

Dependent Structure of Gross Domestic Product and Inflow of Foreign Direct Investment from China in Asean Member Countries Using Varma-Garch Copula Approach

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Abstract

This study aims to investigate and analyse the construction of dependencies between gross domestic product (GDP) and inflow of foreign direct investment from China (FDI) on 5 ASEAN countries (ASEAN-5), namely, Singapore, Malaysia, Thailand, the Philippines, and Indonesia, by using each country's GDP data. The data of ASEAN-5 and FDI from 1996 until 2018 was used via the VARMA-GARCH method, considering the lowest error value in the form of copulas demonstration. The results of the study reveal that the data in the asymmetric copula group that the risk of direct investment from China occurred by gross domestic product volatility of each country has a massive impact. On the contrary, for any country in the symmetric copula group, the risk from gross domestic product volatility that is directly affected from foreign investment has a slight difference.

1. Introduction

This study consists of the principles and the reasons related to the study Dependent Structure of Gross Domestic Product and Inflow of Foreign Direct Investment from China in ASEAN Member Countries as follows. The establishment of the Association of Southeast Asian Nation (ASEAN) was created by the Bangkok Declaration on 8 August 1967. It is known as the organization for regional cooperation. Its function is to promote corporation and stable politics, trade, economic development and social development of 5 founding countries: Indonesia, Malaysia, Philippines, Singapore and Thailand. After the period of cold war, this regional organization (ASEAN) aimed to bond relationships and build cooperation with other countries in the region. The expansion is successfully as 10 more countries participate in the organization including Brunei in 1984, Vietnam in 1995, Laos and Myanmar in 1997, and Cambodia in 1999. The total populace of ASEAN is 650 million people over 4.5 million kilometers of its area. The ASEAN administration is based in Jakarta, Indonesia, ASEAN has become an international association experienced in various ways amidst the volatile situation in the international arena.

The organization has changed itself continuously, the formulation of policies and plans will come from the government meetings and conferences in the member states, providing an opportunity for each member country to participate in the announcement of important goals and plans at the ASEAN Summit has grown,

learned, and played various roles in every age, until becoming a successful regional organization and is widely known internationally. Important factors driving political, economic, and social cooperation as well as promoting peace and security in the region because nowadays, economic integration occurs in various commercial centers of the world causing increased competition as well, especially even more economically, ASEAN has organized the signing of the ASEAN Free Trade Area (AFTA) in 1992 to reduce international customs duties this international trade promotion will help increase the amount of trade in ASEAN together with the cost of producing products including attracting foreign direct investment. Besides, the ASEAN Investment Area (AIA) has also been established to create a perfect economic zone and to create a systematic trade growth direction. (Thepchatree, 2010) [1-3].

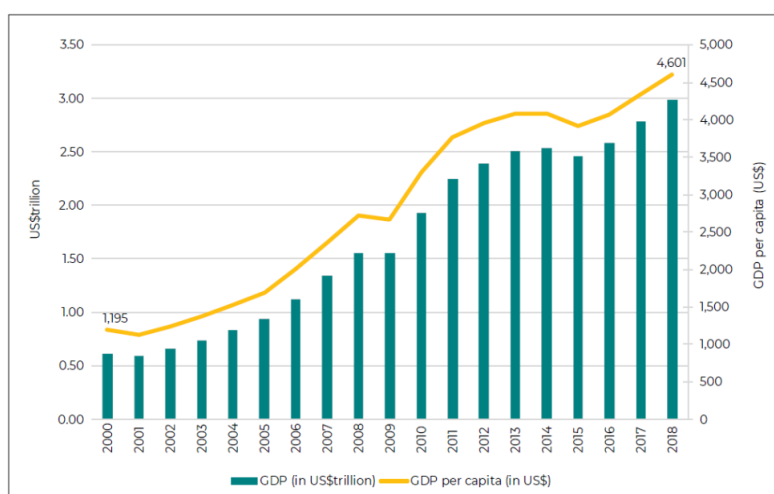
Strengthening the economic competitiveness of ASEAN is developing countries and some are emerging markets. The emerging-market economy requires the tools to drive the economy by using foreign direct investment (FDI) which will help the domestic economy run smoothly with the principle that if capital inflows increase, it will increase the liquidity of the domestic market then resulting in increased investment, employment, and domestic products. The amount of capital flows added can tell the country's economic growth rate. When the political factors in the country and the fundamentals of the economy are at a good level, foreign investors see investment

opportunities and create confidence for investors to invest and the result is the number of cash inflows.

On the other hand, when the fundamental factors of the country are in an unfavorable condition, the economy will slow, resulting in the confidence of investors that none of the investors in that country, thus decreasing the economic downward trend, therefore, funds flow direct inflow from abroad is an important variable in stimulating the economy. Eventhough the economy was in a downturn, capital inflows were the main driving force for the economy to rise again, and this was an important reason for the cooperation of ASEAN economies. In order to derive mutual benefits from trade investments and mutual investments.

Data from key the figures of ASEAN in 2019 reported that the combined Gross Domestic Product (GDP) of 10 ASEAN members is worth three trillion US dollars in 2018, that making ASEAN the fifth largest economy in the world. ASEAN's GDP tends [4,5].

To be positive throughout the period 2000- 2018, despite the global economic crisis in 2008-2009 (Figure1). The region's total GDP in 2018 is close to twice that of the previous decade and nearly five times the value in 2000. A similar trend was found for ASEAN' s GDP per capita, In 2018 when Compared with the year 2010 and nearly four times the value in 2000. [6].



Source: ASEAN Secretariat, ASEAN stats database 2019

Figure 1: ASEAN GDP (US\$ trillion) and GDP per capita (US\$), 2000-2018

As show in figure 3 GDP per in all ASEAN member countries was increased from years 2000-2018. Indonesia is the largest economy among ASEAN member, as reported by 34 percent of the region's GDP in 2018, followed by Thailand (16%) Singapore (12%), and Malaysia (12%) Source: ASEAN Secretariat, ASEAN stats database 2019 [7].

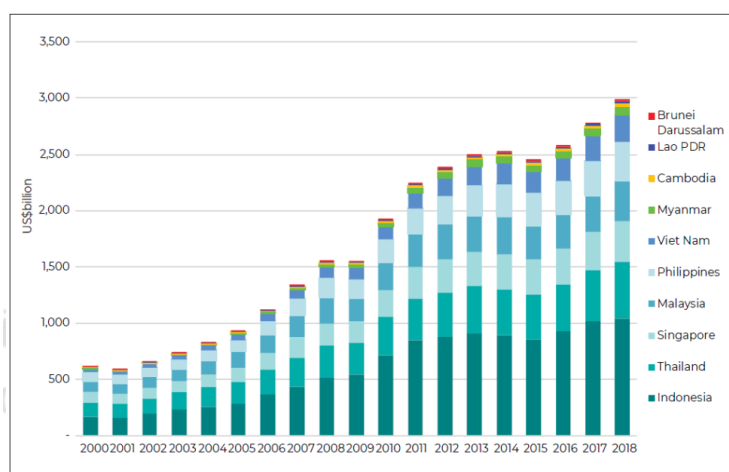


Figure 2: Total GDP (US\$ billion) by ASEAN Member States, 2000-2018

As show of information about gross domestic product of ASEAN member according to the investment and expansion of activities of both global and ASEAN companies are occurring in this region. Simultaneously, those companies are helping strengthen regional production networks and partake in the worldwide

value chain. What' s more, there are continuities of a regional attraction for FDI e. g. stable growing economy, the development of middle-class clients, a rising of regional integration of over 650 million people, and a vibration of industrial landscape [4,5].

Especially, the establishment of the ASEAN- China Free Trade Area Agreement or ACFTA was signed on 4 November 2002 in Phnom Penh, Cambodia, with the aim of being a framework and guidelines for ASEAN- China Free Trade Area negotiation covering the opening of Free Trade of Goods, Trade in Services, Investment and Economic Cooperation. As the establishment of the ASEAN- China Free Trade Area Agreement, the trade value between ACFTA member countries has continuously increased, especially the value of trade between ASEAN and China. In addition to the impact on trade, the approximately 2 billion Population in the ACFTA, or almost one- third of the world's population, is the highest total FTA population in the world. Therefore, the interesting issue that is the impact of the ACFTA on FDI [8].

Foreign direct investment or FDI is one of two types of foreign investment (the other type is foreign indirect investment or Portfolio Investment), where foreign businesses or investors enter the country of business investment, which is usually a high value investment and is a medium to long- term investment. FDI comes with technology and knowledge transfer from foreign countries, resulting in industrial development and increasing domestic competitiveness. These developments lead to employment and long- term economic growth in developing countries who is investment recipient. Additionally, the entry of foreign business competition stimulates the business of the investment recipient country to adjust in order to increase production efficiency to be able to compete with foreign businesses. For these reasons, FDI is an investment that many countries desire, including those in ASEAN as well as FDI is necessary for ASEAN countries due to their inconsistency of the level of domestic savings with the domestic investment requirements. When the level of domestic savings is not enough to meet the needs of domestic investment or the level of domestic savings is too high, it causes the current account surplus.

If the country has a large current account surplus and for a long time, it may result in the currency appreciation of the country compared to foreign currencies. Therefore, FDI can help reduce the gap between saving and investment. Additionally, another advantage of FDI is that there is less risk from capital flight than other types of foreign capital, especially loans [6].

The establishment of the ASEAN- China Free Trade Area Agreement has caused the trade value between ACFTA member countries to continuously increase, especially the value of trade between ASEAN and China. In addition to the impact on trade, the approximately 2 billion people in the ACFTA, almost one-third of the world's population, is the highest total FTA population in the world. Therefore, the impact of the ACFTA on Foreign Direct Investment or FDI is a particularly interesting issue [8].

ASEAN has also benefited from the China's Belt and Road Initiative (BRI) strategy, officially announced in 2013, with a focus on linking the Silk Route Economic Belt and the Maritime Silk Route. In 2015, China's investment value was 14.8 billion US dollars, due to investment in 49 countries on the trade route, which marks a growth of 18. 2 percent from the prior year, mainly due to investment in key countries such as Singapore, Kazakhstan, Laos, Indonesia, Russia, and Thailand (Ministry of Commerce People's Republic of China). The project is expected to make China invest in businesses related to infrastructure, such as energy, transportation, and logistics businesses, especially rail transportation and deep sea ports in ASEAN, which may have support from China or a FDI outflow form of funding, production, equipment procurement, and construction services. The long term investment overseas has increased.

It helps stimulate RMB usage in several forms, such as financial settlement and trade. Due to the fact that China has seen a growth in commercial activity with other regions, the currency will be more accepted than it was in the past. Also, these circumstances will internationalise the RMB, a long term goal of China. Finally, regarding a geopolitical aspect, China has recently been rising as a superpower state. The rising of its power has encouraged the state to gain more interest and form alliances in terms of geopolitical issues like China Sea and land proclamation. China has changed its status from an investment country to a top investor country and became one of the most important investors in Thailand and ASEAN since the Chinese economic development plan became more focused on foreign direct investment [9].

Country Year	Singapore	Malaysia	Thailand	Philippines	Indonesia
1996	2,243.5	459.9	323.3	55.5	93.5
1998	3,403.9	340.3	205.3	107.9	68.9
2000	2,172.2	202.8	203.5	111.1	146.9
2002	2,337.2	367.8	187.7	186.0	212.6
2004	2,008.1	385.0	178.6	233.2	104.5
2006	2,260.4	393.4	144.8	134.3	100.6
2008	4,435.2	246.9	129.2	128.8	167.2
2010	5,428.2	294.3	51.3	138.0	76.8
2012	6,305.0	317.5	77.7	132.2	63.7
2014	5,826.6	157.4	60.5	97.0	78.0
2016	6,046.6	221.1	56.1	77.6	63.9
2018	5,210.2	211.6	45.7	49.8	32.4
Total	91,115.0	7,147.3	3,347.1	2,941.4	2,291.0

Source: CEIC data From Table 1 it can be observed that the country that attracts the most direct capital inflows from China is Singapore which has Malaysia Thailand and Philippines respectively most of the investment in ASEAN will be the investment in the manufacturing industry. Capital is the economic driver in each country by distributing production base and quantity of labor in industrial system more than that the integration of ASEAN member countries also has a positive effect on technology transfer and regional assistance for continued economic and industrial development. In this case, China is a country that brings capital to invest in ASEAN, they see opportunity investment in financial business manufacturing industry as well as real estate and services.

Table 1.1: Foreign Direct investment of China outflow in top 5 countries ASEAN in 1996-2018 USD million.

It is interesting to study the relationship of inflow of FDI from China and the GDP of each country in ASEAN-5 using annual data from CEIC from 1996-2018. The Tom Yum Kung financial crisis in 1997 was caused by the Bangkok International Banking Facilities (BIBF). The bank was first established in Bangkok for processing international loans in order to offer customers financial transactions inside and outside Thailand. As the loan rate of banks in other countries were cheaper than the bank's rate in Thailand, foreign investors loaned money at cheaper rates not under the control of the bank of Thailand. This freedom to make financial transactions with no preventive measures started the crisis and affected the financial system of many countries around the globe.

International trade and domestic industries were severely affected. The crisis had an influence on global economic growth by decreasing trade around the world. Also, it continues to

affect Southeast Asian countries, including Singapore, Thailand, Malaysia, and Indonesia. The region is directly impacted by trading as export trade is the main core of these countries, causing increasing unemployment. Consequently, the Association of Southeast Asian Nations (ASEAN) was founded to operate regional free trade and services by having policies that reduce taxes and rules that obstruct investments. Simultaneously,

recovering and creating an investing environment, aiming to unite all regional countries through a regional trading agreement (RTA) has been set as the goal of fast recovery (V. Ramangkul, 2009) and the relationship of these studies can show how there is a positive or negative relationship and analyze how foreign direct investment has led to economic growth and to study the dependency structure on GDP that comes from the effects of FDI and GDP. To clarify, the dependency structure is used to measure different GDP from other in ASEAN countries in order

to ensure that they tend to depend on another. For example, one country's GDP increasing that influences from the inflow of FDI from China another country's GDP increase. Additionally, this study analyzes the case of ASEAN countries with the top five levels of foreign direct investment, namely Singapore, Malaysia, Thailand, Philippines, and Indonesia.

2. Purpose of The Study

To study the relationship between gross domestic product and inflow of foreign direct investment from China in ASEAN countries. To study the dependency between inflow of foreign direct investment from China in ASEAN countries.

2.1. Advantage of Study

For students and the general public who interested in the analysis of dependency structure, the research results can be used for applies the analysis for further research problems. For entrepreneurs, businessmen, investors and speculators, the research results can be used for study the nature of the changing in gross domestic product that may affect domestic business as well as planning multinational investment. The results can be used as information in the implementation of international economic policy for country government to formulate a policy to stimulate capital inflows directly from abroad.

3. Theories and Literature Review

3.1. International Trade Theory

The theory of international trade describes the reasons for exchanging of goods between different countries, describes the types of goods being exchanged and the benefits of international trade can explain the evolution according to the following. Mercantilism Mercantilism has been popular from the 16th century to the 18th century from countries such as England, Spain, France and the Netherlands. It is a doctrine of international trade aimed to gain financial advantage. In order to have the most gold and silver flowing into the country However, the more gold and the richer in a country it will be more powerful.

Therefore, believe that is the only way to have the greatest power possible in commercialists. They encouraged the government to speed up exports and discourage imports to support trade surplus. Due to the limited amount of gold available and gold flowing into one country. Therefore, making the importing country poorer production and employment in importing countries declined in the long run. The circumstance of commercialism began to deteriorate in the middle of the 18th century until the concept of free trade, which was influenced by the ideas of the classical theory [10].

3.2. Absolute Advantage

Absolute Advantage is a trade theory that emerges after the impact of commercialism. Adam Smith advocate free trade that is a policy of justice for all countries in the world. When trade goes free each country will produce with knowledge and special expertise, only the products that the country has complete advantages (If that country can produce more than one country with the same amount of production factors) and import the products that are completely disadvantageous, therefore,

international trade is made by both sides having absolute advantages from the production of different types of products and then exchanged them, for example, Thailand and the United States of America, Suppose that in the production of the 2 countries, both produce the same products, rice and computers and suppose that in the production of these 2 types of goods, labor is the only factor of production. Therefore, the value of these two products is calculated from the amount of labor used in production. (Benchamasutin, Pantakitphaibun, 2005).

3.3. Comparative Advantage

David Ricardo sees flaws in the theory of Absolute Advantage by saying that the country has no Absolute Advantage in producing every product with other countries can still do business that will benefit all parts. Inefficient countries should produce and export only the products that their countries have less disadvantages. It can be considered that this product is a product manufactured in the country with comparative advantage this comparative advantage theory is well-known and to explain the causes of international trade business. (Benchamasutin, Pantakitphaibun, 2005).

3.4. Heckscher-Ohlin Theory

This theory focuses on the differences of the factors of production in each country and the prices of the factors of production between countries, with each country exporting products that give much importance to existing production factors by comparison, which makes the factors of production cheap and importing products will make the importance of the shortage of production by comparison, which will be expensive. For this reason, the prices of comparative products in each country are different.

Therefore, any country has an abundance of production resources, that country has an advantage in production use that type of production as a component and then export to trade with other countries, For example, if country a has a lot of labor it will cause a low wage level also, the production should use labor because it will produce low cost [10].

3.5. Gross Domestic Product

Gross Domestic Product (GDP) is the total value of the product price in the final product market of countries that can be manufactured domestically within a certain period of time and can calculate the value in one year before the depreciation of the assets used in the production of final products and services, In the administration of the economy of the government of every country all have a desire to increase the number of economic growth and want to increase people's income in the country [11].

3.6. Calculation of Gross Domestic Product

Calculated from the added value added in each distance of production of products and services which is a calculation to avoid problems of double counting of added value the rise of Gross Domestic Product, will make the calculated value to be higher than the true value. Moreover, GDP can calculation from expenses is calculated from the total expenditure of various economic units that was paid for the purchase of the final product

manufactured in that year various economic units that must be paid to purchase the final product produced in one year. Therefore, the expenditure of the economic unit is the consumption expenditure investment expenses government expenditure and the net export value, In the sum of those expenditures is called the national expense can write the equation as follows:

$$GDP = C + I + G + (X - M)$$

By GDP = Gross Domestic Product C= Consumption expenditure
I = Investment expenses

G = Expenses for purchasing goods and services

(X-M) = Net export value (Value of exports - value of imported goods)

As above the equation can calculation of the value of GDP each year and the results of GDP represent the value of all good and service in country and is important to economy to decide either economy growing or facing recession as well as investor can use GDP to make decision to investment [11].

4. Foreign Direct Investment and Spillover Effect

Foreign Direct Investment (FDI) and spillover effect have recently concerned in the global development strategy state that the host country completes the advantage of FDI through two aspects, which are the determinants of microeconomic and macroeconomics. In microeconomics, the local firm has been considered as a principal channel to achieve the benefits of FDI, including the horizontal and vertical spillovers, the training effects, the improvement of skill, and the innovation transfer and work turnover. Another is macroeconomics, host country is able to obtain benefits of FDI by many ways. The first, which is the new innovation of technology transfer obtained by competition, imitation, foreign linkages and the ability of domestic firms to manage a business. Th second, which is the improvement of human skills by training and learning on the advanced process. Therefore, the efficiency of FDI effects may be generating the higher productivity and output growth with new advanced technology and achieving to economic growth (De Mello,1997).

Investment is a form of asset spending with the hope that that money would be able to grow and receive compensation in the future and in the long term. By believing that the cash or additional compensation received can compensate for the period Inflation Or the potential risk of investment can be divided into 3 types. (Khum-Sap, 2001) [12].

- Consumer Investment
- Business or Economic Investment
- Financial or Securities Investment

It is related to investment for consumption and investment in business. To begin with Consumer Investment is an investment in the manner that investors hope to receive satisfied from the use of that asset more than monetary returns caused by purchasing products Durable Goods such as cars, phones. In addition, the purchase of housing is also an investment for consumption it' s call Real Estate Investment. In addition, to the investor's satisfaction in living, if the demand of real estate that increases at a level greater than supply will result in a higher value of housing resulting in taxation from sales continued from foreign parts of the original price. (Khum-Sap, 2001).

Business or Economics Investment is the purchase of various assets with the aim of profit or return in the form of monetary investment, such as the purchase of machinery and factories, which these assets will be used in businesses that generate income or value added to investors and businesses.

Financial or Securities Investment is a trading of securities of various businesses through the stock exchange, which investors believe that the investment able to create future returns, In which investors have decided to accept the risks that may arise from Invest all the time securities in the form of documents showing rights of investors, For example treasury bills, bonds, bills, shares, debentures. In addition, there are investment units such as instruments or evidence showing the right to buy debentures or documents at the securities and exchange commission and the Stock Exchange of Thailand, In this type of investment, the investor is a business owner and has rights receive returns from dividends of businesses or capital gain and rights offering (Khum-Sap, 2001) [12].

However, all forms of investment have risks. Each type has different levels of risk, so investors should be aware of investment objectives and the level of risk that investors can accept that can vary with time period (Khum-Sap, 2001) [12].

5. Investment Objectives

The investor's primary objective is to receive the highest rate of return at a given risk level, on the other hand, to minimize the risk at the rate of return, which requires Invest is a risk averse. If any investment is highly risky, investors will need a high return to compensate for that risk each investor has a different purpose can divided into various purposes as follows; (Khum-Sap, 2001; Phunuwat, 2013).

- Security of Principal is the value of that money changes according to the time and economic conditions therefore, investing is to maintain the value of the principal and avoid the risk of reduced purchasing power.
- Stability of Income is received from investing in securities as well as receiving shares but need a return on investment that gives investors a sustainable and stable return, such as investing for retirement allows investors to make financial planning during consumption or for further investment.
- Capital Growth is the investor chooses to invest in shares of the expanding business or is the return of an investment to increase the value of funds, such as long- term investments in which investors may receive dividends from the business.
- Market Stability is the securities will be traded easily and quickly, depending on the unit price of the securities there are many cases for the market stability, To illustrate one of the cases, the market size securities and reputation of the business issue securities to the stock exchange and many for cases.
- Liquidity is the ability to instantly convert into cash the investor will choose invest in securities with high liquidity, for the reason that if there are other interesting sources of investment, they can convert assets can be capitalized quickly and are ready to change investment locations

immediately.

- Diversification to reduce the risk can be done in many ways, such as choosing to invest in many types of securities choose to invest in many types of businesses, choose to invest in securities of businesses that are geographically different and invest in securities of businesses with different production.
- Favorable Tax Status is investors can avoid paying taxes. For instance, income from assessable income investment in mutual funds with tax deduction or investment in bonds that are tax- exempt or buy securities that do not pay dividends at that time but make a profit from trading securities with future price differences.

Factors that affect investment are important to the direction of the economy and the capital market, which are described as follows. (Khum-Sap, 2001; Phunuwat, 2013).

Economic factors due to economic problems affecting investment in securities and the attitudes and decisions of investors the most. However, economic factors Investors should consider include.

- Financial liquidity, regardless of business, when the liquidity situation occurs discontinuous finance or lack of working capital would be a problem that could have other consequences.
- Interest rates when financial difficulties occur, the interest rates will increase, resulting in the production cost of the company goes up too. While the traveling.
- rate will decrease, resulting in more purchasing power combined with the growth of the industry.
- Foreign exchange rates or currency rates have a direct impact on the industry and businesses that rely on imported raw materials from foreign countries. If the domestic currency is weak, it will affect the import of business products because the cost of buying imported goods is higher but at the same time, it has a positive effect on the country's exports.
- Production when the industry is able to produce and distribute products that meet Market demand and partner countries which may have a reasonable price and quality or better than products from competitor countries Including the competition of production costs or receiving support from the government, resulting in increased and efficient sales of goods and services.
- Foreign economic conditions especially with partner countries when the economy expansion will increase demand for products resulting in an increase in the amount of goods sold and services, as well as attracting money back into the country which in return when the economy is stagnant, it will cause conditions economic stagnation demand for products and the amount of goods sold also decreased.
- Political factors, especially domestic politics, have a direct impact on the economy, such as the determination of tax rates and the promotion of government investment. It also affects domestic security. If the politics in that country is not peaceful May have a severe impact on international trade.
- Other factors, such as natural disasters that affect trade inconvenience, directly affect the domestic and international

economy, the same as the stock exchange which may occur creating speculation rumors that result affect the price of securities.

6. Concept of Inflow - Foreign Direct Investment

Theory of foreign direct investment concepts divided the study group on factors the investment schedule is divided into three types as follow.

- Much Politics, Little Economics will focus on political stability as an important element that will affect foreign direct investment.
- Much Economics, Little Politics will focus on economic stability with the belief that economic variables affect investment rather than political factors.
- Unstructured Amalgamation of Economics and Politics is a combination of economic variables and political equivalent. This may include the stability of the government in performing duties, both political and economic in the country.

7. Econometric Theories

7.1 Time Series Data

Time series are groups of data or quantitative observations that can be measured over time. At any given time with continuous data storage and equal time intervals, which may be collected on a daily, monthly, quarterly, or yearly basis, depending on the purpose for which the time series data will be used very effective in analyzing and making business decisions or making project planning predictions minimal discrepancy by using historical data as base information in predicting future data that will occur time series data can be divided into two type is Stationary and Non-stationary, In which the data will be stable when the mean and the variance has a constant over time and the covariance involved depends on distance and lagging behind between only two periods. It does not depend on the covariance that is calculated at actual time. But if the data does not qualify for one of the statistical values then the data will have non- stationary as a result, the relationship between variables in the system of equations has spurious regression [13-16].

8. Unit Root Test

Unit Root or Order of Integration This is a test for variables in the system of equations, whether the data is stationary [I (d); Integrated of Order Zero] or not stable [I (d); d> 0, Integrated of Order d]. That has no unit root. On the other hand, information that looks unstable is data that has a root unit. Philips-Perron (PP-Test) The examination of data' s stability by the Phillips-Perron method is the means of Non-parametric Statistics, used to control the Serial Correlation in Times Series Data [17-19]. The Phillips-Perron method can be used by this following equation.

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \varepsilon_t$$

In addition, Phillips- Perron modified the t- statistics of the coefficient from the self- regression process (AR (1)) in the equation (2) to create a continuous relationship by fixing the problem heteroscedasticity and autocorrelation with the method of Newey- West follows [17,19]

$$\omega^2 = y_0 + \sum_{u=1}^q \left[1 - \frac{u}{q+1} \right] y_j \quad (2.3)$$

$$y_j = \frac{1}{T} \sum_{t=j+1}^T \hat{\varepsilon}_t \hat{\varepsilon}_{t-j} \quad (2.4)$$

By ω^s = Newey-West Heteroscedasticity Autocorrelation Consistent Estimation

$y\&$ = Coefficient from the self-regression process (AR (1)) The t-statistics of Phillips-Perron can be calculated as follows:

$$t_{pp} = \frac{\frac{1}{2} y_0^2 t_b}{\omega} - \frac{(\omega^2 - y_0) T S_b}{\omega} \quad (2.5)$$

By t_{pp} = Test statistics Phillips-Perron (PP-Test)

t_b , = t-test of

S_b , = Standard Error of

s = Error in reverse order

q = Truncation Lag

Distribution of test statistics Phillips-Perron (PP-Test) is the same as the t-test statistic. In the Augmented Dickey-Fuller (ADF) test, the following assumptions.

H_0 : The time series data of the variables studied at time t is unstable.

H_1 : The time series data of the variables studied at time t is stable.

The conclusion of the above assumptions can be considered by comparing the statistic test of Phillips- Perron (PP- Test)

$$\text{AR}(p) \text{ is } x_t = \mu + \phi_1 x_{t-2} + \dots + \phi_p x_{t-p} + \varepsilon_t \quad (2.6)$$

By μ = Constant Term

ϕ_j = J parameter

ε_t = Time discrepancy t

to Mackinnon Statistics. To clarify, if the Philips-Perron statistic greater than Mackinnon Statistics will reject the key assumptions. In conclusion, the time series data of the variables studied at time t is stable. On the other hand, if the test statistics Phillips-Perron (PP-Test) is less than the Mackinnon Statistics will accept the key assumptions it can be concluded that the time series data of the variables studied at time t is unstable [16,19].

9. Autoregressive (AR (p))

Autoregressive model It shows that the observed value x_t that is determined from the values of x_{t-1}, \dots, x_{t-p} or the previous observed value p. The AR(p) is the principle of Autoregressive with p rating which can be written in the form of the equation as follows [20]

9.1.1. Moving Average (MA (q))

The Moving Average model is a model that shows the x_t observation values are determined from the $\varepsilon_{t-1}, \dots, \varepsilon_{t-q}$ tolerances, or the errors that are preceded by the MA (q) process, which is the principle of the Moving Average with rank q ,can be written as an equation as follows [12]

$$\text{MA}(q) \text{ is } x_t = \mu + \varepsilon_t - \theta_1 \varepsilon_{t-2} - \dots - \theta_q \varepsilon_{t-q} \quad (2.7)$$

By μ = Constant Term

ϕ_j = J parameter

ε_t = Time discrepancy t

Autoregressive Moving Average (ARMA(p,q)) The Autoregressive Moving Average (ARMA) model is a combination of models that

bring processes Autoregressive and Moving Average. The ARMA process (p, q) is the principle of Autoregressive with p rating and Moving Average with q rating, which can be written in the form of ARMA model (p, q). (Shumway, 2006) as follows [21]

$$x_t = \delta + \phi x_{t-1} + \phi x_{t-2} + \dots + \phi x_{t-p} + \varepsilon_t - \dots - \theta_q \varepsilon_{t-q} \quad (2.8)$$

By x_t = Observations in time series at time t

p = Ranking of Autoregressive

q = Ranking of Moving Average

δ = Constant Term

t = Times

ϕ = The parameters of Autoregressive

θ = The parameters of Moving Average

ε_t = Tolerance at time t

10. Autoregressive Conditional Heteroscedasticity (ARCH)

Time series analysis, the stochastic variable is fixed (Homoscedastic), which in applying to some information, the variance of the error term is not just a function of the independent variable but will change with time depending on the magnitude of the movement expectation in the past and in some studies. For example, a model of inflation, interest rates or returns from securities in certain periods of time will have high volatility that will have large expectations and low volatility and small expectations can concluded the past of fluctuations in expectations and the

past will also depend on the volatility of the past expectations of volatility. (Enders, 1995) [20].

The possibility of the model or the possibility of finding the mean and the variance of the time series together. Initially, the conditional forecast will be much more accurate than the unqualified forecast. To illustrate from the model Autoregressive Moving Average (ARMA) will assume that we have a stable ARMA model (Stationary) as follows [20]

$$x_t = a_0 + a_1 x_{t-1} + \varepsilon_t \quad (2.9)$$

By forecasting x_{t+1} with the following conditions:

$$E_t x_{t+1} = a_0 + a_1 x_t \quad (2.10)$$

If the conditional mean is used in forecasting x_{t+1} predictive conditional deviation will have the following format as:

$$E_t [(x_{t+1} - a_0 - a_1 x_t)^2] = E_t \varepsilon_{t+1}^2 = \sigma^2 \quad (2.11)$$

If switching to the unconditional forecast the result will be used as the long run average of the sequence run $\{x_t\}$ which is equal to $a_0/(1 - a_1)$, will have unqualified predictions as follows:

$$E \left\{ x_{t+1} - \frac{a_0}{(1 - a_1)} \right\} = E [(\varepsilon_{t+1} + a_1 \varepsilon_t + a_1^2 \varepsilon_{t-1} + a_1^3 \varepsilon_{t-2} + \dots)^2] \quad (2.12)$$

When $1/(1 - a_1)^2 > 1$ volatility from unqualified predictions (Unconditional Volatility) will be higher than the volatility of the same conditional forecasting (Conditional Volatility). If the volatility of $\{\varepsilon_t\}$ is not stable or constant, the volatility can be estimated using the ARMA model assuming the model as follows [14]

$$x_t = a_0 + a_1 x_{t-1} + \varepsilon_t \quad (2.13)$$

Therefore, the conditional fluctuation of x_{t+1} can be written as follows:

$$Var(x_{t+1}|x_t) = E[(x_{t+1} - a_0 - a_1 x_t)^2] = E_t \varepsilon_{t+1}^2 \quad (2.14)$$

From $E_t \varepsilon_{t+1}^2 = \sigma_{t+1}^2$ it shows that the conditional variance is not a constant and the residual estimation model is given as follows:

$$\varepsilon_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \dots + \alpha_q \varepsilon_{t-q}^2 + v_t \quad (2.15)$$

When v_t = White noise process

These equations as models of Autoregressive Conditional Heteroscedasticity (ARCH) and this equation is ARCH (q) with a value of $E_t \varepsilon_{t+1}^2 = \sigma_{t+1}^2$ are consists of two main components, constant and volatility in the past period, it is the remainder of square in the period. ARCH(q) The coefficient $\alpha_1, \alpha_2, \dots, \alpha_q$ can be determined by the Maximum Likelihood method.

$$\varepsilon_t = v_t \sqrt{h_t} \quad (2.16)$$

Where the variance of $v_t = \sigma_v^2 = 1$

$$h_t = \alpha_0 + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^p \beta_i h_{t-i} \quad (2.17)$$

When $\{v_t\}$ is the White Noise process independent from past events (ε_{t-1}) conditional and unconditional means of ε_t is equal to zero when entering the expected value (Expected Valued) of ε_t will get

$$E\varepsilon_t = E v_t \sqrt{h_t} = 0 \quad (2.18)$$

For the determination of the Conditional Volatility of ε_t is determined by the equation as:

$$E_{t-1}\varepsilon_t^2 = h_t = \alpha_0 + \sum_{i=1}^q \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^p \beta_j h_{t-j} \quad (2.19)$$

Therefore, the conditional fluctuation of ε_t is determined by h_t in the equation, which is called the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) (p,q). Autoregressive and Moving Average for finding variance that looks Heteroscedasticity Volatility when α_i represents the ARCH Effect and β_j represents the (GARCH Effect) called

$\alpha_i + \beta_j$ (Bollerslev, 1986, 2007) Vector Autoregressive Moving Average-GARCH (VARMA-GARCH) An econometric model to gather the relationship of Conditional Volatility used to study the volatility of many variables. By having the model structure (Jathaphai, 2011) [23,24].

$$H_t = W + \sum_{i=1}^q A_i \varepsilon_{t-i}^2 + \sum_{i=1}^q C_i I_{t-i} \varepsilon_{t-i}^2 + \sum_{j=1}^p B_j H_{t-j} \quad (2.20)$$

When $H_t = (h_{1t}, \dots, h_{mt})'$, $\varepsilon_t = (\varepsilon_{1t}^2, \dots, \varepsilon_{mt}^2)'$ and $W = (\alpha_1, \dots, \alpha_m)$, is $A_i (i = 1, \dots, r)$ and $B_j (j = 1, \dots, s)$ a metric $m \times m$, in which the VARMA-GARCH model requires that positive shocks and negative shocks affect conditional volatility the same, where A_i will represent ARCH effects, also known as short-term effects, and B_j will represent GARCH effects, also known as long-term effects ($\sum_{i=1}^q A_i + \sum_{j=1}^p B_j$) (Jatapai, 2011)

4. If T is exactly monotonic, then $\delta(T(X), Y) = \{ \delta(X, Y), T = \text{increasing or } -\delta(X, Y), T = \text{decreasing} \}$

Normally, the Pearson linear correlation fits only the first two properties but the rank correlation measures Spearman's rho and Kendall's tau fits all of the 4 12.

11. Copulas Theory

Many financial theories, such as investment allocation derivative pricing and risk management depend on the level of significant risk factors. The Copulas method describes the structure of variable dependency levels and has become a standard tool for modeling dependent variables in financial time series. The Copula method is the basis for understanding the degree of dependence of random variables, which can separate the degree of dependency from the marginal distribution function [25,26]

11.1. Dependence Measures and Copulas

The general properties of dependence measures can be explained by the 4 items properties shown below (Embrechts, Lindskog, and McNeil (2003)):

1. $\delta(X, Y) = \delta(Y, X)$.
2. $-1 \leq \delta(X, Y) \leq 1$.
3. $\delta(X, Y) = 1$ if X and Y are comonotonic; as well as $\delta(X, Y) = -1$ if X and Y are comonotonic.

$$C(F_1(X), F_2(Y)) = F(X, Y) \quad (2.21)$$

The Copulas function helps to describe the risk of a variable group by linking the risk behaviors of those variables by bringing the unique probability function for each variable through the neck Copulas function $C(F_1(X), F_2(Y))$. In addition, the Copulas function has the Copulas Invariance property. In other words, if two variables, such as the variable X and the variable Y, are related, as described by the Copula function when financial engineers deviate both variables through the method

of increasing the transformation by increasing the function g_1 and g_2 (Increasing Function) which have incremental value according to the variable of the variable. Explained using the original copulas function, namely $C(F_1(X), F_2(Y)) = C(g_1(X), g_2(Y))$ (Sklar, 1959)

12.2. Elliptical Copulas

Elliptical Copulas are elliptic curve interpolation functions with

an optical distribution has some properties. The key advantage of elliptical copula is that one can specify different levels of correlation between the marginals. In addition, the elliptical copula is Normal copula which are the same as for the normal variable of many variables Multivariate Normal Distribution and has simulated multivariate extreme events and Non-normal Dependencies as a result of the simulation of multivariate distribution. Multivariate Elliptical distributions are easy to implement, just like the simulation of Elliptical Copulas so optical copulas can be utilized in the simulation multivariate distribution, which assumes that the increment is not equal or is a different distribution but the dependency between the increments is still a characteristic of the optical distribution. The drawback is that the distribution function does not have an expression in a closed form and the optical copula function is

limited to a symmetrical radius [29,30].

The optical functions can be divided into 2 types, the normal function (Gaussian Copula) and Student's t function, in which each type can be extended to D-Dimensional Space. The D-Dimensional random vector X is an optical distribution with the function $\varphi(\mu, \Sigma, 9)$ and the position $(\Sigma) = r \leq d$. When R-Dimensional vector is available U random distribution, the same in Unit Sphere Surface $\{u \in [-1,1]^r: \|u\| = 1\}$. The two types of optical groups can be described (Tae-Hwy, 2006) as follows Gaussian Copula or Normal Copula. Is the copulas function $C^{Ga}(v, z)$ that connects the X and Y variables that have a unique cumulative probability of the function. $F_1(X)$ and $F_2(Y)$ can be written as follows;

$$C^{Ga}(v, z) = C^{Ga}(\Phi(s), \Phi(t)) = \int_{-\infty}^{\Phi^{-1}(v)} \int_{-\infty}^{\Phi^{-1}(z)} \frac{1}{2\pi\sqrt{1-p_{12}^2}} e^{\frac{2p_{12}st-s^2-t^2}{2(1-p_{12}^2)}} ds dt \quad (2.22)$$

Where the function $\Phi(k) = \int_{-\infty}^k \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\omega^2} d\omega$ is a normal cumulative distribution function for a single variable, and the function $\Phi^{-1}(k)$ is the inverse function of the $\Phi(k)$ function with the value = $\Phi^{-1}(v)$, $v = \Phi(s)$ and $t = \Phi(z)$ values

When the normal CDF copulas function has the form $C^{Ga}(v, z)$ as shown in equation (27), the normal PDF copulas function must have the form $C^{Ga}(v, z)$ corresponding to

$$C^{Gc}(v, z) = \frac{1}{2\pi\sqrt{1-\rho_{12}^2}} e^{\frac{2\rho_{12}st-s^2-t^2}{2(1-\rho_{12}^2)}} \quad (2.23)$$

As for the calculation of the copula function with normal condition can be done as:

$$C_{2|1}^{Ga}(v, z) = Pr(U_2 = F_2(Y) \leq z | U_1 = F_1(X) \leq v) \quad (2.24)$$

$$\int_{-\infty}^{\frac{\Phi^{-1}(z)-\rho_{12}\Phi^{-1}(v)}{\sqrt{1-\rho_{12}^2}}} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}t^2} dt \quad (2.25)$$

The normal copulas function c is equal to the normal distribution function $\Phi_{p_{12}}(X, Y)$ when the unique distribution of variables is a normal distribution, that is, $F(X) = \Phi(X)$ and $F(Y) = \Phi(Y)$. Student's t function copulas is a distribution that has a fatter tail than the distribution of normal variables by indicating the risk behavior of normal variables that are less volatile and there is a probability that the actual values are very different from the expected values. Both the positive and the negative, this

property is used for the copulas function to describe the behavior of variables. If the chance that the variable will have a very high or low value which occurs on the tail end of the distribution on both sides that higher than the probability that can be found from the normal distribution. The Copulas CDF function Student's t form for describing the relationship between two variables has the form as follows [27,29]

$$C_{\rho,\delta}^{\delta}(v, z) = C_{p,\delta}^{\delta}(t_{\delta}(s), t_{\delta}(t)) \quad (2.26)$$

$$= t_{\rho,\delta}(t_{\delta}^{-1}(v), t_{\delta}^{-1}(z)) \quad (2.27)$$

$$= \int_{-\delta_{\infty}}^{t^{-1}(v)} \int_{-\delta_{\infty}}^{t^{-1}(z)} \frac{1}{2\pi\sqrt{1-\rho^2}} \left(1 + \frac{s^2 + t^2 - 2pst}{\delta(1-\rho^2)}\right)^{-\frac{\delta+2}{2}} ds dt \quad (2.28)$$

And the Copulas function PDF. Student's picture for two variables is as follows:

$$C_{\rho,\delta}^{\delta}(v, z) = \frac{1}{\sqrt{\rho}} \frac{\Gamma\left(\frac{\delta+2}{2}\right) \Gamma\left(\frac{\delta}{2}\right)}{\Gamma\left(\frac{\delta+1}{2}\right)^2} \frac{\left(1 + \frac{s^2 + t^2 - 2pst}{\delta(1-\rho^2)}\right)^{-\frac{\delta+2}{2}}}{\left(1 + \frac{s^2}{\delta}\right)^{-\frac{\delta+2}{2}} \left(1 + \frac{t^2}{\delta}\right)^{-\frac{\delta+2}{2}}} \quad (2.29)$$

Where the $\Gamma(m) = \prod_{j=1}^{\infty} (1 - m^j)$ is a Usual Euler Function when $m = \frac{\delta+2}{2}$ and $\frac{\delta+2}{2}$, the value δ is the Degree of Freedom and the value ρ is the correlation coefficient of the variables X and Y. Here, the variables $s = t_{\delta}^{-1}(v)$ and $t_{\delta}^{-1}(u)$ and the variables $U_1 = t_{\delta}(X)$ and $U_2 = t_{\delta}(Y)$ and the function $t_{\delta}(k)$ is a cumulative distribution function for a single variable, Student's t, and following in the equation.

$$t_{\delta}(k) = \int_{-\infty}^k \frac{\Gamma\left(\frac{\delta+1}{2}\right)}{\sqrt{\pi\delta}\Gamma\left(\frac{\delta}{2}\right)} \left(1 + \frac{\omega^2}{\delta}\right)^{-\frac{\delta+1}{2}} d\omega \quad (2.30)$$

The Student's t $C^s(U_2, U_2)$ form copulas is equal to the Student's t $t_{\rho,\delta}(X, Y)$ codistribution function, Particularly when the unique distribution of the variable is Student's t distribution and both variables must have the same independence. In other words, $F(X) = t_{\delta}(X)$ and $F(Y) = t_{\delta}(Y)$. The conditional probability function using the Student's t function, the calculation of Student's t, can be done using relationships (David, 2000; Hotta, 2006) as follows:

$$C_{2|1\rho,\delta}^s(v, z) = \int_{-\infty}^{\frac{t_{\delta}^{-1}(z) - \rho t_{\delta}^{-1}(v)}{\sqrt{1-\rho^2}}} \frac{\Gamma\left(\frac{\delta+2}{2}\right)}{\sqrt{\pi(\delta+1)}\Gamma\left(\frac{\delta+1}{2}\right)} \left(1 + \frac{\omega^2}{\delta+1}\right)^{-\frac{\delta+2}{2}} d\omega \quad (2.31)$$

13. Archimedean Copulas

Consider using the copulas function of the Archimedes Copulas when the relationships between themselves variable asymmetric because forcing the relationship between variables to be symmetrical may cause the analysis to produce false results [31].

To identify the general purpose of Archimedean group the $\varphi(w)$

function must be defined as the generator function, which is a continuous reduction function and a convex function. The generator function has the $\varphi(w = 1) = 0$ and $\varphi(w = 0) = +\infty$ characteristics. Define the function $\varphi^{-1}(w)$ give to the Pseudo-Inverse function of the $\varphi(w)$ function and has (Wiboonpongse, 2012) as follows:

$$\varphi^{-1}(w) = \varphi^{-1}(w) \quad \text{when} \quad 0 \leq w \leq \varphi(0)$$

$$\text{And} \quad \varphi^{-1}(w) = 0 \quad \text{when} \quad \varphi(0) \leq w \leq +\infty$$

$$\text{By} \quad \varphi^{-1}\{\varphi(w)\} = w$$

By defining the generator function with the above characteristics, the CDF copulas functions from $C^A(v, z)$ in the general purpose of Archimedean group as follows:

$$C^A(v, z) = \varphi^{-1}(\varphi(v) + \varphi(z)) \quad (2.32)$$

And specify the Copula function PDF form $C^A(v, z)$ in the Archimedean group has the general format as follows:

$$C^A(v, z) = \frac{-\varphi''(C^A(v, z))\varphi'(v)\varphi'(z)}{(\varphi'(C^A(v, z)))^3} \quad (2.33)$$

When φ'' and φ' are the 2nd and 1st derivatives of the function φ

The Archimedean function is used to describe the relationships between the two variables that are used in the analysis of financial issues. There are 3 types: the Archimedean Gumbel, Archimedean Clayton and the Archimedean Frank can be explained (Vose, 2007) as follows [25].

Making the Generator Function $\varphi(w) = k - \ln(w)^\alpha$ copulas Archimedean Gumbel that shows the most asymmetric relationship between variables with the function specifying a

very high variable relationship when variables occur at the tail of the distribution but will not show a high level of relationship when the variable is in the middle of the distribution can explain the relationship of variable values that are relatively concentrated. The upper tail dependence. In addition, if any two variables have a relation that is explained by the Gumbel copulas function well, the probability that both variables will have a positive value along will be higher than the probability that both variables will be negative at the same time [32].

Copulas CDF function Gumbel

$$C^G(F_1(x), F_2(y)) = e^{-\left\{(-\ln(F_1(x)))^\alpha + (-\ln(F_2(y)))^\alpha\right\}^{\frac{1}{\alpha}}} \quad (2.34)$$

Copulas PDF function Gumbel

$$\begin{aligned} C^G(F_1(x), F_2(y)) &= C^G(F_1(x), F_2(y)) \times \frac{1}{F_1(x)F_2(y)} \times \left(\ln(F_1(x))\ln(F_2(y))\right)^{\alpha-1} \\ &\times \left\{(-\ln(F_1(x)))^\alpha + (-\ln(F_2(y)))^\alpha\right\}^{-2+\frac{1}{\alpha}} \\ &\times \left\{(-\ln(F_1(x)))^\alpha + (-\ln(F_2(y)))^\alpha\right\}^{\frac{1}{\alpha} + \alpha - 1} \end{aligned} \quad (2.35)$$

By the parameter $\alpha \geq 1$ Clayton When the generator function is defined as $\varphi(w) = 1/2 (w^\alpha - 1)$ the Copulas function $C^A(v, z)$ becomes the Copulas Clayton function shows the relation between the variables that are somewhat more symmetrical compared to the degree of symmetry of the relationship of the variables specified by the Copulas function Gumbel. The Clayton copulas function indicates the concentration of

variables in the lower tail dependence, it means the probability that both variables are negative at the same time will be higher than the probability that both variables will have positive values at the same time. However, the Copulas function Clayton still has ability to explain the relationship between both the positive dependence and the negative dependence [25,30].

Copulas CDF function Clayton

$$C^c(F_1(x), F_2(y)) = \text{Max} \left\{ \left[(F_1(x))^{-\alpha} + (F_2(y))^{-\alpha} - 1 \right]^{-\frac{1}{\alpha}}, 0 \right\} \quad (2.36)$$

Copulas PDF function Clayton

$$C^c(F_1(x), F_2(y)) = \{(F_1(x))^{-\alpha} + (F_2(y))^{-\alpha} - 1\}^{-2-\frac{1}{\alpha}} \times (F_1(x))^{-\alpha-1} \times (\alpha + 1) \times (F_2(y))^{-\alpha-1} \quad (2.37)$$

By the parameter values $-1 \leq \alpha \leq 0$ and $\alpha \geq 0$ that is, the parameter value α can be any value not less than -1, except that only 0.00 cannot be. Frank Occurs when the Generator function is defined as $\alpha(w) = \left\{ \frac{e^{-\alpha w} - 1}{e^{-\alpha} - 1} \right\}$ is the Copulas Archimedean Frank that shows the relationship of variables with the most symmetry

level compared to the Gumbel and the Clayton. To illustrate, Frank function is suitable for describing the relationship of the variable in the clustering variable is not quite right or left (No Tail Dependence). The CDF copulas function has a form (Nelsen, 1999; Trivedi, 2007) as follows:

$$C^c(F_1(x), F_2(y)) = -\frac{1}{\alpha} \ln \left\{ 1 + \frac{(e^{-\alpha F_1(x)})(e^{-\alpha F_2(y)} - 1)}{e^{-\alpha} - 1} \right\} \quad (2.38)$$

Copulas PDF function Frank has a form

$$C^c(F_1(x), F_2(y)) = \frac{\alpha f_1(x) f_2(y) e^{\alpha F_1(x) - \alpha F_2(y)}}{(e^{-\alpha} - 1)(1 + D_1(\alpha))} \quad (2.39)$$

By the parameter values $\alpha \neq 0$ and function $D_1(\alpha) = \frac{1}{\alpha} \int_0^\alpha \frac{u}{e^u - 1} du^{14}$

summarized by Bollerslev. This model is an ARMA model with GARCH tolerances can be as an extension of the entire model. ARMA and GARCH models can write ARMA-GARCH as follows (Bollerslev, 2007)[22].

14. Marginal estimation

Marginal estimation can be performed using the ARMA-GARCH model. The model was developed by Engle and is

$$X_t = \sum_{i=1}^p \alpha_i X_{t-i} + \sum_{i=1}^q b_i \eta_{t-i} + \eta_t \quad (2.40)$$

By

$$\eta_t = \sigma_t \varepsilon_t \quad (2.41)$$

$$\sigma_t^2 = c + \sum_{i=1}^r \alpha_i \eta_{t-1}^2 + \sum_{i=1}^s \beta_i \sigma_{t-1}^2 \quad (2.42)$$

By

ε_t = A random variable i.i.d so $c > 0$, $\alpha_i > 0$ for $i = 1, \dots, s$

X_t = Stock price at time t

X_{t-1} = Stock price at time t-1

α_i, b_i = Constants or coefficients of variables

η_t = The product of the standard deviation and the time error t

η_{t-1} = The product of the standard deviation and the time error t-1

η_{t-1}^2 = The product of the standard deviation and the error at t-1 squared.

σ_t = Standard deviation at time t

σ_t^2 = Variance at time t

σ_{t-1}^2 = Variance at time t-1

The main feature of this model is that the Conditional Variance of tolerances can change over time. Often ε_t is assumed to have a Standard Normal Distribution. Therefore, estimation of variables can be obtained by log-likelihood conditional has the highest value (Bollerslev, 2007) [22].

15. Marginal Test

Marginal tests can be performed using the Lagrange Multiplier (LM-Test) and Kolmogorov-Smirnov tests (KS Test). The test methods can be explained (Jeffreys, 1961; Mohsen, 2011) as follows [12]

15.1. Lagrange Multiplier Test (LM Test)

Brush and Godfrey discussed the General Test that is easy to apply and correct for the General Hypothesis of Serial Correlation in Serial Correlation in Errors. This test is derived from the general principle called Lagrange Multiplier (LM Test). (Champawan,

2007; Jatapai, 2011) The Breusch – Godfrey Serial Correlation LM Test is a problem test Autocorrelation of errors in the regression model by using residual values from models that are considered regression analysis can consideration of recession (Chaloeykiatchaya, 2010) [21].

$$y_t = \sum_{i=1}^k x_{it}\beta_i + u_t \quad ; t = 1, 2, \dots, n \quad (2.43)$$

and

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \dots + \rho_p u_{t-p} + e_t \quad (2.44)$$

By

y_t = Dependent variable

x_{it} = Independent variables used in the model

β_i = Coefficient in the main equation

ρp = Coefficient in the error estimation equation

u_t = Error at time t

u_{t-p} = Error at time t-p

e_t = Error values of the approximation error equation

testing Breusch – Godfrey Serial Correlation LM Test is

$H_0: \rho = 0$ = No Serial Correlation

$H_1: \rho \neq 0$ = Serial Correlation

If the P Value is lower than the significance level, the main hypothesis $H_0: \rho = 0$ will be rejected, indicating that there is Serial Correlation. On the other hand, if the P Value is higher

than the significance level, the main assumption is $H_1: \rho \neq 0$ means that there is no Serial Correlation.

16. Kolmogorov - Smirnov (KS Test)

Kolmogorov- Smirnov test is a technique that does not use parameters to test the distribution of populations. Is a test about the sample group whether they have the form of distribution like the theory or like the population or not by using the cumulative frequency of the samples divided in stages, Kolmogorov - Smirnov test is different from the chi-square test (Chi-square test) where the Kolmogorov-Smirnov test specifies that the distribution of the samples must be continuous, not discrete, that is, the dividing dividers cannot be separated. Got the Kolmogorov- Smirnov test. The test statistics given by.

$$D = \max |F(x) - S(x)| \quad (2.45)$$

$F(x)$ = The expected proportion of data with scores less than or equal to X

$S(x)$ = Relative cumulative frequency observed in the sample

The hypothesis Kolmogorov - Smirnov (KS Test) is to compare the cumulative probability of the sample ($S(x)$) with the cumulative probability, namely

H_0 = The population is distributed as expected.

H_1 = The population is not distributed as expected.

If D is greater than the critical values obtained from the Kolmogorov-Smirnov test table, $F(x)$ and $S(x)$ are very different, rejecting the H_0 key assumption that the population does not have the expected distribution but if D is small than the critical values from the Kolmogorov-Smirnov test table have to accept the H_0 key hypothesis, that the population has the expected distribution.

17. Choosing the right Copula model

In estimating the econometric equations, the criteria for selecting the model of the model are most appropriate if there are many Copulas models, also wanted a way to compare models many

tests were proposed for testing the limitations of copulas. The appropriateness testing of many distributions has only a small selection criteria, which is appropriate for the copula. (A. L. Patton, 2006a; 2004)

18. Bayesian Information Criterion: BIC

One idea that can easily be considered to find the best model that is to consider the probability after the highest adjustment. This Bayesian concept is a concept that can lead to finding the best model with a probability model. In some cases, considering a model will find multiple models with the highest probability of adjusting many models simultaneously [16,26,33].

Since selection of the model with Bayesian concept will determine the later probability value for every interesting subject which may contain all of the larger possible spaces and it is difficult to consider all possible models Therefore, there is a need to find a method to find the model, Occam's Window, which is a method for determining the probability ratio for comparing two models with the principles of consideration (Shumway, 2006) as follows:

- If the Log Posterior Odds are positive, then the data is clear in supporting the model. Therefore, will reject M_1 and

will consider M_0 . The Log Posterior Odds can be set as a constant plus $O_R W$ before rejecting M_1 .

- If the Log Posterior Odds are negative That shows that the available data is unclear in supporting the simple model. Therefore, have to keep both of these models.

- If the Log Posterior Odds are large and positive, that is less than $O_L = \log(C)$, so will reject M_0 and consider M_1 .
- If the subject has a later probability of being away from the best model that model is no longer reliable and is no longer considered.

$$A' = \left\{ M_1 : \frac{\max_1 \{p(M_0|X)\}}{p(M_1|X)} \right\} \leq C \quad (2.46)$$

Therefore, the model that According to the above equation (2.76) will be cut off from the model space in the above equation, C is a large value and is the value chosen by the researcher for most researches. $C = 20$ is usually determined for comparison in cases where the significance level is 0.05 and $C = 100$ for comparison in cases where the significance level is 0.01.

19. Literature Review

Balamurali and Bogahawatte studied the relationship between foreign direct investment and economic growth of Sri Lanka. Using yearly time series data from 1997 to 2003 using the maximum likelihood co-integration technique of Johansen and Juselius as economic variables and GDP is a function of foreign direct investment, domestic investment and international trade [34]. In addition, it also tested the reasoning between the Granger Causality Test from the Error Correction Model, found that foreign direct investment there are two relations that are related to Gross Domestic Product. Which has a positive relationship same as Domestic investment and international trade as well.

James B. Ang Studied Determinants of Foreign Direct Investment in Malaysia by using yearly time series data from 1960 to 2005, independent variables were financial development growth rate of Gross Domestic Product, Infrastructure development, Net import and export, real exchange rate economic instability and the tax rate under the law using GARCH and Error-Correction Model. The results of the study showed that the growth rate of the Gross Domestic Product varies directly with foreign direct investment. The tax rate and exchange rate stability are hindering foreign investment [35].

Intar studied Independent Study Title Test of Relationship between Inflation and Economic Growth of Thailand by Using Bivariate GARCH Model [36]. The objective of this study was to study the relationship between inflation in Thailand and economic growth using the Bivariate GARCH model. Real GDP and consumer price index (CPI) were selected to study for 2 affecting economic variables. Data for analysis were time-series starting quarterly from the first quarter, 1998 to first quarter of 2008. The results showed that both economic growth and inflation rate had the same order of integration with 0 or I(0).

For the fluctuation of inflation rate and economic growth rate, it was found that the volatility of economic growth rate was GARCH (1, 1) and the inflation in Thailand was GARCH (0, 1). The resulting relationship between inflation and economic growth of Thailand by using Bivariate GARCH, signified a

Bivariate GARCH (0,1). The relationship between 2 variables had positive and negative relationship. By explaining, the volatility of inflation in Thailand had negative effects to the volatility of economic growth, while the volatility of economic growth had positive effects to the volatility of inflation in Thailand.

Kawewong studies of Test of Relationship Between the Foreign Direct Investment and Economic Growth of Thailand Using the Vector Autoregression Approach. Variables used in the study are real gross domestic product, domestic consumption, foreign direct investment, domestic direct investment, government spending and balance of trade [37]. Before conducting Vector Autoregression (VAR) model estimation stationary test of the time series were undertaken as well as the lag length determination. Used were quarterly data during 1997–2008, for analysis by Impulse Response Function to study the direction of response of variables of interest when shock occurred in GDP, and for deriving Variance Decomposition to determine the extent of impact on one variable from other variables as well as from itself. Augmented Dickey-Fuller test (ADF test) and Phillips Peron test (PP test) were undertaken to assure the stationarity of the time series. Sets of data were found stationary at I(0) at 0.01 statistically significant level shows. The results of VAR Impulse Response Function estimation showed that a shock in the GDP would cause the GDP in subsequent periods to go down and the GDP would recover to normal level in 8th quarter. The shocks in government spending, domestic consumption, balance of trade, the net foreign direct investment, and domestic were found to have similar effect on the GDP in terms of direct investment response direction and time length for adjustment. The investigation of Variance Decomposition found volatility of GDP growth depended primarily on the GDP growth the preceding period and secondarily on the government spending, domestic consumption, the net foreign direct investment, net domestic direct investment and balance of trade but all in smaller.

Timanee studied the Test of Relationship Between Interest Rate and Foreign Direct Investment in Thailand by Using Bivariate GARCH Model [38]. Two variables, foreign direct investment and interest rate, were studied by using secondary data as a time series on a monthly basis between 1997 to 2009 with a total of 146 observations. The Augmented Dickey-Fuller test (ADF test) results found that the interest rates and foreign direct investment had the same order of integration with 0 or I(0). The estimation of the average interest rate equation resulted in the form of ARMA as AR(5) MA(5). The average equation for foreign direct investment resulted AR(1). The volatility of

interest rates and foreign direct investment are both GARCH (1,0). The relationship between interest rates and Constant Conditional Correlation (CCC) investment and the relationship between interest rates and Dynamic Conditional Correlation (DCC) investment from standardized shocks test results both indicated that they had no relation between interest rates and foreign direct investment. Paolimlee studied of The Relationship Between Foreign Direct Investment and Economic Variables of the APEC Member Economies Using Panel Data, The objective of this study is to study the relationship between foreign direct investment and the economic variables of countries in Asia Pacific using panel data, with the economic variables used in the study such as Gross Domestic Product [39]. Basic domestic Exchange rate Loan interest rate The export value and consumer price index of each country are based on quarterly secondary data from 1998 to 2008 by using the method of estimation using the Pool OLS method, Fixed Effect Model and Random Effect Model. The results show that the interest rates on loans and export values are stable at order of integration at level 1 or at level I (1), while foreign direct investment data Gross domestic product The exchange rate and the consumer price index are characterized by the order of integration equal to 0 or at level I (0). The results of the Pooled OLS method and the Random Effect Model provide the same result: the value of foreign direct investment. Correlated with gross domestic product value Consumer price index and foreign direct investment in the previous quarter in the same direction, only the exchange rate has the opposite direction. As for the test of the Fixed Effect Model, it was found that the value of foreign direct investment correlated with the value of foreign direct investment in the previous quarter in the same direction and is related to the exchange rate in the opposite direction.

Manlikamarl studied Dependent Structure of Exchange Rate and Inflow Foreign Direct Investment in ASEAN Member Countries Using VARMA- GARCH Copula Approach [40]. The time series data of daily exchange rate since January 1st, 2000 until December 31st, 2013 and quarterly data of foreign direct investment (FDI) from 1st quarters of 2000 to 4th quarters of 2013 of 4 ASEAN member countries including Singapore, Thailand, Malaysia, and Indonesia were analyzed. The study found that when data was grouped in the Asymmetric Copula, the risk on exchange rates volatility was high. While, the data was grouped in the Symmetric Copula, the risk on exchange rates volatility was limited.

Inphomthilath studied the Analysis of Dependency Structure among Exchange Rate, Inflation Rate, and Gross Domestic

Product of The Lao People's Democratic Republic Using Multivariate Copula Approach. Laos's economic factors such as exchange rates, inflation rates and gross domestic products (GDP) during 1991 to 2015 were analyzed by the AR-GJR Copula model [11]. The result estimated in symmetric Copula models represented the monetary policies of Laos PDR were an efficient implementation in the past, while the outcome analyzed in asymmetric Copula models showed the contrary Phyu studies of Effect of Foreign Direct Investment on GDP Growth of Myanmar: Analysis for the year of 1989-2014 [41]. As Myanmar is one of the developing countries, this paper investigates mainly on how FDI promotes economic growth of Myanmar in terms of GDP and what the fundamental investment policies are to unleashing FDI potential for Myanmar. To analyze the effects of FDI on GDP growth of Myanmar before and after new foreign investment law has been enacted is the main objective of this study. Annual time series data set of Myanmar were collected from many sources for the year from 1971 to 2014. The results from OLS regression obviously revealed that all the variables play an important role by explaining the gross domestic product. Moreover, the result from SWOT analysis discovered that the factors which the firms considered most important for evaluation investment climate of a host country are the political stability, followed by infrastructures, well established laws and regulations, administrative efficiency, availability of foreign exchange and low wages. From these results, it can be concluded that the effects of foreign direct investment on GDP growth of Myanmar had positively significant during the study period of 1989 to 2014. The foreign investment law and exchange rate policy were significantly effects on economic growth of Myanmar.

Sapsaard studies of foreign direct investment and spillover effect in ASEAN to Thai economy. The main components that are interested in this study are Capital flows directly from the ASEAN countries that flow into Thailand. Which is classified by country and the economy of Thailand is financial market the growth of Gross Domestic Product, Industrial production, inflation, import and export. Use data as a quarterly time series from the first quarter of 2005 to the 2nd quarter of 2017, a total of 49 quarters were analyzed. Time series data and Bayesian estimation were applied in the study. And the methods below are based on the VAR model and multiple analysis Therefore, the results of the study found that the impact of direct investment from ASEAN countries and the side effects are very important to the Thai economy [42].

Author	Title	Method/Variable
Balamurali & Bogahawatte (2004)	Study the Relationship Between Foreign Direct Investment and Economic Growth of Sri Lanka.	Method of the study using the maximum likelihood co-integration technique of Johansen and Juselius as economic variables and using yearly time series data from 1997 to 2003
James B. Ang (2007)	Determinants of Foreign Direct Investment in Malaysia.	Using yearly time series data from 1960 to 2005 and independent variables and using GARCH and Error-Correction Model.
Intar (2008)	Test of Relationship Between Inflation and Economic Growth of Thailand by Using Bivariate GARCH Model.	Real GDP and CPI were analyzed with time-series starting quarterly from the first quarter, 1998 to first quarter of 2008 by using the Bivariate GARCH model.
Kawewong (2009)	Test of Relationship Between the Foreign Direct Investment and Economic Growth of Thailand Using the Vector Autoregression Approach.	Variables used in the study are real gross domestic product, domestic consumption, foreign direct investment, domestic direct investment, government spending and balance of trade. By using the Vector Autoregression Approach. Before conducting Vector Autoregression VAR) model estimation stationary test of the time series were undertaken as well as the lag length determination. were used quarterly data during 1997 – 2008.

Table: 2 Summary of Literature Review Table 2.1: Summary of Literature Review (cont.)

Author	Title	Method/Variable
Timanee (2009)	The Test of Relationship Between Interest Rate and Foreign Direct Investment in Thailand by Using Bivariate GARCH Model.	Foreign direct investment and interest rate, were studied by using secondary data as a time series on a monthly basis between 1997 to 2009 with a total of 146 observations.
Paolimlee (2010)	The Relationship Between Foreign Direct Investment and Economic Variables of the APEC Member Economies Using Panel Data.	The economic variables used in the study such as Gross Domestic Product. Basic domestic Exchange rate Loan interest rate, the export value and consumer price index of each country are based on quarterly secondary data from 1998 to 2008 by using the method of estimation using the Pool OLS method, Fixed Effect Model and Random Effect Model.

Table 3: Summary of Literature Review (cont.)

Author	Title	Method/Variable
Manlikamarl (2014)	Dependent Structure of Exchange Rate and Inflow Foreign Direct Investment in ASEAN Member Countries Using VARMA- GARCH Copula Approach.	Econometric method using VARMA- GARCH Copula Approach and data is the time series data of daily exchange rate since January and quarterly data of foreign direct investment (FDI) from 1st quarters of 2000 to 4th quarters of 2013 of 4 ASEAN member countries including Singapore, Thailand, Malaysia, and Indonesia were analyzed.
Inphomthilath (2015)	The Analysis of Dependency Structure among Exchange Rate, Inflation Rate, and Gross Domestic Product of The Lao People's Democratic Republic Using Multivariate Copula Approach.	Using Multivariate Copula Approach. Laos's economic factors such as exchange rates, inflation rates and gross domestic products (GDP) during 1991 to 2015 were analyzed by the AR- GJR Copula model.

Table 4: Summary of Literature Review (cont.)

Author	Title	Method/Variable
Phyu (2017)	Effect of Foreign Direct Investment on GDP Growth of Myanmar: Analysis for the year of 1989-2014.	To analyze the effects of FDI on GDP growth of Myanmar before and after new foreign investment law has been enacted is the main objective of this study. Annual time series data set of Myanmar were collected from many sources for the year from 1971 to 2014. The results from OLS regression obviously revealed that all the variables play an important role by explaining the gross domestic product.
Sapsaard (2018)	Foreign Direct Investment and Spillover Effect in ASEAN to Thai economy.	Use data as a quarterly time series from the first quarter of 2005 to the 2nd quarter of 2017, a total of 49 quarters were analyzed. Time series data and Bayesian estimation were applied in the study and the methods below are based on the VAR model and multiple analysis.

Table 5: Summary of Literature Review (cont.)

20. Methodology

20.1. Scope of the Study

The study in the dependency structure of Gross Domestic Product and inflow of foreign direct investment from China in the Five ASEAN countries, uses Secondary Data which is a time series data. This research uses the annual gross domestic product of ASEAN countries, including Singapore, Malaysia,

Thailand, Philippines, and Indonesia from 1996 to 2018, with the yearly data on direct capital inflows from China to the mentioned ASEAN countries in the same period of time. The data were obtained from the CEIC data database for analysis of the dependency structure between Gross Domestic Product and inflow of foreign direct investment from China in ASEAN countries using VARMA-GARCH Copula method.

21. Conceptual framework/Model

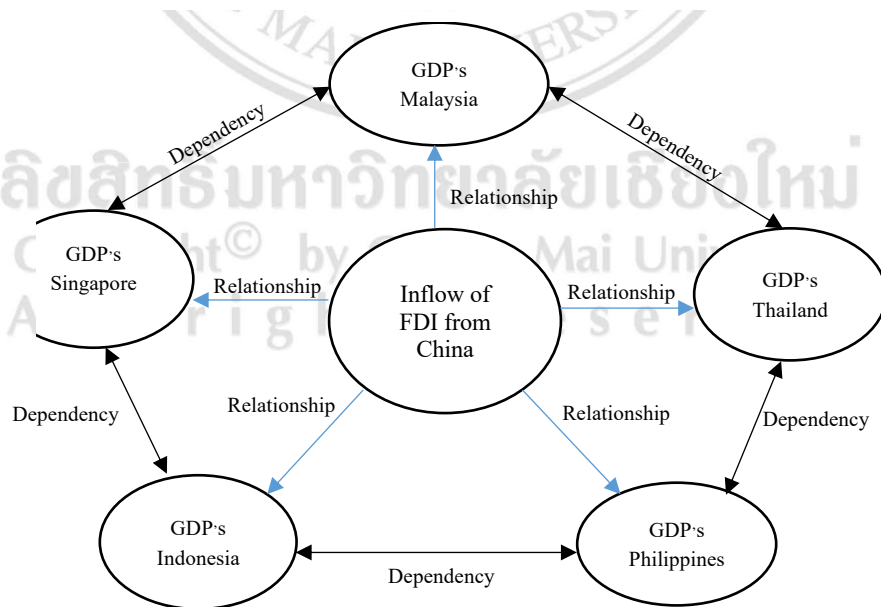


Figure 3: Framework and Model in Education.

According to the previous framework to clarify, the relationship of inflow FDI from China that relates to GDP of each country in ASEAN in this study can show how their had relationship in positive or negative way. Additionally, the study the dependency structure in different GDP in each country, in order to ensure that they tend depend on another. can measure by the secondary data of Gross domestic product from Singapore, Malaysia, Thailand, Philippines and Indonesia, and the data of inflow of foreign direct investment from China within Singapore, Malaysia, Thailand, Philippines and Indonesia are converted into growth rate. Afterwards, the rate of growth will be used to analyze the fluctuation to analyze the relationship between each other including the calculate of residual by econometric method namely VARMA-GARCH and then take the residuals test in unit root tests by using the Philips-Perron and Ng-Perron method. When the data stationary, the autocorrelation problems and the data distribution are tested by Lagrange Multiplier and Kolmogorov-Smirnov to determine whether there is a consistent distribution or not. In addition, from the result used to choose the appropriate Copula in order to explain the structure of dependency between gross domestic product and inflow of

foreign direct investment from china.

22. Data Collection

In analyzing the dependency structure between Gross Domestic Product and Inflow of Foreign Direct Investment from China, ASEAN countries use the Secondary Data of Gross Domestic Product of each country since 1997 to 2018 and data of Inflow of Foreign Direct Investment from China since 1997 to 2018 from the CEIC data database.

22.1. Research Methodology/ Data Analyzing Method

In analyzing the dependency structure between Gross Domestic Product and Inflow of Foreign Direct Investment from China in ASEAN countries by using the VARMA-GARCH copulas method has the following steps. Convert Gross Domestic Product (GDP) and Inflow of Foreign Direct Investment (FDI) from China into each country to be in the form of growth rates which can be calculated as follows:

Growth rate of gross domestic product

$$GGDP_{G,t} = \left(\frac{y_t - y_{t-1}}{y_{t-1}} \right) \times 100 \quad (3.1)$$

By $GGDP$ = Growth rate of gross domestic product at time t
 y_t, y_{t-1} = Growth of gross domestic product, t and $t-1$

$$GFDI_t^i = \left(\frac{FDI_t^i - FDI_{t-1}^i}{FDI_{t-1}^i} \right) \times 100 \quad (3.2)$$

By $GFDI_t^i$ = Growth rate of inflow of foreign direct investment from china in each country at the time of t
 FDI_t^i = Inflow of Foreign Direct Investment from China into each country at the time of t
 FDI_{t-1}^i = Inflow of Foreign Direct Investment from China into each country at the time of $t-1$

foreign direct investment from China in each country tested in unit root tests by using the Philips- Perron (PP) as follows:

Philips-Perron Test (PP-Test)

The examination of data's stability by the Phillips-Perron method is the means of Non-parametric Statistics, used to control the Serial Correlation in Times Series Data. The Phillips-Perron method can be used by this following equation.

Take the residuals of the gross product rate and the amount of

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \varepsilon_t \quad (3.3)$$

By ΔY_t = First-order self-regression values for each country 'residual values
 Y_{t-1} = Time series data for residual values for each country
 α, β = Constants or coefficients of variables
 ε_t = Random deviation

the Mackinnon Statistics will reject the key assumptions. In conclusion, the time series data of the variables studied at time t is stable. On the other hand, if the test statistics Phillips-Perron (PP-Test) is less than the Mackinnon Statistics will accept the key assumptions it can be concluded that the time series data of the variables studied at time t is unstable.

Hypothesis testing Phillips-Perron (PP-Test) are as follows:

H_0 : The time series data of the variables studied at time t is unstable.

H_1 : The time series data of the variables studied at time t is stable.

Take the endogenous variables in model by using Gross Domestic Product and the amount of inflow of Foreign Direct Investment from China of in each country that is in the form of the growth rate to analyze the relationship between each other including the calculate of residual from the Vector Autoregressive Moving Average-GARCH (VARMA-GARCH) model as follows:

If the test statistic Phillips-Perron (PP-Test) greater than

$$y_t = c + \sum_{i=1}^r \Phi_i y_{t-i} + \sum_{l=0}^L \beta_l x_{t-l} + \varepsilon_t + \sum_{j=1}^s \Theta_j \varepsilon_{t-j} \quad (3.4)$$

By Φ_i = Autoregressive Coefficient Matrix $k \times k$ Θ &
 Θ_j = Moving Average Coefficient Matrix $k \times k$
 x_t = Vector $m \times 1$ of Inflow of Foreign Direct Investment from China in each country.
 y_t = Gross Domestic Product.
 β_t = Coefficient $k \times m$ of x_{t-l}
 ε_t = Error term (Spillover effect)

of gross domestic product and the amount of inflow of foreign direct investment from China into each country for further analysis of the dependent structure.

Autocorrelation test and data distribution by testing Lagrange Multiplier (LM-Test) and Kolmogorov-Smirnov (KS-Test)

Lagrange Multiplier (LM-Test)

Lagrange Multiplier (LM-Test) is a test of problems Autocorrelation of errors in the regression model by using residual values from models that are considered regression analysis, regression can be considered as follows:

From the above VARMA-GARCH model, it can explain the effects and shocks, both positive shock and negative shock, which can affect conditional volatility along with the residual values from the analysis of the relationship of the growth rate

$$y_t = \sum_{i=1}^k x_{it} \beta_i + u_t \quad ; t = 1, 2, \dots, n \quad (3.5)$$

And

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \dots + \rho_p u_{t-p} + e_t \quad (3.6)$$

By

y_t = Inflow of Foreign direct investment from China in each country.

x_{it} = Gross domestic product rate

β_i = Coefficient in the main equation

$\rho\rho$ = Coefficient in the error estimation equation

u_t = Error at time t

u_{t-1} = Error at time t - p

e_t = Error values of the approximation error equation Hypothesis testing Breusch – Godfrey Serial Correlation LM Test is

$H_0: \rho = 0$ No Serial Correlation

$H_1: \rho \neq 0$ With Serial correlation

If the P Value is lower than the significance level, the main hypothesis $H_0: \rho =$

0 will be rejected, indicating Serial Correlation. On the other hand, if the P Value is higher than the significance level, the main assumption is $H_0: \rho = 0$ Means that there is no Serial Correlation.

Kolmogorov - Smirnov (KS Test)

Kolmogorov - Smirnov (KS Test) is a technique that does not use parameters to test the distribution of populations. Is a test about the sample group whether they have the form of distribution like the theory or like the population or not by using the cumulative frequency of the samples divided into stages, whether different from the theory or the population or not. Kolmogorov-Smirnov test has the test statistics as follow:

$$D = \max |F(x) - S(x)| \quad (3.7)$$

When $F(x)$ = The expected proportion of data with scores less than or equal to X $S(x)$ = Relative of cumulative frequency observed in the sample

The hypothesis of Kolmogorov - Smirnov (KS Test) is

H_0 : The population is distributed as expected.

H_1 : The population is not distributed as expected.

If D is greater than the critical values obtained from the Kolmogorov-Smirnov test table, $F(x)$ and $S(x)$ are very different, rejecting the H_0 : key assumption that the population does not have the expected distribution but if D is small than the critical values from the Kolmogorov-Smirnov test table have to accept the key assumption H_0 : , that the population has the expected distribution.

Find a suitable model to explain the dependency structure using the Copulas, The Copula model can be classified into 2 families namely the Elliptical Copula function and the Archimedean Copulas function as follows:

Elliptical Copulas The Copula function Optimal groups can be divided into 2 types are the Gaussian Copula function and the Student's t function the 2 types of Copula functions can be described as follows:

Gaussian Copula or Normal Copula The Gaussian Copula is the copulas function $C^{Ga}(v, z)$ that connects the X and Y variables that have a unique cumulative probability function is $F_1(X)$ and $F_2(Y)$ can be written as follows:

$$C^{Ga}(v, z) = C^{Ga}(\Phi(s), \Phi(t)) = \int_{-\infty}^{\Phi^{-1}(v)} \int_{-\infty}^{\Phi^{-1}(z)} \frac{1}{2\pi\sqrt{1-p_{12}^2}} e^{\frac{2p_{12}st-s^2-t^2}{2(1-p_{12}^2)}} ds dt \quad (3.8)$$

By

v, z = Expectations of gross domestic product and inflow of foreign direct investment from China in each country (SG, TH, MAL, PHIL and ID)

The Student's t copula function indicates the risk behaviors

of normal variables that are less fluctuate and that the actual probability is very different from the expected value it can be the positive and the negative.

The Copula function CDF form Student's t as follow:

$$C_{\rho, \delta}^{\delta}(v, z) = \int_{-\infty}^t \delta^{-1}(v) \int_{-\infty}^t \delta^{-1}(z) \frac{1}{2\pi\sqrt{1-\rho^2}} \left(1 + \frac{s^2 + t^2 - 2\rho st}{\delta(1-\rho^2)}\right)^{-\frac{\delta+2}{2}} ds dt \quad (3.9)$$

v, z = Expectations of gross domestic product and inflow of foreign direct investment from China in each country (SG, TH, MAL, PHIL and ID)

The Copula function PDF form Student's t as follows:

$$C_{\rho, \delta}^{\delta}(v, z) = \frac{1}{\sqrt{\rho}} \frac{\Gamma\left(\frac{\delta+2}{2}\right) \Gamma\left(\frac{\delta}{2}\right)}{\Gamma\left(\frac{\delta+1}{2}\right)^2} \frac{\left(1 + \frac{s^2 + t^2 - 2\rho st}{\delta(1-\rho^2)}\right)^{-\frac{\delta+2}{2}}}{\left(1 + \frac{s^2}{\delta}\right)^{-\frac{\delta+2}{2}} \left(1 + \frac{t^2}{\delta}\right)^{-\frac{\delta+2}{2}}} \quad (3.10)$$

By v, z = Expectations of gross domestic product and inflow of foreign direct investment from China in each country (SG, TH, MAL, PHIL and ID)

Archimedean Copulas The Archimedean Copulas for describing the relationships between the two most commonly used variables are 3 types: Archimedean Gumbel, Archimedean Clayton and Archimedean Frank.

The Archimedean Gumbel Copulas shows the most asymmetric relationship between variables by copula function Gumbel able to explain the relationship of the variable values concentrated to the right (Upper Tail Dependence).

Copulas PDF function Gumbel as follow:

$$C^G(F_1(x), F_2(y)) = C^G(F_1(x), F_2(y)) \times \frac{1}{F_1(x), F_2(y)} \times \left(\ln(F_1(x)) \ln(F_2(y)) \right)^{\alpha-1} \times \left\{ \left(-\ln(F_1(x)) \right)^\alpha + \left(-\ln(F_2(y)) \right)^\alpha \right\}^{-2+\frac{1}{\alpha}} \times \left\{ \left(-\ln(F_1(x)) \right)^\alpha + \left(-\ln(F_2(y)) \right)^\alpha + \alpha - 1 \right\} \quad (3.11)$$

The Archimedean Clayton Copulas show relationship between variables that have the nature is quite symmetrical. To illustrate, the indicates of Archimedean Clayton has concentration of the variables in the lower tail area quite a lot. (Lower Tail Dependence)

Copulas CDF function Clayton as follow:

$$C^c(F_1(x), F_2(y)) = \max \left\{ \left[(F_1(x))^{-\alpha} + (F_2(y))^{-\alpha} - 1 \right]^{-\frac{1}{\alpha}}, 0 \right\} \quad (3.12)$$

By v, z = Expectations of gross domestic product and inflow of foreign direct investment from China in each country (SG, TH, MAL, PHIL and ID)

Copulas PDF function Clayton as follow:

$$C^c(F_1(x), F_2(y)) = \left\{ (F_1(x))^{-\alpha} + (F_2(y))^{-\alpha} - 1 \right\}^{-2-\frac{1}{\alpha}} \times (F_1(x))^{-\alpha-1} \times (\alpha+1) \times (F_2(y))^{-\alpha-1} \quad (3.13)$$

By v, z = Expectations of gross domestic product and inflow of foreign direct investment from China in each country (SG, TH, MAL, PHIL and ID)

describing the relationship of variables where the concentration of variables is not quite right or left (No Tail Dependence).

The Archimedean Frank Copulas function shows the relationship of variables with the most symmetry levels it is suitable for

Copulas CDF function Frank type has a form

$$C^c(F_1(x), F_2(y)) = -\frac{1}{\alpha} \ln \left\{ 1 + \frac{(e^{-\alpha F_1(x)})(e^{-\alpha F_2(y)} - 1)}{e^{-\alpha} - 1} \right\} \quad (3.14)$$

By v, z = Expectations of gross domestic product and inflow of foreign direct investment from China in each country (SG, TH, MAL, PHIL and ID)

Copulas PDF function Frank –type has a form

$$C^c(F_1(x), F_2(y)) = \frac{\alpha f_1(x) f_2(y) e^{\alpha F_1(x) - \alpha F_2(y)}}{(e^{-\alpha} - 1)(1 + D_1(\alpha))} \quad (3.15)$$

By v, z = Expectations of gross domestic product and inflow of foreign direct investment from China in each country (SG, TH, MAL, PHIL and ID)

23. Empirical Result and Discussion

23.1. Methodology

Transforming the gross domestic product (GDP) and inflow of foreign direct investment from China (FDI) to 5 ASEAN countries into the growth rate form Revealing the results of a test for stationarity or the Unit Root Test from the data in the growth rate form by the Philips-Perron (PP) approach Analysing the GDP growth volatility and China's foreign direct investment in the countries of ASEAN-5 by the VARMA-GARCH approach. Finding the error values (Residuals) of each country by the autocorrelation test, data distribution by the Lagrange Multiplier test (LM-Test) and applying the Kolmogorov-Smirnov test (KS-Test) to investigate that if there is a uniform distribution or there is none, Analysing the structure dependency from the copulas demonstration and comparing the results in order to discover the most suitable model.

Analysing and comparing values from the model selection criteria by using the Bayesian Information Criterion: BIC to find the most appropriate model. By that, the model which gives the lowest AIC value, provides the accurate prediction of value.

24. Empirical Result

The result of the stationarity test or the Unit Root test for each country is discovered by the Philips-Perron method (PP-Test). The Phillips-Perron test is used to reveal the order of integration that makes the data stationary by starting with the order of integration's value. The value needs to be 0 or I (0) at levels with intercept point, levels with trend and intercept, and levels without trend and intercept, respectively. If the time series data is non-stationary at I(0), it must be tested by using the order of integration with a value greater than or equal to 1 or I(1), known as the first difference level. The test is continued, until the data is stationary.

Variables	With Intercept	
	1 st difference	Probability
SG	-9.6268	0.0000
MA	-8.6998	0.0000
TH	-7.8916	0.0000
PH	-12.7259	0.0000
IN	-9.1962	0.0000
CHFDI	-17.43427	0.0000

Source: computation

Table 6: Results of data stability test using Phillips-Perron (PP Test) with intercept

Table 6. shows the results of data tested by Phillips- Perron test at levels with intercept. The tests found that all data for Singapore, Malaysia, Thailand, Philippines, and Indonesia regarding China's foreign direct investment (CHFDI) was stationarity at I(1) with a 99% confidence level.

The results of structure dependency between GDP and FDI in ASEAN-5 are tested by the VARMA-GARCH method.

After the conversion of GDP and China's foreign direct investment (CHFDI) in Singapore (GDPSH, CHFDI), Malaysia (GDPMA, CHFDI), Thailand (GDPTH, CHFDI), Philippines (GDPPH, CHFDI) and Indonesia (GDPID, CHFDI), the next step is to analyse the ASEAN- 5's GDP volatility and CHFDI by the VARMA- GARCH method which illustrates through unexpected circumstances (Shock) including positive shock and negative shock. Both shocking circumstances have an influence on the conditional volatility.

	c	AR	MR	ω	α_{GDPSH}	α_{CHFDI}	β_{GDPSH}	β_{CHFDI}	$\alpha + \beta$	Loglikelihood
GDPSH	-0.056	0.167	0.089	109.699	0.009	0.194	-0.077	-0.843	-0.649	-504.1048
CHFDI	-1.563	-0.168	-1.684	190324.890	0.208	-0.995	-0.361	-0.477	-0.153	

Source: computation

Table 7: The result of ASEAN-5's GDP growth volatility and CHFDI of Singapore by the VARMA-GARCH method

Tables 4.2 to 4.6 show the mean estimation and conditional volatility by the VARMA- GARCH model. The ARCH (α) refers to the short-term impact of each variable while the GARCH (β) refers to the long-term impact of each variable.

4. 2 shows that the impact of own past shock, or short- term impact (the value α), of the GDP remains at 0. 194, a short- term impact lower than Singapore' s FDI (0. 208) . Moreover, it is

found that there are relations of volatility between GDP and FDI within the country, influencing each other at high levels, as seen by looking at β , which has statistical significance. Apart from that, the value of $\alpha + \beta$ gives an assumption of moving back to equilibrium in the long term after being affected by shock of the country' s GDP (-0.649). The country's GDP recovers lower than FDI from China in Singapore (-0.153)

	c	AR	MR	ω	α_{GDPSH}	α_{CHFDI}	β_{GDPSH}	β_{CHFDI}	$\alpha + \beta$	Loglikelihood
GDPMA	0.164	0.024	0.694	99.163	-0.035	0.194	0.094	-0.843	-0.649	-504.1048
CHFDI	-1.563	-0.168	-1.684	190324.890	0.341	-0.311	-0.681	-2.114	-0.34	

Source: computation

Table 8: The analysis results of volatility between GDP and CHFDI of Malaysia by the VARMA-GARCH model.

It states that the impact of own past shock or a short-term impact or the value (α) of GDP remaining at 0. 194, which have a short-term impact lower than Malaysia' s FDI from china (0. 341). Moreover, it is found that there are relations of volatility between

GDP and FDI from china within the country, influencing each

other at high levels by looking from the value (β) that has statistical significance. Apart from that the value of $\alpha + \beta$ gives an assumption of moving back to equilibrium in the long term after being affected by shock of the country' s GDP (- 0. 649). The country's GDP gets recovered lower than FDI from China in Malaysia (-0.34).

	c	AR	MR	ω	α_{GDPSH}	α_{CHFDI}	β_{GDPSH}	β_{CHFDI}	$\alpha + \beta$	Loglikelihood
GDPMA	0.247	0.159	0.164	96.556	-0.002	0.194	0.111	-0.843	-0.649	-504.1048
CHFDI	-1.563	-0.168	-1.684	190324.890	0.355	-2.426	-0.741	10.657	-0.386	

Source: computation

Table 9: The analysis results of volatility between GDP and CHFDI of Thailand by the VARMA-GARCH model.

The impact of own past shock or a short-term impact or the value (α) of GDP remaining at 0.194, which have a short-term impact lower than Thailand's FDI from china (0.355). Moreover, it is found that there are relations of volatility between GDP and

FDI from china within the country, influencing each other at high levels by looking from the value (β) that has statistical significance. Apart from that the value of $\alpha + \beta$ gives an assumption of moving back to equilibrium in the long term after

being affected by shock of the country's GDP (-0.649). The country's GDP gets recovered lower than FDI from China in Thailand (-0.38).

	c	AR	MR	ω	α_{GDPSH}	α_{CHFDI}	β_{GDPSH}	β_{CHFDI}	$\alpha + \beta$	Loglikelihood
GDPMA	-0.381	0.940	0.131	263.216	0.074	0.194	-0.067	-0.843	-0.649	-504.1048
CHFDI	-1.563	-0.168	-1.684	190324.890	0.446	-0.212	-0.030	-0.019	0.416	

Source: computation

Table 10: The analysis results of volatility between GDP and CHFDI of Philippines by the VARMA-GARCH model.

The impact of own past shock or a short-term impact or the value (α) of GDP remaining at 0.194, which have a short-term impact lower than Philippines's FDI from china (0.446). Moreover, it is found that there are relations of volatility between GDP and FDI from china within the country, influencing each other at high levels by looking from the value (β) that has statistical

significance. Apart from that the value of $\alpha + \beta$ gives an assumption of moving back to equilibrium in the long term after being affected by shock of the country's GDP (-0.649). The country's GDP gets recovered faster than FDI from China in Philippines (0.416).

	c	AR	MR	ω	α_{GDPSH}	α_{CHFDI}	β_{GDPSH}	β_{CHFDI}	$\alpha + \beta$	Loglikelihood
GDPMA	-0.060	0.045	0.195	215.728	-0.009	0.194	-0.211	-0.843	-0.649	-504.1048
CHFDI	-1.563	-0.168	-1.684	190324.890	0.261	-0.221	-0.371	0.075	-0.11	

Source: computation

Table 11: The analysis results of volatility between GDP and CHFDI of Indonesia by the VARMA-GARCH model.

The impact of own past shock or a short-term impact or the value (α) of GDP remaining at 0.194, which have a short-term impact lower than Indonesia's FDI from china (0.261). Moreover, it is found that there are relations of volatility between GDP and FDI from china within the country, influencing each other at high levels by looking from the value (β) that has statistical significance. Apart from that the value of $\alpha + \beta$ gives an assumption of moving back to equilibrium in the long term after being affected by shock of the country's GDP (-0.649). The country's GDP gets recovered lower than FDI from China in Indonesia (-0.11). The result of the autocorrelation is tested by using the Breusch–Godfrey SerialCorrelationLMTtest.

The autocorrelation has a problem when the error residuals in a present time series have the relation with the error residuals in the previous time series. This error usually occurs in a time series data. Therefore, there must be an experiment for the autocorrelation before taking the data to analyse the variables afterwards.

The results of the serial correlation problem were examined from the residuals obtained from the Breusch-Godfrey Serial Correlation LM Test. The autocorrelated error terms can be tested by applying the Breusch–Godfrey Serial Correlation LM Test having $H: \rho = 0$ Non-Serial Correlation as its hypothesis. To clarify the hypothesis, $H: \rho = 0$ Serial correlation, if the P value is lower than the level of statistical significance, it will reject the null hypothesis. On the contrary, if the P value has more value than the level of statistical significance, it means that it is not problematic with the autocorrelation.

The results of error values (Residuals) of the autocorrelation from the ASEAN-5 countries are found by the Serial Correlation LM Test. The procedures of the Serial Correlation LM Test contain as follow.

F-statistic 0.042272				Prob. F(1, 14) 0.8401		
	SH	MA	TH	PH	ID	CHFDI
First Lag of LM test						
Prob.	0.9348	0.9960	0.9562	0.9453	0.9635	0.9910

Source: computation.

Table 12: Result of the serial correlation problem that were test by residual value from all countries.

Testing the residual values are independent of each other or not by The Breusch- Godfrey Serial Correlation LM-Test had a hypothesis that H_0 = Non - Serial Correlation from the probability part of the hypothesis test. All countries accept the hypothesis (H_0), meaning that the residuals of all countries are independent of each other (Non- Serial Correlation) The result of population distribution is discovered by the Kolmogorov-Smirnov (KS-Test) method. In this research, the Kolmogorov-Smirnov method (KS-Test) does not involve a parameter in the examination for population distribution in order to find out if the distributing method is the same as in the theory or not. Yet, this research aims to investigate the population distribution if

the distribution data is in a form of a uniform distribution or it is not. The hypothesis of Kolmogorov-Smirnov test (KS-Test) is H_0 , meaning that the data is in a form of a uniform distribution and H_1 , meaning that the data is not in a form of a uniform distribution. After considering the examination, if it is found that the Asymp.Sig values are higher than the statistical significance value for 0.05, the null hypothesis will be accepted that the population data is distributed in a form of a uniform distribution. In contrast, if the Asymp. Sig values are less than the statistical significance value for 0.05, it will reject the null hypothesis and refer to the data that is in a form of a non-uniform distribution.

	Kolmogorov-Smirnova		
	Statistic	df	Sig.
Z1	.076	21	.200*
Z2	.076	21	.200*
Z3	.076	21	.200*
Z4	.076	21	.200*
Z5	.076	21	.200*
Z6	.076	21	.200*

*.This is a lower bound of the true significance

a. Lilliefors Significance Correction

Table 13: Shows the result of population distribution tested by the Kolmogorov-Smirnov (KS-Test) method.

This is a lower bound of the true significance Lilliefors Significance Correction It is found that the resicible error value of all countries has the Sig. value as 0.200, which is greater than statistical significance value for 0.05. Therefore, the main hypothesis is acceptable that the residuals of these countries have an uniform distribution.

The result of structure dependency between GDP and FDI in ASEAN-5 is tested by the copulas method. The copulas approach is a statistical theory, invented by Sklar. The theory has been used on varied fields, for example, the field of financial administration which uses it for a measurement of value-at-risk in the analysis of structure dependency between GDP and FDI within the ASEAN-5 countries by collecting the data of GDP

and FDI from each country equally. Hence, there are 5 pairs for analysis including

Singapore (GDPSH and CHFDI), 2) Malaysia (GDPMA and CHFDI), 3) Thailand (GDPTH and CHFDI), 4) Philippines (GDPPH and CHFDI) and 5) Indonesia (GDPIDandCHFDI).

The copulas containing two variables have five different forms which are used in the examinations, namely Student's t Copula, Normal Copula, Frank Copula, Clayton Copula and Gumbel Copula. After finishing all investigations of these forms, the most appropriate model has to be selected to indicate the volatility of each group by analysing and comparing values from the Bayesian Information Criterion: BIC. Thus, the result reveals

the most suitable model by indicating the lowest AIC value. The model gives the accurate and correct prediction.

Parameter		Elliptical		Archimedean		
		t	normal	clayton	frank	gumbel
(SH,CHFDI)	BIC (Loglikelihood)	-15.11237 (10.6)	-17.77835 (10.41)	-16.91199 (9.978)	-16.6133 (9.829)	-16.078 (9.562)
(MA, CHFDI)		-51.77348 (28.93)	-53.63299 (28.34)	-55.07008 (29.06)	-49.30654 (26.18)	-49.52832 (26.29)
(TH, CHFDI)		-48.29836 (27.19)	-51.34291 (27.19)	-	-54.41971 (28.73)	-50.84318 (26.94)
(PH, CHFDI)		-46.01163 (26.05)	-48.20229 (25.62)	-	-56.01761 (29.53)	-46.71773 (24.35)
(ID, CHFDI)		-31.2383 (18.66)	-34.27071 (18.66)	-	-39.35385 (21.2)	-37.76274 (20.4)

Source : computation.

Table 14: The results of the analysis of the dependence structure of the data from the copula model.

As portrayed in table 9, it shows the volatility estimation in a form of the copulas demonstration for GDP and FDI in the countries (ASEAN-5). By that, the normal copula model of Singapore has the lowest point of BIC value as - 17. 77835 and has the log-likelihood value as 10.41. Moreover, Thailand, Philippines and Indonesia had the lowest BIC at the Frank copulas.

25. Discussion

The study of the construction of dependencies between gross domestic product (GDP) and inflow of foreign direct investment from China (FDI) within 5 ASEAN countries, utilizing VARMA-GARCH Copula as a mean proves that gross domestic product (GDP) of each country is the main variable effecting the foreign direct investment from China. As a result, in a short term, volatility of the gross domestic product growth in the focused countries has a positive impact on the inflow of Chinese direct investment in every country. Nonetheless, there is a negative impact afterwards. When the situation turns into balance, the volatility of gross domestic product growth has a small amount of impact from Chinese direct investment as appeared in Singapore, Malaysia, Thailand and Indonesia.

In contrast, the Philippines, its volatility of gross domestic product growth has a huge impact on Chinese direct investment as its gross domestic product still has the related direction with the Chinese investment. In other words, the country still has the positive relation with the investment as stated in The research mentions that gross domestic product per population is attractive for foreign direct investment when gross domestic product changes to increase. Due to the fact that gross domestic product of every country reflects the countries' income and expenses of households, business sections and government of ASEAN countries namely Cambodia, Laos, Myanmar and Vietnam (CLMV), when gross domestic product in a country per its population is high, it means the people in the country have efficient income to afford products and services increasingly.

This is the factor that attracts many foreign investors and causes developments in the country [9].

Apart from the gross domestic product factor, there is another associated study, called Dependent Structure of Exchange Rate and Inflow Foreign Direct Investment in ASEAN Member Countries by The study examines the factor that causes the direct investment is not only the unexpected risk that cannot be predicted, but also a risk of exchanging. Normally, the inflow of foreign currency has an effect towards money quantity in domestic economic system which may cause international business sections like importation and exportation to be considered about risk of investment [40]. In the same way, the result of this study provides the same explanation on (Maneejuk, 2014) saying that the economic cycle of ASEAN-5 has an expanded growth in a short term. In the length, the economy is prosperous. Fast and well-expanded investment is raised as investors expect profits and great interest from the investment. By that, it causes investors to be confident to invest. This also motivates employments and full uses of producing resources. Desired consumption expenditure is higher and inflation is increased. On the other hand, deflation status shows ASEAN-5 members have a growing rate of unemployment and a decreased number of gross domestic product, causing instable investments, less employment, less income for citizens and ending up with worse economy.

26. Conclusion and Suggestion

26.1. Analysis result

This study attempts to analyze the construction of dependencies between gross domestic product (GDP) and inflow of foreign direct investment from China (FDI) within 5 ASEAN countries, including Singapore, Malaysia, Thailand, Philippines, and Indonesia. To analyze, the GDP's data of each country and the data of foreign direct investment from China from 1996 to 2018 are used to discover the result by the VARMA- GARCH method

which is to consider from the lowest value of residuals in order to choose the most appropriate Copulas model.

According to the importance of ASEAN economy which is the world's great agriculture source as a large number of food and agricultural goods production, ASEAN has been currently known for its growing economy, a big market for international trades, a source of agricultural production by both domestic and foreign investments, and a high purchasing power on the market. Thus, this study reveals the results from the 5-ASEAN countries: Singapore, Malaysia, Thailand, Philippines, and Indonesia.

The results state that when the data is in the group of Asymmetric Copula, the foreign direct investment from China caused by the GDP's volatility of each country has been greatly affected. Those countries are Malaysia, Thailand, Philippines, and Indonesia. To illustrate, the economic circumstances of the countries are in the form of Asymmetry Copulas, known as the countries are facing the crisis of FDI from China which makes the economy within each country to have a problem in volatility towards GDP. This causes the economic simulation in their country in order to cope with the Chinese direct investment which makes their economy well expanded, so they can attract the foreign.

direct investments. This is important as every government pays attention to the attraction of foreign direct investment because this is the factor creating the country's GDP which spurs employment and incomes towards its population. The government has to consider the currency rate for the country to attract foreign direct investments, and develop policy corresponding to the economic situation that they need to recover and develop with sustainability. On the other hand, if the Copulas model of any country is considered in the Symmetric Copula, the volatility of GDP has been slightly affected by the foreign direct investment from China. Singapore is included in the category. Hence, the economy of the country has been growing steadily.

As the GDP growth within the country influences the foreign direct investment from other countries, if there was a sudden change of GDP, the FDI would be the most affected variable. Therefore, this study discovers the dependencies between gross domestic product (GDP) and inflow of foreign direct investment from China (FDI) that the most influential factor affecting FDI is GDP within those countries. The GDPs have a relationship with the foreign direct investment from China significantly. Also, economic growth is a cause that creates foreign direct investments.

27. The Knowledge from Literature Review

The study observed the construction of dependencies between gross domestic product (GDP) and inflow of foreign direct investment from China (FDI) in 5 ASEAN countries. Therefore, the researcher has collected different theories and various studies that are related to econometrics and the field. The engaged theories consist of 1. International Trade Theory, 2. Gross Domestic Product, 3. Foreign Direct Investment and Spillover Effect, 4. Concept of Inflow - Foreign Direct Investment, and 5. Econometric Theories.

28. The Knowledge Gaps Bridge to the Objectives

According to the associated research and analysis of economic variables such as gross domestic product (GDP), exchange rate, unemployment rate that might affect the whole economic system including gross domestic product, export value, or inflow of foreign direct investment etc., it is found that most of the surveyed studies are not deeply complex as they provide an explanation of statistical significance relations at an only specific level, not combined levels. The study does not only concentrate on the relation.

between gross domestic product (GDP) and 5 ASEAN countries' inflow of foreign direct investment from China (FDI), but also explains the relation from time to time by demonstrating an unexpected situation (shock) along with the construction of dependencies between gross domestic product (GDP) in ASEAN countries and direct inflow from China (FDI). By that, it is suitable for being seen through the influence of changes in gross domestic product (GDP) of ASEAN countries. The study is beneficial for all kinds of people like students, businesspersons, investors, governmental officers, and ordinary people who are interested in the construction of dependencies. For students and normal people, it is for them to learn and get to see the process in order to utilize this database for resolution in further research because the Copula model can be used and adapted in other fields e.g., Medicine, Engineering and Science via analyzing variables related to one another which is possible to have whether a great impact or not.

For investors and businesspersons, it helps them to see the changes of gross domestic product (GDP) that might influence businesses in the country where they are interested to establish a business in, as a way of making plan for international investment. Investors must learn and are able to analyze investing risks via economic news or modern research, so they can decide to invest afterwards.

For government and economic developers, by learning through the research, they can take this research to use as a database for making international policies. Each country, individually, can create the policies motivating foreign inflow for their country as this responsibility of controlling foreign investment (either support or prevention) lies in their hands.

29. The Important Results

The result of the study, it is discovered that in a short time, the volatility of gross domestic product (GDP) has a positive impact towards inflow of foreign direct investment from China (FDI) in every country. On the contrary, after the length has passed the positive point, the volatility of the gross domestic product growth has a negative impact towards the inflow of Chinese direct investment. This means, in a long term, economy in countries has adjusted itself to the situation after Chinese investors came. There is no economic adjustment in the short length of time which makes the economy changes to balance into the volatility of the gross domestic product growth. So, this has a small influence on the inflow of foreign direct investment from China (FDI) in Singapore, Malaysia, Thailand, and

Indonesia. Yet, in the Philippines, it has the volatility of the gross domestic product growth that massively affects the inflow of foreign direct investment from China (FDI) since its gross domestic product still has the same direction of relation with Chinese direct investment, known as positive relation.

The result of choosing the Copula model that is proper for explaining the construction of dependencies between gross domestic product (GDP) and inflow of foreign direct investment from China (FDI) in ASEAN-5 countries. It is found that Asymmetric Copulas model is suitable for these countries: Malaysia, Thailand, Philippines, and Indonesia as after Chinese direct investment, it makes these countries' economy have a well-expanded movement. Nevertheless, Singapore is categorized by using Symmetric Copulas model because its gross domestic product (GDP) has low volatility towards Chinese direct investment. As a matter of fact, Singapore, a developed country amidst the rest, can be independent and rely on itself that makes the Chinese direct investment have no impact towards its gross domestic product (GDP) and causes the domestic economy to grow.

30. Policy Suggestions

As a result, the policy suggestions can be provided as a beneficial contribution to normal people and governmental sections which is portrayed in the following paragraphs. Normal people such as students, analysts, and researchers in any fields can use the econometrics model analyzing the dependent structure by properly adapting to find out the explanation of dual relation's problem.

In medical field, for example, it can be used to discover the relation between continuously taking antibiotic medicines and liver capability as basically, antibiotic pills immensely affect the work ability of liver. The result can be found by the quantity of pills intake and the intense of urine value. It is possible that the result does not match the main hypothesis thanks to unpredicted conditions like a sample group having congenital diseases that makes the consequence different from the prediction.

In agriculture aspect, the model of dependent structure can also be used. To clarify, the dependence between quantitative rate of rainfall and reproductive products, divided into several categories: vegetables and fruits. In the same way, the result may not appear the same way of prediction. It is because of unpredicted situations like abundance of ground that can bear with different types of weather and plant. Therefore, dependent structure model can give a proper explanation of resolution of the relation.

Investors and entrepreneurs of multinational company who are planning to invest in a country they are interested in can learn from the result of the study and make a prediction of risk. International investment is a big business which must be well planned and prevented from risk factors like economy, international policies, and domestic and international investment. Afterwards, they can decide the place to invest and cope with bearable risks they must confront. It cannot deny that there will always be risks in

every investment. Hence, making a prepared decision must be made by considering effecting factors and risks in details. The model can be transformed with types of variable in order to see how business get affected by many factors such as interest rate, employing rate, importation and exportation value, and reserve currencies. To choose the best choice for their investment, they should not take this aspect for granted as in the future, they expect positive feedback to return and can deal with all risks effectively. However, unexpected factors like domestically political impact, and natural disasters can cause the business at risk.

Government and related sectors have to take the responsibility of control and support foreign investment since it is an important factor that determines exchange-rate policy, trade policy, and other associated policies. So, this situation supports the source of investment fund in the country which is effective and suitable for economic development in each country differently. Not only should government create exchange rate policy to support foreign investment, but also developing fundamental structures in the country as a preparation for foreign investments is important. For instance, logistic is a salient factor for foreign investors' decision because logistic can attract investors to come and invest and it is a way to remain their confidences for a long time.

International relation between a host country and a business country is also a factor for investing decision as if both countries have a good relationship to one another, business commitments will be significant by giving special investment opportunities, quota of import and export, and supporting brand-new investors to make an international commitment in terms of exportation, or tourism business as well. Limitation As this study focuses on the dependent structure between gross domestic product (GDP) and inflow of foreign direct investment from China (FDI) within 5 ASEAN countries by the VARMA-GARCH Copula approach which is relevant and appropriate for the analysis of dependent structure, it cannot thoroughly explain all of the economic situations in the focused 5 countries since the analysis in this research only states the explanation in the recent time span. It is because of the influence from trade policies, changes of investment, labour migrants and free movement of capital which are a result of the uncertain GDP and economic crisis in each country, having a lower influence on attracting the inflow of foreign direct investment from China and the research is limited by the data collection as the database is gathered after the Tom Yum Kung Crisis.

31. Recommendations for Further Studies

This study attempts to analyse the data after the Tom Yum Kung crisis in 1996 onwards. Thereby, the time states the volatility of GDP that changes and attracts inflow of foreign direct investment effectively. Moreover, it offers the analysis of influence from different changes even though these 5 countries are in the same region and share similarity in industry. Therefore, a possibility for future studies is to focus on the influences from the change of GDP and other factors after the Association of Southeast Asian Nations (ASEAN) having compromised policies and getting involved in the changes of economic crisis more than the past. It is possible that the data analysis in the next studies will be

different from this study and it will be the analysis in the time of a big economic change in this region, which is interesting.

32. Conclusion

This study attempts to analyze the dependent structure between gross domestic product (GDP) and inflow of foreign direct investment from China (FDI) within 5 ASEAN countries, including Singapore, Malaysia, Thailand, Philippines, and Indonesia. To study, the results are discovered by the GDP's data of each country and the data of foreign direct investment from China from 1996 to 2018. The VARMA-GARCH is utilized as a main approach by considering the lowest value of residuals in order to choose the most appropriate Copulas model. The results state that when the data is in the group of Asymmetric Copula, it means that the foreign direct investment from China caused by the GDP's volatility of each country has been greatly affected. On the contrary, if the Copulas model of any country is categorized in the Symmetric Copula, it means that the volatility of GDP has been slightly affected by the foreign direct investment from China. All in all, the study summarizes that by taking the Copula model to demonstrate the variance of the Dependent structure, economic conditions of each country have been changed by always being based on the direction of economic development from each country individually. The government is responsible for developing policies and frequently stimulating its economy.

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