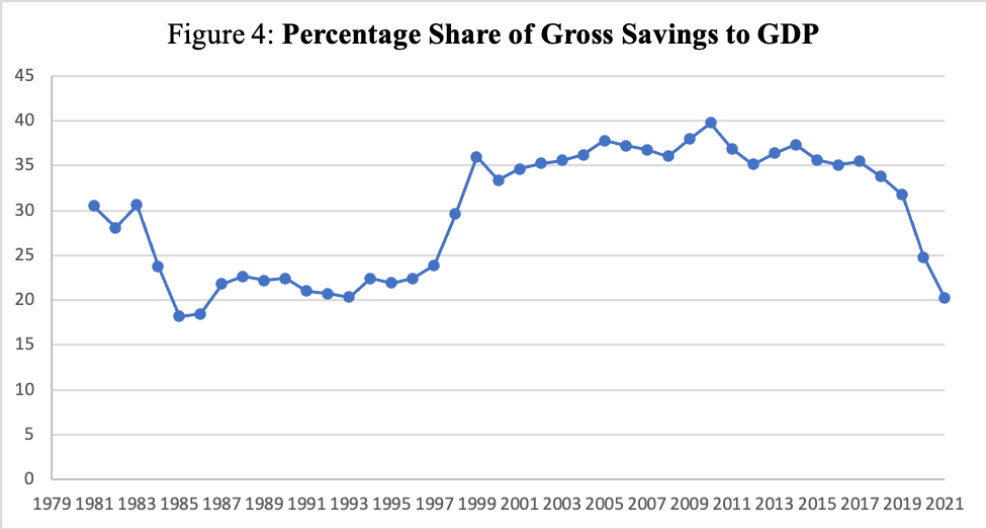


Figure 4 above illustrates the trendline for the gross savings from 1981 to 2021. It is evident that in the same year, from 1983 to 1985, there was a slight decrease in the data, which is considered to be a serious matter since savings is important as well as it is equivalent to investments, whereas investment is also considered to be one of the major driving forces of economic growth. Also, in 2020, a continuous decrease in the trend has been observed from the figure above, in which during the COVID-19 pandemic, savings and funds have been one of the problems in order for the economy to survive. Many funds should be allocated in many areas to help sustain the economy.

### *4.1.1.3 Trendline of Gross capital formation*

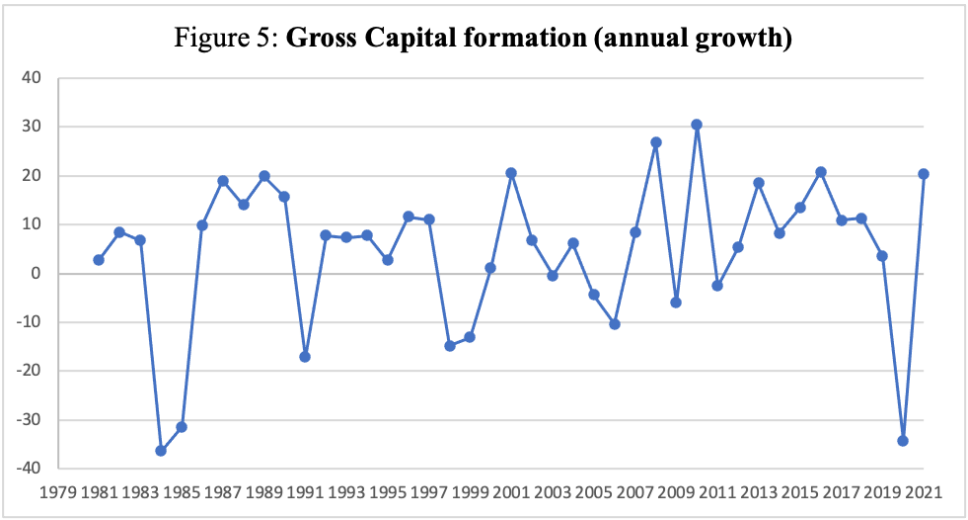


Figure 5 above, which shows quite similar to the trendline of the GDP growth, also shows to be fluctuating. There is no trend that can be seen clearly. Although the trend of the variables varies from each year, gross capital formation shows to have lower data each year. While 1984 has the lowest percentage for the 41 years gathered, Martial law has been considered to affect the lowest Gross Capital formation over the 41 years gathered. Moreover, in 2020 COVID-19 is a reason for the decline of the Gross Capital Formation in the Philippines.

### *4.1.2 Descriptive Statistics*

The table shown in Appendix B is the descriptive statistics of GDP growth, gross savings, and gross capital formation during the annual time-series from 1981 to 2021. GDP growth, gross savings, and gross capital formation are all negatively skewed to the left since all of the values of the mean are less than the value of the median.

### *4.1.3 Augmented Dickey-Fuller (ADF) Test*

*Table 3. Augmented Dickey-Fuller (ADF) Test Results*

| Variables | Trend and Intercept, At Level | Trend and Intercept, At First Difference |
|---|---|---|
| **GDP_growth** | 0.0015 | - |
| **GSV** | 0.9521 | 0.0084 |
| **GCF** | 0.0015 | - |

The results of the Augmented Dickey-Fuller test are shown in the summary table above. The variables were conducted using the ADF test to determine whether the data was stationary or nonstationary. The researchers used the Augmented Dickey-Fuller test to analyze the level and proceed to the first difference in conducting the unit-root test if the probability is not less than the 5% level of significance. At the level with trend and intercept, GDP growth and gross capital formation are both stationary, indicating less than a 5% level of significance, which rejects the null hypothesis that there is a unit root. On the one hand, only gross savings are stationary at first difference with trend and intercept.

### *4.1.4 Regression Results*

This section shows the regression output and analysis of the following:

#### *4.1.4.1 Regression Output*

*Table 4: Regression Output Results*

| Variables | Coefficient |
|---|---|
| **Intercept** | 2.866195 |
| **d_GSV** | 0.253224 |
| **GCF** | 0.190300 |

With regard to the results shown in (table), the empirical model as presented in Chapter 3 is:

$$GDP = \beta 0 + \beta 1\ d\_GSV + \beta 2\ GCF + \varepsilon$$

As mentioned beforehand, this study sought to determine the relationship between GDP growth as the dependent variable and gross savings and gross capital formation as the independent variables. Having said that, setting other variables constant, as shown that the intercept is 2.866195, shows an increase of 2.866195 in GDP growth. To add, there will be an impact of an increase of 0.253224 in GDP growth if there is a one-unit increase in gross savings. While for the gross capital formation, it shows that there will be an increase of 0.190300 in GDP growth if there is a one unit increase in gross capital formation.

#### *4.1.4.2 Coefficient of Determination*

*Table 5: Coefficient of Determination Results (R-squared and Adjusted R-squared)*

| | |
|---|---|
| **R-squared** | 0.669880 |
| **Adjusted R-squared** | 0.652036 |

Given that the R-Squared is 0.669880, this means that 66.99% of the variability in the dependent variable is well explained by the independent variable. Also, the Adjusted R-Squared is 0.652036 or 65.20%, which is lower than the R-Squared, which also means that upon having some adjustments when it comes to the degrees of freedom, the variability in gross savings, and gross capital formation, can explain 65.20% of the variability in GDP growth. This means that the overall model implies to be robust.

#### *4.1.4.3 Individual Significance of Parameters (t-test)*

*Table 6: T-test Results*

| **Variables** | **t-Statistic** | **Probability** |
|---|---|---|
| **d_GSV** | 1.765223 | 0.0858 |
| **GCF** | 7.279345 | 0.0000 |

a. The t-Statistic value for the gross savings is 1.765223, which is lower than 2.024, and the probability is 0.0012, which is less than the 5% level of significance. Thus, gross savings is significantly different from zero.
b. The t-Statistic value for the gross capital formation is 7.279345, which is greater than 2.024, and the probability is 0.0000, which is less than the 5% level of significance. Thus, gross capital formation e is significantly different from zero.

Since the p-values of all the independent variables are less than the 5% level of significance except for the GSV or the gross savings, this is supported by the related studies authored by Misztal (2017), whereas the study and relationship between savings and economic growth are mostly observed and consistent with those advanced economies. Given that the scope of this study is the Philippines, which is considered to be a developing country, this is a result of having insignificant variability in explaining the GDP growth from 1981 to 2021.

#### *4.1.4.4 Overall Significance of the Model*

*Table 7. F-test Results*

| | |
|---|---|
| **F-statistic** | 37.54030 |
| **Probability** | 0.000000 |

The F-Statistic value is 37.54030, which is greater than 2.85, and the probability is 0.0000, which is less than the 5% level of significance. Thus, the R-squared is significantly different from zero.

### *4.1.5 Multicollinearity Test*

*Table 8. Multicollinearity Test Results*

| Variable | Centered VIF |
|---|---|
| **d_GSV** | 1.148820 |
| **GCF** | 1.148820 |

In assessing one of the assumptions that there is no multicollinearity, the Variance Inflation Factors or VIF test for multicollinearity has been utilized, and the results are shown above. It shows that for all variables, the centered VIF are as follows: the gross savings is 1.148820, and the gross capital formation is 1.148820, which are all below the standard value of 10. This implies that there is no multicollinearity detected in the model. Thus, the null hypothesis of having multicollinearity is rejected.

### *4.1.6 Serial Correlation*

*Table 9. Serial Correlation Results*

| Number of Lags | Probability Chi-Square |
|---|---|
| **2 Lags** | **0.3262** |

The Breusch-Godfrey Serial Correlation LM Test was used; the Probability Chi-Square is greater than 0.05, which means that autocorrelation is not present and detected, which means there is not enough evidence to reject the null hypothesis of having no autocorrelation up to 2 lags.

### 4.1.7 *Normality of the Residual*

The figure shown in Appendix H is the histogram of residuals in which it follows the normal distribution. As presented in the figure, the residuals show to be normally distributed.

### *4.1.8 Heteroscedasticity Test*

*Table 10. Heteroscedasticity Test Results*

| | |
|---|---|
| **Obs*R-squared** | 1.795333 |
| **Prob. Chi-Square** | 0.4075 |

The Breusch-Pagan-Godfrey test was used to determine whether or not the model has any heteroskedasticity. The table above shows that the probability chi-square is 0.4075. The null hypothesis indicates that the data are homoscedastic or have the same dispersion or range. The null hypothesis of no heteroscedasticity is accepted when the p-value is more significant than 0.05. A p-value of less than 0.05, on the other hand, indicates heteroscedastic data. Thus, the null hypothesis that homoscedasticity exists was rejected.

### *4.1.9 Specification*

*Table 11. Specification Test Results*

| | |
|---|---|
| **F-statistic** | 23.34834 |
| **Probability** | 0.0000 |

The Ramsey RESET test was used to find out if the test was correctly specified. In analyzing the test, the probability shown above is 0.0000, which is lower than the significance level of greater than 5%. Thus, the null hypothesis of having no specification errors failed to be rejected.

### *4.1.10 Cointegration*

The results are shown in Appendix J; the decision rule was to reject the null hypothesis of no cointegration if the p-value is less than the 5% level of significance. Upon the estimation, the Vector Autoregressive Model (VAR) was utilized, whereas the variables were stationary at first difference. As shown in the results in Appendix J, the p-values are all greater than the 5% level of significance, which are all insignificant. With regard to the first lagged period of the gross savings, which is the C(3), it has a positive influence on the GDP growth; however, the two lagged periods show a negative influence on the GDP growth, which is also lower than the previous. With that said, when it comes to the short term, increasing gross savings can increase GDP growth. However, using all variables in the 1st difference, the results for cointegration show that at most 1 and 2, the p-value is less than the 5% level of significance, which means that there is cointegration detected. Thus, there is a long-run relationship between GDP growth, gross savings, and gross capital formation in testing the data from 1981 to 2021.

## 5 Summary, Conclusions and Recommendation

### *5.1 Summary*

The research study mainly focuses on the significant relationship between GDP growth and gross savings, and gross capital formation. And what possible changes have occurred among the variables from 1981 to 2021 in the Philippines. In addition to that, there is a long-run relationship between the dependent and independent variables. Also, the paper focuses on whether there is a significant relationship between the dependent variable and the two independent variables. Implicating time series data which consists of 41 years, it shows that through employing the multiple Ordinary Least Squares (OLS) regression, the dependent variable is the annual GDP growth, and the independent variables are the annual gross savings and annual gross capital formation. In order to identify and determine if each of the independent variables has a significant relationship, the p-values and the R-squared were used, respectively. Furthermore, to assess if the model contained biases and failed to follow the assumptions, several tests have been conducted, which include the test for multicollinearity (Variance Inflation Factor), test for heteroscedasticity (Breusch-Pagan-Godfrey test), test for serial correlation (Breusch-Godfrey test), test for the normality (Histogram of Residuals), the test for misspecification (RESET specification test), and cointegration (Johansen Cointegration test).

Furthermore, based on the results, there are no adjustments and treatments on the first regression results, the gross capital formation is significant, but the gross savings showed to be insignificant in explaining the variability of GDP growth. A possible explanation for this is that savings are not enough, for the reason that the government lacks policy in terms of saving for individuals that can help the growth of the economy.

### 5.2 *Conclusion*

After the statistical tests and measurements have been done and shown from Chapter 4, it shows that there are results which violate the assumptions of the CLRM. Therefore, it would be better if the researchers would continue analyzing the raw results of the data and variables.

- Trendline shows the following changes in the 3 variables during the years 1981 - 2021. The independent variables, which are gross savings and gross capital formation, depicted a constant increase from the year 1981-2019, while the dependent variable, which is the GDP growth, shows fluctuations along the trendline. On the other hand, variables under 2020-2021, with the current pandemic, have affected the Philippine economy drastically.
- After analyzing the results of the Johansen Cointegration Test, it seems that Based on the results of the Johansen Cointegration test, the results were higher than the expected level of significance. Thus, there is a long-run relationship between the dependent variable, namely GDP growth, and the independent variables, namely gross savings and gross capital formation.

- The researchers found that gross capital formation has a significant relationship with GDP growth, which also justifies the related studies and literature mentioned in Chapter 2. On the one hand, gross savings shows to be insignificant. This result goes in line with the findings of Ribaj, A. and Mexhuani, F. (2021), where they have mentioned that a higher rate of savings seems to be one of the determinants that cause the growth of an economy to be fast, unlike having lower rates which will definitely lead them to lower economic growth as well. Increasing the savings of a country is a sign of achieving higher GDP growth. The same goes for gross savings, where the results from the regression are insignificant.

After analyzing the results of the Ordinary Least Squares, the R-squared is 66.99%, and the p-value of the gross savings shows to be insignificant, implying a value greater than the 5% level of significance, while the gross capital formation shows to be significant. With that said, upon analyzing the results, this shows that the Harrod-Domar model is not applicable in the Philippine setting. As savings is one of the components of the model, it tells that an increase in savings will lead to an increase in the GDP growth of the country. However, given that situation and findings, it is best to come up with more policy recommendations since it has been mentioned from one of the related studies that despite having a negative and insignificant impact and results, still, it shows to have a lower rate. Comparing the Philippines and Nigeria, which are both developing countries, it shows that the study shows to have positive and significant related parameters; however, compared to Nigeria, based on the related studies, it shows having a negative impact and insignificant relationship. Moreover, the Harrod-Domar model today is not relevant in the Philippine setting since the Philippines is considered a developing country. Also, a possible reason why the gross savings is insignificant is that given that there is limited literature and studies primarily focused on the Harrod-Domar model in terms of assessing the growth of an economy. According to the study by Akter (2018) that in long-term economic growth, savings are viewed as the major factor that can affect the growth of society. Also, one of the main reasons why the model is not applicable in the Philippines is due to the criticisms of the Harrod-Domar model, whereas developing countries seem to strive in terms of increasing savings due to several factors. Poverty is one of the great impacts on why there is difficulty in influencing savings.

### *5.3 Recommendation*

Based on the findings of this empirical study, the following recommendations are made:

• The researchers recommend implementing policies that are very accurate and will be helpful to the economy. Also, to achieve a positive relationship between GDP growth and variables in the economy from the study result since it has a positive relationship with each variable. In connection with this, developing policies that will generate increasing savings would also be better.

- Since the trendline of gross savings and GDP growth are consistent, the researchers recommend that it is better for the Philippine economy to continue saving to achieve the positive and significant parameters for the given variables. Moreover, according to the studies of Ribaj, A. and Mexhuani, F. (2021), a higher rate of savings seems to be one of the determinants that cause the growth of an economy to be fast, unlike having lower rates which will definitely lead them to lower economic growth as well. Increasing savings in a country is a sign of achieving higher GDP growth; that is why the authors have expounded that the developing countries which save more could lead them to consume less, which could result in larger capital and investment.
- The researchers recommend that future studies develop through additional time-series data, especially the post-COVID-19 pandemic, that will show how the indicators affect the GDP growth during its recovery state. Also, this could imply more analysis of the trends and events in the country. Aside from utilizing a quantitative-correlational study, future researchers could also use a comparative analysis of the Philippines and its neighboring developing countries as an additional option to see their similarities and differences in utilizing the model.

Some of the limitations of this study are as follows: (i) the study used limited time-series data; (ii) a quantitative-correlational study has been utilized. Therefore, the researchers recommend additional time-series data that are beyond the scope of this study and as well as the data during the post-COVID-19 pandemic. Also, this could imply more analysis of the trends and events in the country. Aside from utilizing a quantitative-correlational study, future researchers could also use a comparative analysis of the Philippines and its neighboring developing countries as an additional option to see their similarities and differences in utilizing the model.

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## Appendices

**APPENDIX A. Raw Data**

| YEAR | GDP_growth | GSV | GCF |
|---|---|---|---|
| | | | |
| 1981 | 3.422208738 | 30.4943387 | 2.83229134 |
| 1982 | 3.698406099 | 28.0903166 | 8.46324407 |
| 1983 | 1.89695179 | 30.6211581 | 6.7367772 |
| 1984 | -7.039378201 | 23.7699693 | -36.377954 |
| 1985 | -6.858377209 | 18.2089737 | -31.431019 |
| 1986 | 3.51068403 | 18.4915662 | 9.83077442 |
| 1987 | 4.361809673 | 21.808916 | 19.0283233 |
| 1988 | 6.696931105 | 22.6268357 | 14.0045397 |
| 1989 | 6.183918203 | 22.1740522 | 19.9313803 |
| 1990 | 3.082672529 | 22.4397324 | 15.6573422 |
| 1991 | -0.436390081 | 20.994024 | -17.096963 |
| 1992 | 0.417629066 | 20.7100679 | 7.81003667 |
| 1993 | 2.181889986 | 20.3512717 | 7.33560389 |
| 1994 | 4.373665918 | 22.4209087 | 7.81187179 |
| 1995 | 4.625225117 | 21.9351338 | 2.67898506 |
| 1996 | 5.860347872 | 22.4067471 | 11.5924613 |
| 1997 | 5.186411674 | 23.9122354 | 10.9961397 |

| | | | |
|---|---|---|---|
| 1998 | -0.5140906 | 29.6191588 | -14.78289 |
| 1999 | 3.346451184 | 35.967804 | -13.067098 |
| 2000 | 4.382504833 | 33.3916818 | 1.09656271 |
| 2001 | 3.04923151 | 34.6236833 | 20.4953678 |
| 2002 | 3.716255002 | 35.2688501 | 6.70838112 |
| 2003 | 5.086911135 | 35.6099498 | -0.4083065 |
| 2004 | 6.569228512 | 36.229228 | 6.13889243 |
| 2005 | 4.942505119 | 37.7714567 | -4.3377005 |
| 2006 | 5.316416821 | 37.2282071 | -10.315869 |
| 2007 | 6.51929155 | 36.7544242 | 8.33485814 |
| 2008 | 4.344487305 | 36.0222771 | 26.7697151 |
| 2009 | 1.448323063 | 37.9486941 | -5.9984473 |
| 2010 | 7.33449996 | 39.7514978 | 30.4596862 |
| 2011 | 3.858232828 | 36.8750643 | -2.5387846 |
| 2012 | 6.896951711 | 35.1328502 | 5.42636009 |
| 2013 | 6.750531301 | 36.3544043 | 18.4427704 |
| 2014 | 6.347987483 | 37.3474559 | 8.27797802 |
| 2015 | 6.348309717 | 35.6348267 | 13.4076986 |
| 2016 | 7.14945675 | 35.0547783 | 20.7895701 |
| 2017 | 6.930988326 | 35.4886285 | 10.8987572 |
| 2018 | 6.341485572 | 33.8070463 | 11.2823347 |
| 2019 | 6.118525662 | 31.7551896 | 3.49344659 |
| 2020 | -9.518294741 | 24.818174 | -34.224416 |
| 2021 | 5.703155968 | 20.2171223 | 20.2961522 |

**APPENDIX B. Descriptive Statistics**

| | GDP_GRO... | GSV | GCF |
|---|---|---|---|
| Mean | 3.649609 | 29.75924 | 4.547533 |
| Median | 4.382505 | 31.75519 | 7.810037 |
| Maximum | 7.334500 | 39.75150 | 30.45969 |
| Minimum | -9.518295 | 18.20897 | -36.37795 |
| Std. Dev. | 3.845859 | 6.972759 | 15.23387 |
| Skewness | -1.986334 | -0.271190 | -1.055422 |
| Kurtosis | 6.702455 | 1.427540 | 3.965081 |
| Jarque-Bera | 50.37920 | 4.726629 | 9.202866 |
| Probability | 0.000000 | 0.094108 | 0.010037 |
| Sum | 149.6340 | 1220.129 | 186.4489 |
| Sum Sq. Dev. | 591.6252 | 1944.775 | 9282.833 |
| Observations | 41 | 41 | 41 |

**APPENDIX C. Augmented Dickey-Fuller Test**

| Variables | Trend and Intercept, At Level | Trend and Intercept, At First Difference |
|---|---|---|
| **GDP_growth** | 0.0015 | - |
| **GSV** | 0.9521 | 0.0084 |
| **GCF** | 0.0015 | - |

**APPENDIX D. Unadjusted OLS**

Sample: 1981 2021
Included observations: 41

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| GSV | 0.165521 | 0.047095 | 3.514589 | 0.0012 |
| GCF | 0.190300 | 0.021556 | 8.828089 | 0.0000 |
| C | -2.141562 | 1.425816 | -1.501991 | 0.1414 |

| | | | |
|---|---|---|---|
| R-squared | 0.729889 | Mean dependent var | 3.649609 |
| Adjusted R-squared | 0.715673 | S.D. dependent var | 3.845859 |
| S.E. of regression | 2.050703 | Akaike info criterion | 4.344598 |
| Sum squared resid | 159.8045 | Schwarz criterion | 4.469981 |
| Log likelihood | -86.06426 | Hannan-Quinn criter. | 4.390256 |
| F-statistic | 51.34143 | Durbin-Watson stat | 1.768017 |
| Prob(F-statistic) | 0.000000 | | |

## APPENDIX D. Adjusted OLS

Sample (adjusted): 1982 2021
Included observations: 40 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| GSV1 | 0.253224 | 0.143451 | 1.765223 | 0.0858 |
| GCF | 0.186075 | 0.025562 | 7.279345 | 0.0000 |
| C | 2.866195 | 0.387547 | 7.395733 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.669880 | Mean dependent var | 3.655294 |
| Adjusted R-squared | 0.652036 | S.D. dependent var | 3.894678 |
| S.E. of regression | 2.297411 | Akaike info criterion | 4.573481 |
| Sum squared resid | 195.2896 | Schwarz criterion | 4.700147 |
| Log likelihood | -88.46962 | Hannan-Quinn criter. | 4.619279 |
| F-statistic | 37.54030 | Durbin-Watson stat | 1.534298 |
| Prob(F-statistic) | 0.000000 | | |

## APPENDIX E. Multicollinearity Test

Sample: 1981 2021
Included observations: 40

| Variable | Coefficient Variance | Uncentered VIF | Centered VIF |
|---|---|---|---|
| GSV1 | 0.020578 | 1.159115 | 1.148820 |
| GCF | 0.000653 | 1.253166 | 1.148820 |
| C | 0.150193 | 1.138234 | NA |

## APPENDIX F. Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

| | | | |
|---|---|---|---|
| F-statistic | 1.038433 | Prob. F(2,35) | 0.3647 |
| Obs*R-squared | 2.240605 | Prob. Chi-Square(2) | 0.3262 |

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/24/23 Time: 23:34
Sample: 1982 2021
Included observations: 40
Presample missing value lagged residuals set to zero.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| GSV1 | 0.021384 | 0.144157 | 0.148339 | 0.8829 |
| GCF | -0.006391 | 0.025923 | -0.246541 | 0.8067 |
| C | 0.034792 | 0.388170 | 0.089630 | 0.9291 |
| RESID(-1) | 0.236904 | 0.171876 | 1.378347 | 0.1768 |
| RESID(-2) | 0.013638 | 0.178483 | 0.076413 | 0.9395 |

| | | | |
|---|---|---|---|
| R-squared | 0.056015 | Mean dependent var | 6.68E-16 |
| Adjusted R-squared | -0.051869 | S.D. dependent var | 2.237728 |
| S.E. of regression | 2.295028 | Akaike info criterion | 4.615836 |
| Sum squared resid | 184.3504 | Schwarz criterion | 4.826946 |
| Log likelihood | -87.31672 | Hannan-Quinn criter. | 4.692167 |
| F-statistic | 0.519216 | Durbin-Watson stat | 1.997541 |
| Prob(F-statistic) | 0.722123 | | |

## APPENDIX G. Heteroskedasticity Test

Ramsey RESET Test
Equation: UNTITLED
Omitted Variables: Squares of fitted values
Specification: GDP_GROWTH GSV1 GCF C

| | Value | df | Probability |
|---|---|---|---|
| t-statistic | 4.832012 | 36 | 0.0000 |
| F-statistic | 23.34834 | (1, 36) | 0.0000 |
| Likelihood ratio | 19.99621 | 1 | 0.0000 |

F-test summary:

| | Sum of Sq. | df | Mean Squares |
|---|---|---|---|
| Test SSR | 76.82923 | 1 | 76.82923 |
| Restricted SSR | 195.2896 | 37 | 5.278096 |
| Unrestricted SSR | 118.4603 | 36 | 3.290565 |

LR test summary:

| | Value |
|---|---|
| Restricted LogL | -88.46962 |
| Unrestricted LogL | -78.47152 |

Unrestricted Test Equation:
Dependent Variable: GDP_GROWTH
Method: Least Squares
Date: 04/24/23 Time: 23:37
Sample: 1982 2021
Included observations: 40

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| GSV1 | 0.116820 | 0.116731 | 1.000763 | 0.3236 |
| GCF | 0.262318 | 0.025619 | 10.23918 | 0.0000 |
| C | 4.867981 | 0.515034 | 9.451760 | 0.0000 |
| FITTED^2 | -0.102579 | 0.021229 | -4.832012 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.799753 | Mean dependent var | 3.655294 |
| Adjusted R-squared | 0.783066 | S.D. dependent var | 3.894678 |
| S.E. of regression | 1.813991 | Akaike info criterion | 4.123576 |
| Sum squared resid | 118.4603 | Schwarz criterion | 4.292464 |
| Log likelihood | -78.47152 | Hannan-Quinn criter. | 4.184640 |
| F-statistic | 47.92611 | Durbin-Watson stat | 1.318797 |
| Prob(F-statistic) | 0.000000 | | |

**APPENDIX H. Normality of Residual**

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

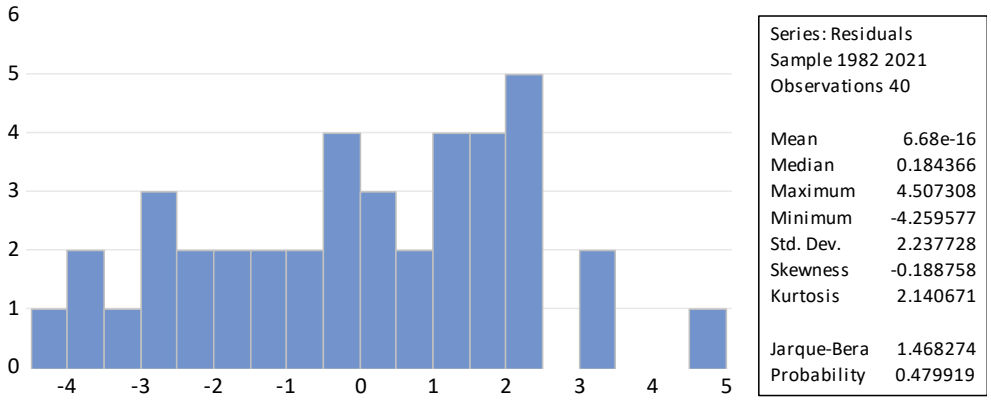
| | | | |
|---|---|---|---|
| F-statistic | 0.869361 | Prob. F(2,37) | 0.4276 |
| Obs*R-squared | 1.795333 | Prob. Chi-Square(2) | 0.4075 |
| Scaled explained SS | 0.876111 | Prob. Chi-Square(2) | 0.6453 |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/24/23 Time: 23:33
Sample: 1982 2021
Included observations: 40

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 5.054356 | 0.893804 | 5.654880 | 0.0000 |
| GSV1 | -0.214019 | 0.330844 | -0.646889 | 0.5217 |
| GCF | -0.049474 | 0.058954 | -0.839193 | 0.4068 |

| | | | |
|---|---|---|---|
| R-squared | 0.044883 | Mean dependent var | 4.882239 |
| Adjusted R-squared | -0.006745 | S.D. dependent var | 5.280767 |
| S.E. of regression | 5.298545 | Akaike info criterion | 6.244780 |
| Sum squared resid | 1038.760 | Schwarz criterion | 6.371446 |
| Log likelihood | -121.8956 | Hannan-Quinn criter. | 6.290579 |
| F-statistic | 0.869361 | Durbin-Watson stat | 2.330113 |
| Prob(F-statistic) | 0.427606 | | |

**APPENDIX I. Ramsey RESET Test**



**APPENDIX J.**

Sample (adjusted): 1984 2021
Included observations: 38 after adjustments
GDP GROWTH = C(1)*GDP GROWTH(-1) + C(2)*GDP GROWTH(-2) + C(3)*GSV1(-1) + C(4)*GSV1(-2) + C(5)*GCF(-1) + C(6)*GCF(-2) + C(7)

| | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C(1) | 0.436270 | 0.335664 | 1.299723 | 0.2033 |
| C(2) | -0.031703 | 0.354215 | -0.089501 | 0.9293 |
| C(3) | 0.065545 | 0.308720 | 0.212313 | 0.8333 |
| C(4) | -0.037087 | 0.321926 | -0.115202 | 0.9090 |
| C(5) | -0.045674 | 0.078983 | -0.578277 | 0.5673 |
| C(6) | -0.006736 | 0.075948 | -0.088690 | 0.9299 |
| C(7) | 2.482930 | 1.362829 | 1.821894 | 0.0781 |

| | | | |
|---|---|---|---|
| R-squared | 0.099028 | Mean dependent var | 3.700431 |
| Adjusted R-squared | -0.075353 | S.D. dependent var | 3.987823 |
| S.E. of regression | 4.135343 | Akaike info criterion | 5.841839 |
| Sum squared resid | 530.1328 | Schwarz criterion | 6.143500 |
| Log likelihood | -103.9950 | Hannan-Quinn criter. | 5.949168 |
| F-statistic | 0.567883 | Durbin-Watson stat | 1.798119 |
| Prob(F-statistic) | 0.752562 | | |

**APPENDIX K. Cointegration Test**

Sample (adjusted): 1985 2021
Included observations: 37 after adjustments
Trend assumption: Linear deterministic trend
Series: GDP GROWTH1 GSV1 GCF1
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.468731 | 46.77814 | 29.79707 | 0.0002 |
| At most 1 * | 0.368549 | 23.37611 | 15.49471 | 0.0027 |
| At most 2 * | 0.158064 | 6.365900 | 3.841465 | 0.0116 |

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.468731 | 23.40202 | 21.13162 | 0.0235 |
| At most 1 * | 0.368549 | 17.01021 | 14.26460 | 0.0179 |
| At most 2 * | 0.158064 | 6.365900 | 3.841465 | 0.0116 |