



Faculty of Economics and Business

**THE DETERMINANTS OF CHINA'S TOTAL IMPORT OF
NATURAL RUBBER FROM ASEAN-4**

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**Bachelor of Economics with Honours
(International Economics)**

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This project is submitted in partial fulfillment of the requirements for degree
of Bachelor of Economics with Honours
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Statement of Originality

The work described in this Final Year Project, entitled
**“THE DETERMINANTS OF CHINA’S TOTAL IMPORT OF
NATURAL RUBBER FROM ASEAN-4”**
is to the best of the author’s knowledge that of the author except where
due reference is made.

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THE DETERMINANTS OF CHINA'S TOTAL IMPORT OF NATURAL RUBBER FROM ASEAN-4

ABSTRACT

Over the last 70 years, agriculture sector was the world important sector compare with manufacturing and services sector where the agriculture sector contributed 55.40% to the world GDP. After the year, contribution of agriculture sector to world GDP kept decline until recent year (2018), which only contributed 3.00% to the world GDP. Addition, in ASEAN group countries, there are four countries are mainly focusing in agriculture sector which they grouping them self as ASEAN-4. ASEAN-4 is grouping by Indonesia, Malaysia, Thailand and Philippines. Thus, the objective of this study is to determine the China's total import of natural rubber from ASEAN-4. China was selected as the targeted group in this study is because according to The World Bank Annual Report 2017, purchasing power parity of China was ranked No.1 in the world. Next, due to strategic location of China and ASEAN-4, this also is the reason China been select. Based on several previous research papers, they examined the determinants of China's imports are distant, language, total population, inflation rate, exchange rate, and gross domestic product.

PENILAIAN PENETAPAN JUMLAH CHINA IMPOR GETAH ASLI DARI ASEAN-4

ABSTRAK

Selama 70 tahun terakhir, sektor pertanian adalah sektor penting dunia dibandingkan dengan sektor pembuatan dan perkhidmatan di mana sektor pertanian menyumbang 55.40% kepada KDNK dunia. Selepas tahun ini, sumbangan sektor pertanian kepada PDB dunia terus menurun sehingga tahun terakhir (2018), yang hanya menyumbang 3.00% kepada KDNK dunia. Selain itu, di negara-negara kumpulan ASEAN, terdapat empat negara yang terutama memfokuskan diri dalam sektor pertanian yang mereka kelompokkan sebagai ASEAN-4. ASEAN-4 dikumpulkan oleh Indonesia, Malaysia, Thailand dan Filipina. Oleh itu, objektif kajian ini adalah untuk menentukan jumlah import getah asli China dari ASEAN-4. China dipilih sebagai kumpulan sasaran dalam kajian ini adalah kerana menurut Laporan Tahunan Bank Dunia 2017, pariti daya beli China berada di kedudukan No.1 di dunia. Seterusnya, kerana lokasi strategik China dan ASEAN-4, inilah juga alasan China memilih. Berdasarkan beberapa makalah penyelidikan sebelumnya, mereka meneliti penentu import China adalah jauh, bahasa, jumlah penduduk, kadar inflasi, nilai tukar, dan produk domestik bruto.

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CHAPTER ONE

INTRODUCTION

1.0 INTRODUCTION

Agriculture¹ is the most comprehensive word been used to signify the numerous manners by which crop plants and domestics animals support the worldwide human population by providing food and other products. Agriculture has come to subsume a very wide spectrum of activities that are integral to agriculture and have their own descriptive term, such as cultivation, domestication, horticulture, arboriculture, and vegeculture, as well as forms of livestock management such as mixed crop-livestock farming, pastoralism, and transhumance (Fuller, 2014). The Oxford English Dictionary (1971) defines agriculture comprehensively as “The science and art of cultivating the soil, including the allied pursuits of gathering in the crops and rearing live stock; tillage, husbandry, farming (in the widest sense)”. In this section, we also utilize the term in its broadest, comprehensive sense.

By 2,000 years ago until now, much of Earth’s population had become depend on agriculture (Allen, 2019). Thus, agricultural development is one of the important sector in the world. This is because it was the main tools which will influence to people. Agriculture sector create job opportunities for people especially for rural area people which on a large scale in underdeveloped and developing countries. It also make a lot contribution to economic development. Agriculture is the basic source of food supply of all countries of the world, no matter is underdeveloped, developing, or developed (Macatta, 2016).

¹ The English word agriculture derives from the Latin *ager* (field) and *colo* (cultivate) signifying, when combined, the Latin *agricultura*: field or land tillage, (Fuller, 2014).

Beside, agri food is key sectors throughout Southeast Asia. The agri-food market in Southeast Asia has been activated by the area's steady economic and population growth, and by its deepening regional and international economic integration. The region's diverse agricultural market to world. Next, ASEAN² is the fourth-largest exporting region in the world. ASEAN also is one of the most productive agricultural baskets in the world. ASEAN lead the producers of staple crops and food. The reason is because ASEAN countries leveraging on the region's balanced climate, fertile lands, and mix of lowlands and uplands, forests, rivers, and coastlines, are likely to become their opportunity not just in crop and livestock production but also in managing food supply chain, agriculture infrastructure and safety, and agribusiness. ASEAN agriculture sector are expanding in terms of providing needed infrastructure to increase and climate-change-proof crop production, professionalizing and systematizing small-scale food processing, driving high-tech agribusiness, and other activities along the value chain. Agriculture sector in ASEAN are optimism is high on the growth.

ASEAN supplier about 17 percent (\$18 billion dollar) of China's agro-food imports (Dy, 2017). The key products and key country-suppliers are palm oil (Indonesia and Malaysia), Natural rubber (Thailand, Indonesia, Malaysia, Vietnam, and Myanmar), and rice (Vietnam, Thailand and Cambodia). Based on this result, most countries is come from ASEAN-4³. In ASEAN, there are four countries is expert in agricultural sector. This grouping calls itself as "ASEAN Four". ASEAN is one of the

² The Association of Southeast Asian Nations (ASEAN) is a local intergovernmental association involving ten nations in Southeast Asia, which advances intergovernmental collaboration and encouraged financial, political, security, military, instructive and sociocultural reconciliation among its individuals and different nations in Asia, (Association od Southeast Asian Nations, 2019)

³ ASEAN-4 stand from four countries which are Indonesia, Malaysia, Philippines and Thailand.

most productive agricultural baskets in the world, hence ASEAN-4 was also contribution a lot in agricultural baskets. Not only that, ASEAN-4 strong with their export growth. But, in this four group countries, only the Philippines is not in the top three products trade with China, because Philippines mainly supply fruits and nuts, while it was the number fourth trade product. ASEAN-4 focus the agriculture product trade with China because China economy growth is the fastest in world. The economy growth of China with growth rate averaging of 6 percent over 30 years (Morrison, 2019). The economy of China is a socialist market economy⁴ that ranks as the second largest in the world by nominal GDP and the largest in the world by purchasing power parity (International Monetary Fund (IMF), 2019).

Figure 1.1: Asia Map



Source: China Briefing, 2012

Not only that, based on the world map, the distant between China and ASEAN is closer than western country. The transportation cost for trade with China is cheaper than trade with western country. Therefore, distant become a very important factor for

⁴ The socialist market economy (SME) is the economic system and model of economic development employed in the People's Republic of China.

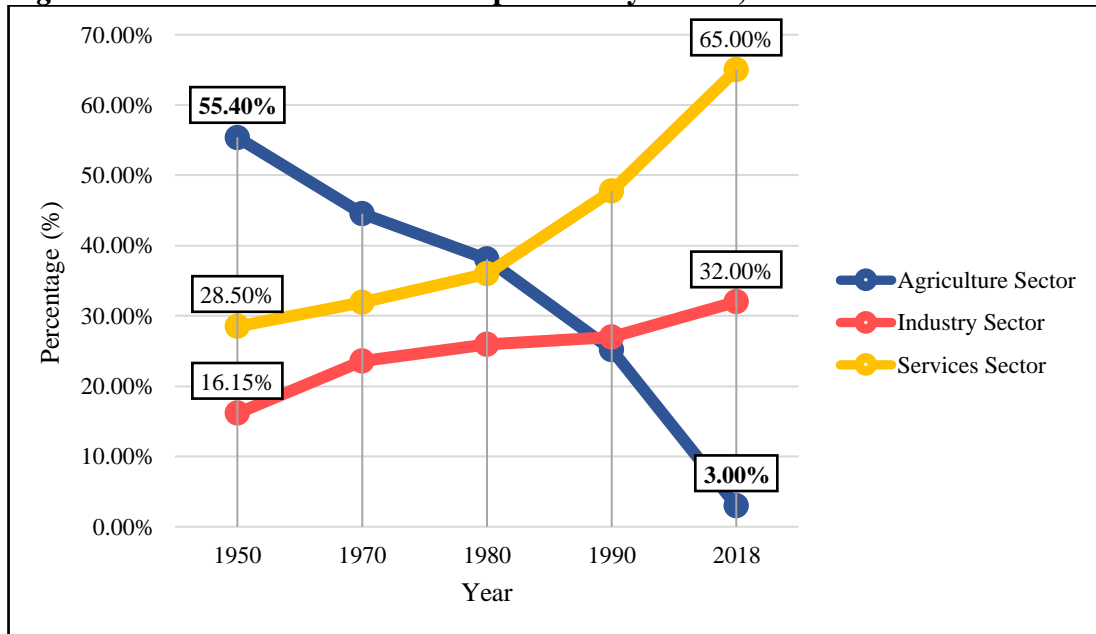
a country to make decision on trade. Hence, this reason is strongly supported by previous researcher. Based on previous researcher Fang and Shamim (2018), the trade cost can determine overall agro-food trade growth. Thus, distance become a main reason for ASEAN-4 trade with China. Next, the total distance between ASEAN-4 countries and China is only around 4,000km to 5,000km. The distance is measure by the city to city countries. The figure 1.1 above was showing the distance between ASEAN-4 and China.

Furthermore, the researchers in this study is aim to study the determinants of agriculture product trade between ASEAN-4 and China from year 2001 to 2018. The purpose of this research is mainly to examine whether there are any impacts will influence agriculture trade between ASEAN-4 and China from 2001 to 2018, depending on the different economic and non-economic factors.

1.1 BACKGROUND OF THE STUDY

Agriculture is an important sector to world economy and also country economic development. It is a largely and important role as a commercial activity because it can brings benefits to society and creates economic growth. There is no denying that agriculture sector is a large group of sector that supply numerous of food product to the world. Currently, agriculture sector become the one of the world's smallest contribution to world economic sectors. There are several reason lead the agriculture sector become less important for the world such as natural disaster. Natural disaster will bring huge loss to agriculture sector, therefore a lot countries were move to services and industry sector. Next, the figure below will shows the GDP share composition by sector from year 1950 to 2018.

Figure 1.2: World GDP Share Composition by Sector, 1950-2018



Source: World Development Indicator, The World Bank (2019)

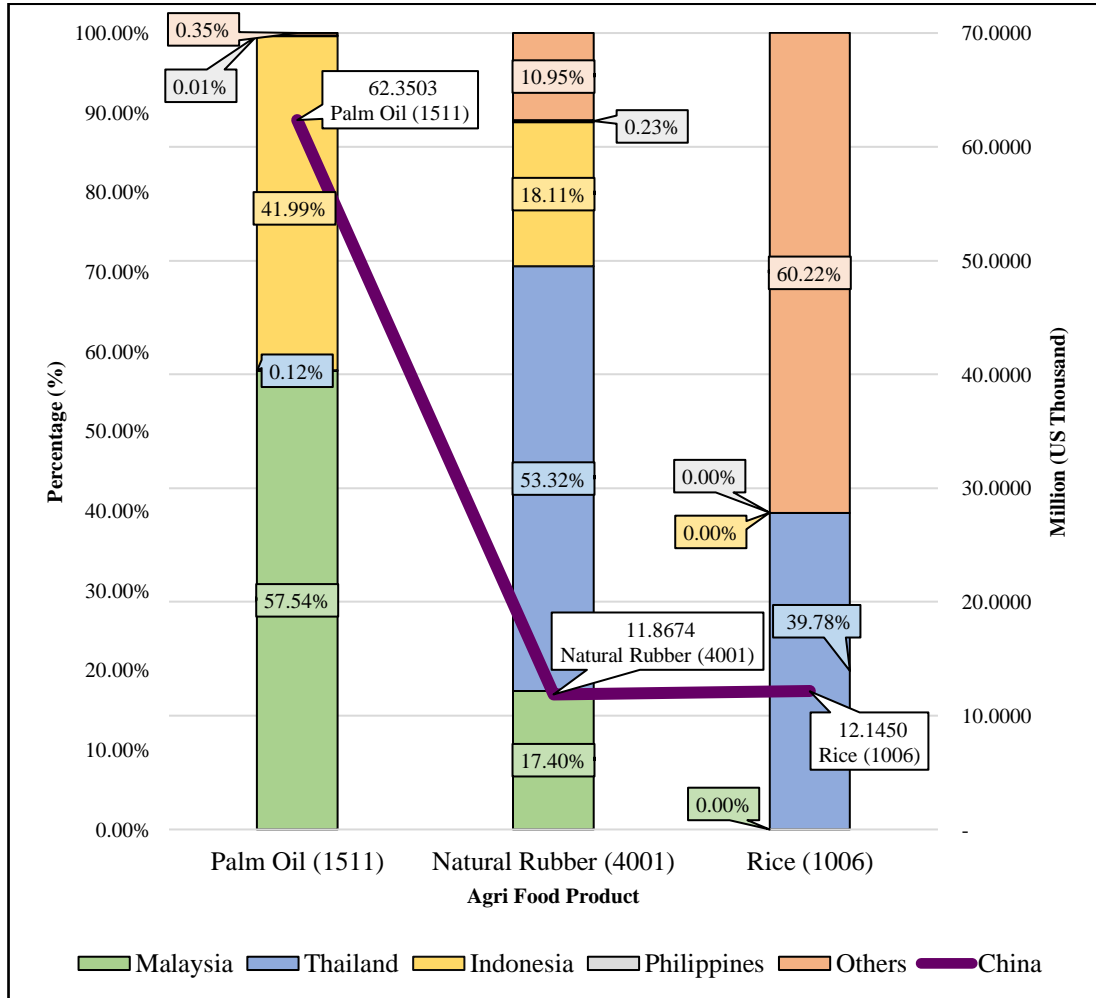
At year 1950, agriculture sector was contributed 55.40% to world GDP. At that time, agriculture is the world important sector. After that year, agriculture sector kept decline until recent year, 2018 which only contribute 3.00% to world GDP and there

are a lot of the countries was move their target to industry sector and especially to services sector. In these 68 years, agriculture sector contribution to world GDP was drop around 52.5%, it was a huge decrease. Although agriculture sector was been put behind, but according to the research, agriculture sector was the second greatest source of employment worldwide after services sector and it accounts 28% of global employment (Folnovic, 2019). Besides that, agriculture sector creates 33% of all employment growth. Therefore, this study will focus on view on Southeast Asia.

ASEAN plays an important role in agricultural trade with China. ASEAN supplies about 17% (\$18 billion) of China's agri-food imports. There are some key product are supply by ASEAN to China, which are palm oil, fruits and nuts, natural rubber, cassava chips, rice, cassava starch, cocoa preparations and coffee. These products are the main 8 products China import from ASEAN. The product been selected in this research to represent the trade for ASEAN-4 and China are palm oil, natural rubber and rice. These product are the main crop product for all countries. Besides, palm oil and natural rubber are the main agricultural products for ASEAN-4, because these product contribute huge in their countries GDP. In terms of commodity export earnings, rubber product is the second largest contributor while palm oil is the largest contributor for ASEAN-4 countries GDP. Next, rice was the third contributor product for GDP of ASEAN-4 countries. Due to the trade partners been choose in this study of ASEAN-4 is China, thus, rice was the third highest trade product. Based on Primary Industries Minister Teresa Kok Suh Sim of Malaysia, she said that the contributed of rubber industry and palm oil to ASEAN-4 country's economy is huge, but these commodities were facing difficulties in the international market (The Star Online, 2018). The reason is because there are a lot countries is moving their focus to

others sector. After that, the figure bellow will shows the China total import product from ASEAN-4.

Figure 1.3: Top Three Imported Agri Food Product of China from ASEAN-4, 2001-2018



Source: International Trade Statistics, (2019)

Figure 1.3 shows China total imported of agri food product from ASEAN-4. The top three agri food trade between China and ASEAN-4 are palm oil, natural rubber and rice. The highest agri food trade product between ASEAN-4 and China is palm oil. The total export volume of palm oil imports from the AEAN-4 countries to China is 99.65%. There are only 0.35% of palm oil in China is imported from others countries. Figure above shows Malaysia is the largest exporter while Indonesia is the second. Due to the good whether in Malaysia and Indonesia, this encourage them become

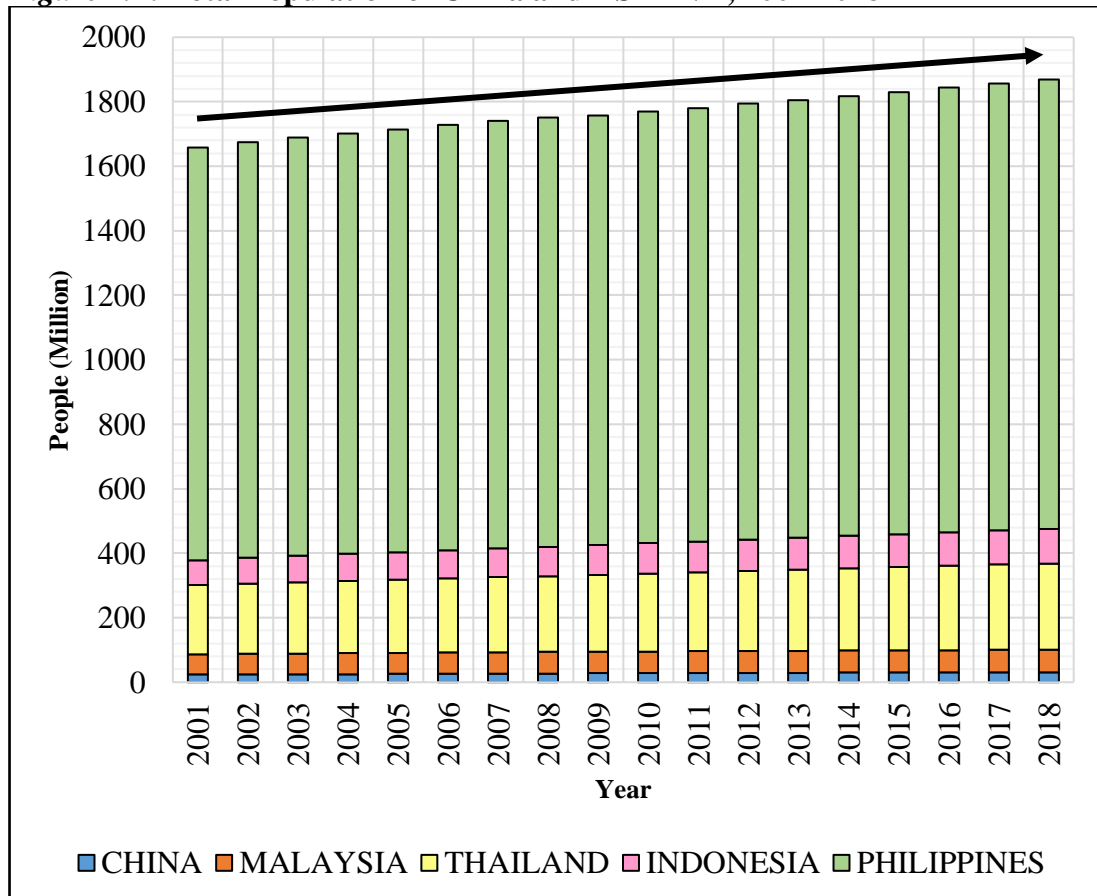
world largest producer of palm oil. The total contribution on palm oil of ASEAN-4 to China has shown in an incredible percentage which recorded 99.72% of China total import on palm oil, while the rest 0.28% is from other country. Palm oil is the highest trade product between ASEAN-4 and China. The annual requiring of palm oil in China is around 40,000 tons. The palm oil commonly is not used the domestic cooking for China, it mainly because it's high melting point. Since, the annual average temperature in China is between 10°C until 24°C, the oil is frequently in a semi-solid or solid state at room temperatures, while China citizen more prefer liquid oils. Not only that, instant noodle producer in China also is the highest, therefore the huge demand from the instant noodle producer also drive to China increase the import of palm oil.

The second largest trade agri food product between ASEAN-4 and China is natural rubber. The total exported natural rubber is Thailand, while follow by Indonesia and Malaysia. At the past 18 year, Malaysia and Thailand were the largest exported natural rubber, but currently the largest exported natural rubber to China is Thailand. Due to western countries demand on natural rubber, Malaysia change their target natural rubber export to western countries because the profit from western countries is higher than make trade in Southern Asia (Jeffrey, 2015). Summarize, ASEAN-4 contributed around 89.05% to China total import of natural rubber.

The third agri food product trade between ASEAN-4 and China is rice. Thailand is the largest exported country of rice to China which recorded around 39.78%. Malaysia, Indonesia and Philippines is not the rice producer country because their production of rice can't fulfil the international market demand and also the domestic market demand. The total contribution of ASEAN-4 to China on rice is 39.78%. Even it contributed is more than half on China agriculture product trade, but rice is one of

the important agriculture commodities for all country especially for China. Rice is a major staple food in China. Based on Chinese people traditional, they used rice in many dishes and eat rice almost every day. Therefore, Rice is one of the most popular foods in China.

Figure 1.4: Total Population of China and ASEAN-4, 2001-2018

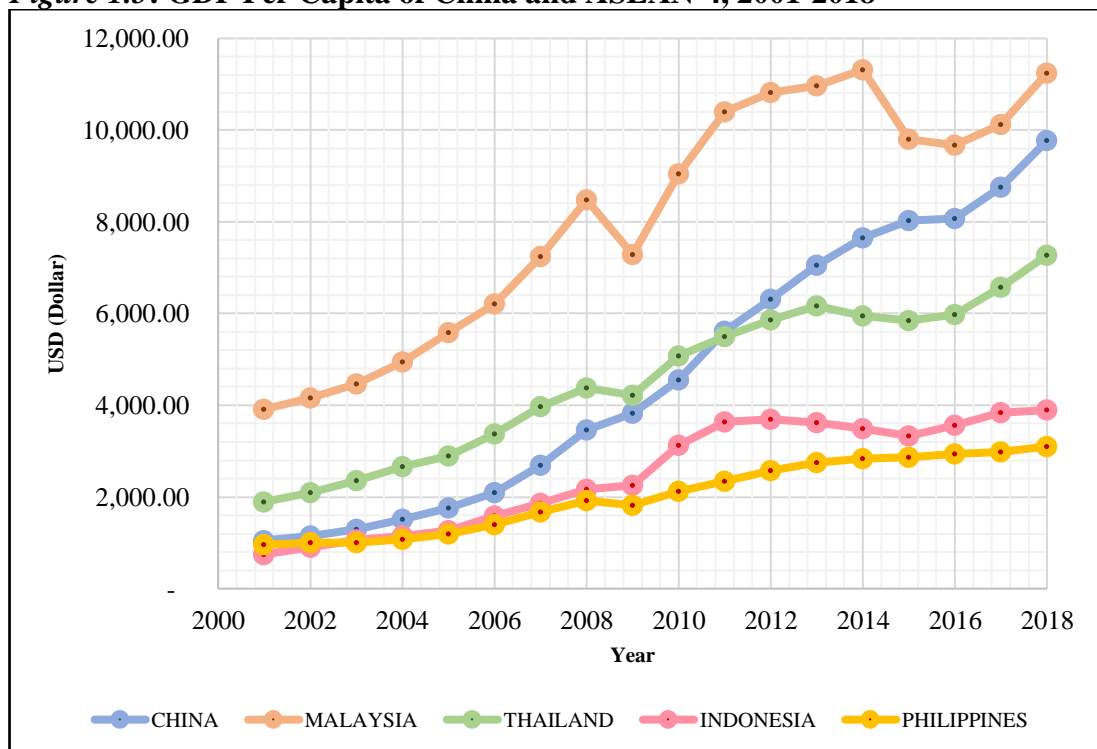


Source: Nation-Line Organization Nation-Line Organization, (2019)

Based on the figure 1.4, the figure illustrate the total population of China, Malaysia, Thailand, Indonesia and Philippines from 2001 to 2008. The total population of China shows an incredible amount. While, in ASEAN-4, the country with largest population is Indonesia, but it still far with China. China total population is higher than the sum of the total population of ASEAN-4. Not only that, the total population of China is kept increase in these 18 years. In world population view, China is the largest population in the world today. The huge population of China become one

of the reason of ASEAN-4 make trade between China. The higher the population of the country, the higher the demand of that country. The population size will increase the market demand. Moreover, food is the main basic living needs, thus the large population country might need a large demand on agri food product

Figure 1.5: GDP Per Capita of China and ASEAN-4, 2001-2018



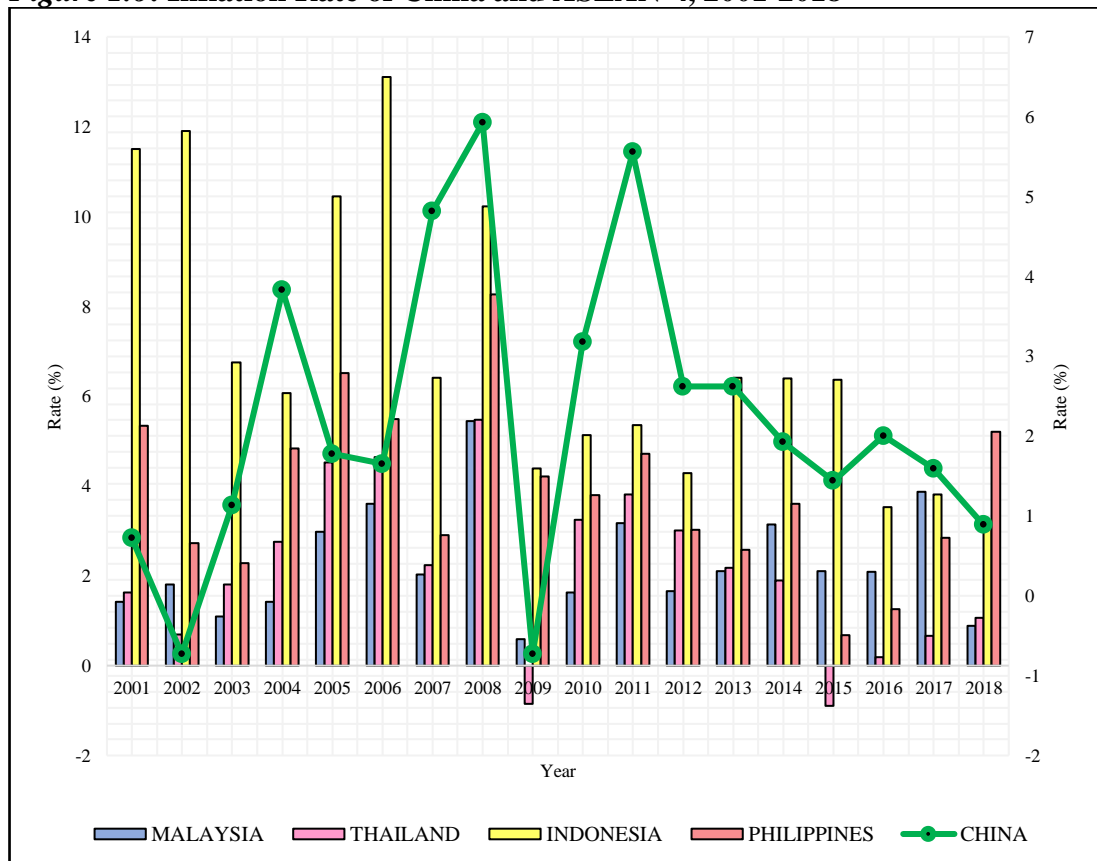
Source: World Development Indicator, The World Bank (2019)

The figure 1.5 shows the Gross Domestic Product (GDP)⁵ Per Capita of China, Malaysia, Thailand, Indonesia, and Philippines from year 2001 to 2018. GDP per capita refer to the purchasing-power parity of that country. The highest GDP per capita is Malaysia. At the year 2000, China GDP per capita performance is lower than Malaysia and Thailand, and a bit higher than Philippines and Indonesia. After 18 years, the GDP per capita of China is much greater than Thailand, Indonesia, and Philippines. China GDP per capita is kept increasing and never decline, while the increase trend of

⁵ GDP per capita refer to a country's economic output that divided by the total population of the country. This is the best measurement of a country's standard of living.

Philippines and Indonesia is the slowest. GDP per capita of Thailand had decrease on 2008 but after that increase again until 2018. At year 2008 to 2009, the GDP per capita of ASEAN-4 was decline whilst Malaysia is the one been affected much exclude China. At begin in 2007, global financial crisis was happened. This emergency in the subprime contract showcase in the United States, and formed into an out and out worldwide financial emergency with the breakdown of the speculation bank Lehman Brothers on 15 September 2008 (Mark, 2010). Excessive risk-taking by banks such as Lehman Brothers helped to magnify the financial impact globally. This crisis was bring a huge effect to a lot countries especially developing country such as Malaysia. GDP per capita is one of the determined on the demand of trade. China GDP per capita shows a higher amount, it means the China have a greater purchasing-power parity.

Figure 1.6: Inflation Rate of China and ASEAN-4, 2001-2018



Source: World Development Indicator, The World Bank (2019)

The figure 1.6 shows the inflation rate of China and ASEAN-4 countries from year 2001 to 2018. The bar illustrate the inflation rate of ASEAN-4 while the line represent the inflation rate of China. The China inflation rate is showing a fluctuated trend in these 18 years. Next, the inflation rate of Malaysia, Thailand, and Indonesia in fluctuated at the beginning years, but finally decline and record a good rate which lower than 1%. While, the inflation rate for Philippines is fluctuated and at year 2018 record a high rate which is more than 2%. The inflation problem in Philippines is more serious compare with other countries. The inflation rate will give impact to international trade because inflation will increase the agri food product price. Based on law of demand, when the price of goods increase, the quantity demanded will decrease. Thus, inflation will lead the price of goods increase, and the total demand on imported goods will drop. Finally, inflation rate for a country is very important, because it will determine the price of product and the quantity demanded.

As a conclusion, the top three agriculture product trade between ASEAN-4 and China is palm oil, natural rubber and rice. This study will investigate the determined of agriculture product trade between ASEAN-4 and China from year 2001 to 2018.

1.2 PROBLEM STATEMENT

ASEAN is one of the most productive agricultural baskets in the world. At the past 50 years, agriculture sector in ASEAN contribute around 40% to 50% to their GDP Growth. But, based on current economic situation, ASEAN were more focus on manufacturing and services sector. They believe that manufacturing sector can growing the opportunities to ASEAN economic integration. However, the previous research state that agriculture sector is the starting to drive the economic growth of ASEAN to the world level. Besides, the agriculture sector always face the problem of climate change and limited land arable, this affect most countries transform their focus to manufacturing sector. Agriculture plays a crucial role in the economy especially for developing countries. Because it provides the main source of food, income and employment to the rural area populations. According to Food and Agriculture Organization of United Nations (2000), it has been established that the share of the agricultural population in the total population is 67% that agriculture accounts for 39.4% of the GDP and that 43% of all exports consist of agricultural goods. Next, according the data statistics show that China is the world largest importer on nature rubber, and China was occupy 50% of the natural rubber demand in the world. Besides that, there are more than 40,000 products creation by using natural rubber⁶ as their essential raw material (Marina Arias, 2019).

Thus, China was the important targeted group for ASEAN-4 due to several reason. First, China is the world largest purchasing power country and the second economy strongest country. Second, based on geographical distance, China is nearly

⁶ Natural rubber, also called by other names of India rubber, latex, Amazonian rubber, caucho or caoutchouc, as initially produced, consists of polymers of the organic compound isoprene, with minor impurities of other organic compounds, plus water.

with ASEAN-4 because they are in Southern Asia area. The closer distance is encourage ASEAN-4 and China to make trade compare trade with Western countries.

Moreover, according to the Sustainable Development Goals (SDGs⁷), the goals no. 2 which is “Zero Hunger”, the indicator 2.4.1 mention the proportion of agricultural area under productive and sustainable agriculture. This indicator measure the progress in achieving more productive and sustainable agriculture. Sustainable agriculture sector is one of the aim in SDGs. SDGs set this as one of the goals because it want to ensure the sustainable food production systems and implement resilient agricultural practice that increase productivity and production, because it is important in help maintain ecosystem, strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality (Food and Agriculture Organization (FAO) of the United Nations, 2019). The sustainable in agriculture sector is important in the world not only ASEAN-4.

⁷ SDGs are a collection of 17 global goals designed to be a “blueprint to achieve a better and more sustainable future for all”.

1.2.1 Research Question

The research question in this study are:

- i. What is the relationship between China's total imports of natural rubber and total population?
- ii. Why population become a determined of China's total imports of natural rubber?
- iii. What is the relationship between China's total imports of natural rubber and GDP Per Capita?
- iv. What is the impact of GDP per capita to China's total imports of natural rubber?
- v. What is the relationship between China's total imports of natural rubber to inflation rate?
- vi. How important inflation rate influence to the China's total imports of natural rubber?

1.3 OBJECTIVE OF THE STUDY

1.3.1 General Objective

The purpose of this research is to investigate the relationship of total population, Gross Domestic Product (GDP) Per Capita, and inflation rate with China's total imports of natural rubber with ASEAN-4.

1.3.2 Specific Objective

The specific objectives include:

- i. To study the relationship between China's total imports of natural rubber and total population.
- ii. To research the relationship between China's total imports of natural rubber and GDP Per Capita.
- iii. To investigate the relationship between China's total imports of natural rubber on inflation rate.

1.4 SIGNIFICANCE OF THE STUDY

There are a lot of study that related to agricultural sector and agricultural industry. In the past, most of the researchers only focus on the agricultural sector trade at western countries and only few of them focus Asia countries, but the contribution of Asia countries in agricultural sector is much high. The others scope of study normally will be put on several or multiple country in agricultural sector trade.

From this study could provide an overview to the current situation and consequences of ASEAN-4 agricultural market to China. This study give an alert to the local government that the agricultural sector still important for a country's GDP. Due to previous research, agricultural sector at the pass as an important sector for a country's GDP, but currently, a lot of the countries is more focus on manufacture sector, because manufacture is easier to get the profit compare with agriculture sector. They put agriculture behind, due to agriculture got a lot problem such as climate change problem and product shelf life.

The first target of ASEAN-4 can be China because they are capable to spend and the geographical distance is not that far compare with Western countries. China is the world highest purchasing power group, thus, make trade with China can increase countries export. Moreover, the distance between ASEAN-4 and China is closer compare with western countries. The distance in trade is very important because it will determine the transportation cost. High transportation cost is discourage to make trade.

1.5 SCOPE OF THE STUDY

This study will mainly focus in ASEAN-4 and China. While the target group of this study will be China's total imports of natural rubber with ASEAN-4. The secondary data of the study will be in yearly period and from year 2010 until latest year 2018. All the data will be obtain from well-known and official website and organization such as World Bank, International Trade Statistics (ITC), World map, and Nation-Line Organization.

1.6 LIMITATION OF THE STUDY

In this study, the researcher only focused on ASEAN-4, which are Malaysia, Thailand, Indonesia, and Philippines. There are a lot country in ASEAN which are Singapore, Vietnam, Brunei, Cambodia, Laos and Myanmar are not included due to several reason. Firstly, Singapore was excluded because its focus sector is on manufacturing not on agricultural sector. Singapore can't develop in agricultural sector due to limited arable land. Thus, this shall lead to biasness on the research. Secondly, another founding member which is Brunei is been exclude because its trade value in agricultural sector is too small compared to the rest of ASEAN-4 countries. This somewhat shall create bias as well. Thirdly, the new AFTA participating countries that are Cambodia, Laos, Vietnam and Myanmar are not include in the research study because of their incomplete data available especially in their trade record.

At this study is only focused on the trade activities between ASEAN-4 and China only. The agriculture commodities been selected are natural rubber (4001). However, due to data unavailability, there are a lot commodities being dropped in this study especially the top one and top three agriculture product trade between China and Asean-4. Overall, here is a commodities being vet through from 2010 until recent 2018.

1.7 STRUCTURAL OF THE STUDY

This study is organized as follows. In chapter two, there are discussions on the theoretical framework, reviews on past and recent literatures relating to agriculture trade, relationship between ASEAN-4 and China, economic integration and gravity model. Chapter three provides the methodology including empirical analysis under practice and the procedure of panel data analysis, while selection of gravity model by previous researcher also will shows in chapter 3, next is data and variables justification. In chapter four, there are discussion on empirical findings. Last but not least, chapter five provides conclusion and recommendations.

1.8 CONCLUDING REMARKS

In conclusion, this paper aim to study the determinant of China's total imports of natural rubber from ASEAN-4 and its significant determinant variable used in this research. Besides that, this paper used secondary data by getting the related data from the official website and refer to the past researchers in economic performance to draw a conclusion. In addition, this paper will help in many aspects such as in helping policy maker reference to draw a better policy in order to lead the country's economic development.

CHAPTER TWO

LITERATURE REVIEW

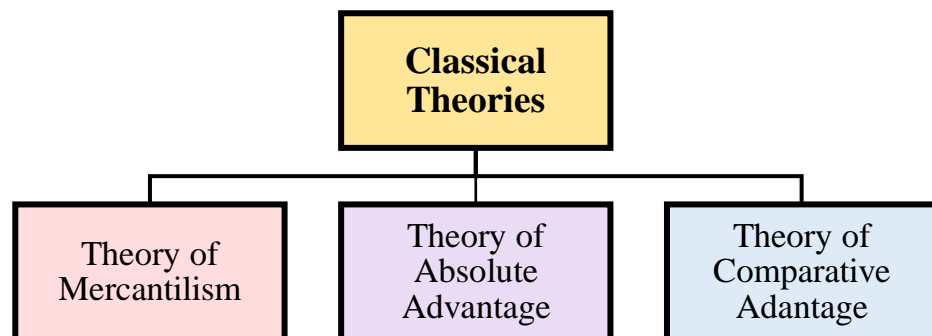
2.0 INTRODUCTION

Agricultural sector was possible to give impact on country's future trend. This study was carried out the determinants of agricultural product trade between ASEAN-4 and China from year 2010 to 2018. Moreover, the study also aims to study the relationship of distant, total population, gross domestic product (GDP) per capita, and inflation on agricultural product trade. This chapter includes a review of theoretical framework that had postulated by previous researches. It was elaborated further by methodology and findings.

2.1 THEORETICAL FRAMEWORK

2.1.1 Trade Theory

Figure 2.1: Classical Trade Theories



The classical theory divide into three, which are theory of mercantilism, theory of absolute advantage, and theory of comparative advantage. For the first theory, mercantilism theory is introduce by Father of Economics, Adam Smith. This theory mention that countries should encourage in export and discourage import. The reason

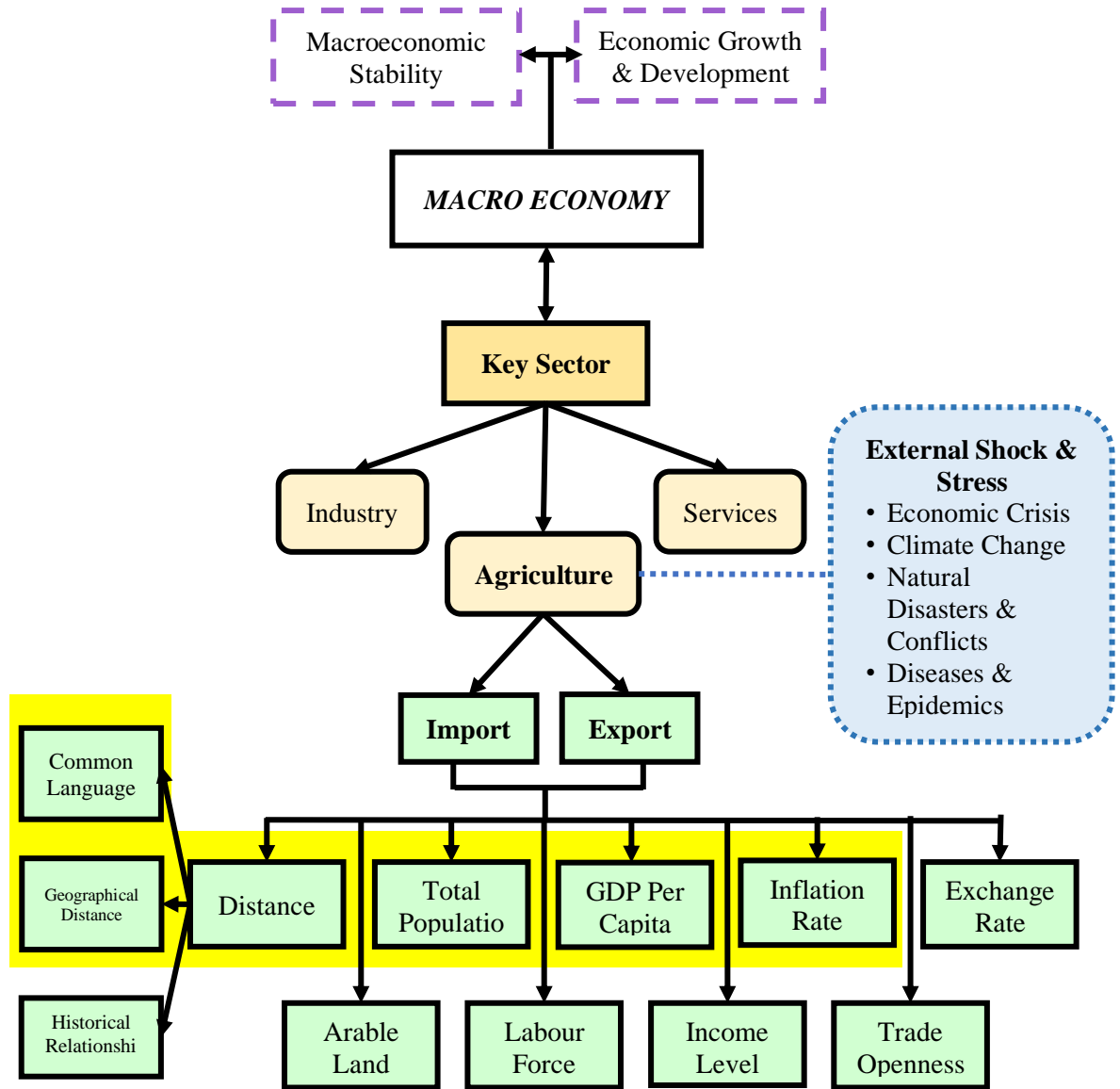
is because the trade balance is come from the formula of export minus import. Thus, government should play an important role in a country economy for enhance the country's export and reduce the import by using subsidies and taxes. The theory of mercantilism believed in selfish trade that is a one-way transaction and ignored enhancing the world trade. Mercantilism theory also called as a zero-sum game, which is only one country can gain the benefit from trade.

Next, the theory of absolute advantage is adopt by Adam Smith also in year 1776. Absolute advantage mention that a country should specialize in those products which it can efficiently produce. This theory assumes that there is only one factor of production that is labour. Adam Smith mention that, if under the theory of mercantilism, it was impossible to make a country become rich simultaneously. Hence, the wealth of a countries should depend on others goods and services available. In the book of "The Wealth of Nations", he said that: "If a foreign country can supply us with a commodity cheaper than we ourselves can make it, better buy it of them with some part of the product of own industry, employed in a way in which we have some advantage". Simple to say, we should export what we expert and import what is more benefit to us.

The last theory in classical trade theory is comparative advantage. Comparative advantage is introduce by David Ricardo. In this theory, he state that the trade can bring beneficial for two countries if one country has an absolute advantage in all the products and the other country has no absolute advantage in any of the product. Make trade can between two countries can bring benefit to both, which one country can receive the earning while another one country can receive the goods or services that they needs.

2.2 CONCEPTUAL FRAMEWORK

Figure 2.2: Agriculture Trade Conceptual Framework



The figure above shows the conceptual framework of the agriculture trade. A country economic growth and development will be affected by three main sector, which are industry sector, agriculture sector and services sector. In this study will mainly focus on agriculture sector. Agriculture sector will affect by some external shock or stress. The shock can be economic crisis, climate change, natural disasters or conflicts and also diseases and epidemics. Moreover, focus in agriculture sector trade,

trade is a basic concept involving the activities of buying and selling goods and services in international market. Buying can consider as import, while selling is export. A country's balance of trade is defined by its net export, which export minus imports. There are several factors that will affect international trade. The first factor is factor endowments. Factor endowment refer to labour force, land and capital. Focusing in agriculture trade research, the factor endowment will influence to agri food product trade are agriculture sector labour force and also the arable land⁸. Labour force will determine the productivity, the large labour force will increase the productivity in agriculture sector. Thus, the total export of commodity will increase. Whilst, agriculture trade can determined by arable land, because land describes the natural resources available. The more arable land can bring more place to planting. Thus, the supply of agriculture product can increase. The Heckscher-Ohlin model of international trade emphasized differences in these areas to explain trade patterns (Hall, 2018). Moreover, GDP per capita, inflation rate, total population, exchange rate, income level and trade openness also will influences in trade activity. These factor will give direct effect to trade activity, but there are also several indirect effect such as distance. Distance been measure by common language share by trading countries, geographic distance between countries and also the historical relationship between countries.

⁸ Arable land refer to the land area that is either arable, under permanent crops, or under permanent pastures.

2.2 EMPIRICAL FINDING SUMMARY

Previous research has established that distance is one of the common variable to test the agricultural trade. Researcher by David and Shahera (2009) using the time-series method to investigate two countries which are South and Central America on trade creation and diversion effects of preferential trade associations on agricultural and food trade. On their study, they also used the physical distance as their independent variable. In order to measure the distance, they use common language and historical relationships to represent the distance. The result of distance variable have the positive effects on food trade on agricultural product trade. Based on a recent study by Marilynne et al. (2015), he support that the trade partner countries which sharing common language or colonial relationship links tend to trade more together. Thus, the common language and colonial relationship to agri food trade had positive effect. But, in the research by Simeon (2017), the independent variable of distance found that there is a negative effects on the value of food trade. The distance measure by Simeon (2017) also used the language and membership of the GCC⁹, which extremely similar with the measurement by researcher David and Shahera (2009). Additionally, David and Shahera (2009), Simeon et al. (2017), also investigate GDP per capita (purchasing-power parity per capita) and population to export BED (Food and Beverage) and value of food trade. Coefficient on per capita GDP for both origin and destination countries are statistically significant and positive effect. Next, researcher also mention that countries with large populations similarly experience grater agricultural product trade. But this statement by David and Shahera (2009) are contrary with Simeon et al. (2017). The result of population in their research found

⁹ GCC stand of Gulf Cooperation Council, which is a regional intergovernmental political and economic union consisting of all Arab states of Persian Gulf except Iraq.

that the coefficient for population is not statistically significant and had negative effect. From my opinion, the both research issue and the measurement on distance and population is similar, but the selected sample size will affect to the final result. In the research by Simeon (2017), he used a big sample size which is the country from Qatar and its trading partners, while the researcher of David and Shahera (2009) only use two country as their sample size. Hence, the result on Simeon et al. (2017) different with result of study by David and Shahera (2009). Next, the result by Lateef et al. (2018) on GDP and population is similarly with the result by Simeon et al. 2017). Their research mention that higher GDP of exporter indicated higher production potential that may lead to higher exports. Thus, result of the study shows agricultural of both origin and destination countries had positive relationship. While the population of an importing country has a negative effect on its agricultural trade.

Conversely, they are few researcher also using distance as a determined of trade such as Lateef et al. (2018), on their research, they found that the distance between capital to trade volume has a negative impact. Because the distance been used to measure the trade partners is considered as trade cost. Trade cost refer to the transportation cost between trading partners. The researcher mention that the higher the trade cost will reduce the countries to make trade while the low trade cost is encourage trading countries to have trade. Won et al. (1993) also used distance on meat trade analysis, the distance measurement from this study is different with others researchers. In their study, they measure the distance by the transportation cost. The result of distance is negative and significant at 5% level. This result is especially true for meat trade for which transportation costs are higher than other agricultural product. Other than that, the study by Marilynne et al. (2015) and Pascal (2015), they use the

geographic distance between trading partners countries to test the relationship with export on agricultural food product. On their research, they mention that higher distance between countries tends to discourage their bilateral exports and imports. However, Pascal (2015) also use common language and common border on processed agricultural food trade flows. The result shows there are positive effect of common language and common border to processed food trade flows.

Moreover, there are several study investigate in other perspective. In an analysis by Simeon et al. (2017) found that foreign exchange rate¹⁰ and inflation rate also is an important independent variable to value of food trade. The rate of inflation in food exporting countries is expectedly positive and highly statistically significant. Inflation as an independent variable to analyse to agricultural trade is not often used by others researcher. Afterwards, in the study by Simeon et al. (2017) found that the exchange rate between the domestic currencies with US dollar had negative effect. Besides, inflation rate in food exporting countries is positively affected. Muhammad (2018) has a different result of study on exchange rate with Simeon et al. (2017). He mention the exchange rate fluctuated have significant effects on agricultural trade. Higher exchange rate normally has a positive effect on agricultural exports. In the case research by Simeon et al. (2017), it explains that if there is a depreciation in the currency of the exporter country, it will cause a decrease in agricultural exports of the country, this result prove that exchange rate had a positive and significant effect on agricultural trade between China and Pakistan. This result support by researcher Won (1993). In his study, his mention the coefficient of exchange rate is positive as

¹⁰ Exchange rate used to define the changes in the prices of importing countries' currencies in terms of exporting countries' currencies (Won et al., 1993).

hypothesized. The casual relation is not statistically significant at 1% level. In contrast, Cho et al. (2015) used real effective exchange rate to determined agricultural trade. Exchange rate uncertainly has negatively affected agricultural trade. Result presented make a contribution to our understanding of the connection between exchange rate movements and international trade flows. In addition, Robert and Richard (1986) including a separate exchange rate variable (involving a weighted price index of other traded goods if feasible) in the regression equations. They mention that if simply use own price adjusted by exchange rate may lead to a downward bias on estimates of exchange rate impacts. The result of this paper suggest that much of the problem of measuring exchange rate impacts in agriculture are due to lack of appropriate price indices for certain commodity bundles.

Furthermore, there are some of the variable been used by David and Shahera such as arable land and agricultural labour force¹¹. This both variable had a direct effect to agriculture sector. These two variable will reflect on the agriculture sector productivity. The productivity of agriculture sector will give impact on agriculture sector international trade. The ratio of arable land and agricultural labour had negative and significant impacts on both food imports and exports. The reason is because the more arable land and agricultural labour will lead the price of agricultural products become more expensive, thus, there is a negative relationship of arable land and agricultural labour to agricultural food trade. Then, Simeon et al. (2017) use trade openness as independent variable to the value of food trade. Their study found trade opened coefficient is statistically significant and positive effect. Therefore, this variable also is one of the important variable of the determined of food trade. In a

¹¹ All the citizens in a country who are able to work.

study conducted by Won (1993), it was shown that income also important because income determine the consumer's purchasing power. He mention that the purchasing power of the importing country is important because it will also dominate to a country demand level to the agricultural product.

2.3 EMPIRICAL TESTING PROCEDURES

2.3.1 Gravity Model

A part from that, to data, various method been developed and introduced on agriculture sector trade by David and Shahera, (2009), Simeon et al., (2017), Muhammad (2018), Marilyne (2015), Ghazalian (2015), Won et al. (1993), Ling and Shamim (2018) and Cho et al. (2015). The method been used by these researcher is gravity model¹². David and Shahera (2009) had pioneered the application of gravity model is the best way in estimating the trade effect of agriculture food between nations empirically. Won et al. (1993) was the first researcher investigate the gravity model in agriculture trade. In his research, he mainly used gravity model to make the analysis. After that, more researchers have adopted and employed the equation when analysing trade relationship between countries. Moreover, Simeon et al. (2017) and Marilyne et al. (2015) also support that gravity equation properly estimate bilateral trade flows. Simeon et al. (2017) generated the traditional gravity model equation form as:

$$X_{ij} = \sum_s a_s c_{ijs} + \sum_s B_{is} X_{is} + \sum_s B_{js} X_{js} + \sum_k \delta_{ijk} d_{ijk} + \sum_k \delta_{ik} d_{ik} + \sum_k \delta_{jk} d_{jk} + \varepsilon_{ij} \quad 2.1$$

Where, X_{ij} represent the value of exports from country i and j ; c_{ijs} represent the characteristics that are shared by both countries, such as a common language, historical relationships and a measure of physical distance between that two countries; X_{is} and X_{js} is the specific attributes of exporting country i to country j , such as GDP per capita and population; d_{ijk} refer to the dummy variable for both countries such as

¹² Gravity model derived from Newton's theory of gravity that explains the gravitation between two objects is comparatively in reverse to the square of the distance between them (Endoh, 1999). In international economics, the gravity model also has a distance term that explains the transaction volume between two nations (Syarifah, 2014).

members of PTA¹³; δ_{ik} is the intra-bloc trade captured of both countries; and ε_{ij} is error term. Based on the empirical studies, the coefficient of c_{ijs} , B_{is} and δ_{ijk} are expected to be positive whilst δ_{ik} , δ_{ik} and δ_{jk} are expected to be negative. However, Marilyne et al. (2015) generated the gravity equation by used double log-linearized form as:

$$\begin{aligned} \ln(M)_{ijt} = & \beta_0 + \beta_1 \ln(TGDP)_{ijt} + \beta_2 \ln(TPOP)_{ijt} + \beta_3 \ln(DIST)_{ij} + \\ & \beta_4 \ln(INF)_{it} + \beta_5 \ln(CPI)_{it} + \beta_6 \ln(ER)_{it} + \beta_7 \ln(OPEN)_{it} + \\ & \beta_8 (GCC)_{it} + \beta_9 (LANG)_{ij} + \beta_{10} \ln(RFE)_{ijt} + \beta_{11} \ln(SIM)_{ijt} + \\ & \alpha_{ij} + u_{ijt} \end{aligned} \tag{2.2}$$

Where, M_{ijt} represents the value of food export into country j from country i in time period of t . The explanatory variables include total GDP ($TGDP$) as a measurement of the economies size for bilateral trade partners; total population ($TPOP$) for both countries; distance ($DIST$) for both trade countries; inflation rate (INF) in exporting countries; corruption perception index (CPI)¹⁴ in exporting countries; exchange rate (ER) of domestic current to the US dollar in exporting country; degree of openness ($OPEN$) of the exporters' economies; member of the GCC (GCC)¹⁵ which established in year 1981; language ($LANG$) is a proxy for cultural integration and customs; factor endowment (RFE)¹⁶; and similarity index (SIM). Simeon et al. (2017) mention that (RFE) and (SIM) as important determinants of trade because there are among many authors who have used this both variable to measure the trade analysis. Based on the

¹³ Preferential trade area or preferential trade agreement is a trading bloc that gives preferential access to certain products from participating countries.

¹⁴ The CPI generally defines corruption as "the misuse of public power for private benefit".

¹⁵ The GCC is a customs union in which there is significant amount of food shipments without any additional payments beyond ordinary transportation costs.

¹⁶ Measured as the absolute value of the difference between per capita GDP of each set of bilateral trading partners.

empirical studies by researcher, the coefficient sign of $\beta_1, \beta_2, \beta_4, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}$, and β_{11} are expected positive yet β_3 , and β_5 are expected negative.

The gravity model equation was developed especially for cross-sectional analysis in the beginning and following being applied to the panel data analysis at year 1980s. Afterwards, most researchers are preferred applying the gravity method in panel data analysis compared to the cross-sectional study because the cross-sectional specification is apt to suffer from omitted variable bias. Hence, in trade studies, gravity method equation is one of the stable tools in international research field especially for international trade studies. Most researchers point out that the gravity method equation can correctly to approximate the bilateral trade flow. As a result, most researchers have adopted the gravity method equation when investigate the economic integration impact on trade performance.

2.4 CONCLUDING REMARKS

As a conclusion, the past and current literature on economic integration, agriculture sector studies, trade studies and gravity model has provided us with important information relating to this study. Next, there are many authors used secondary data method to examine the agricultural trade analyse. From the review also, gravity model is said to be one of the best and stable tools of international studies. Table 2.1 below will shows the summary table of important discussions on the empirical literatures in tabulate form.

Table 2.1: Summary Table of Literatures Review

Author (s)	Country(s)	Methodology	Findings
David & Shahera (2009)	South and Central America	Time-series method of two countries Gravity model	<ul style="list-style-type: none"> ❖ Distance adversely influences agricultural trade between nations. ❖ Coefficient on per capita GDP for both origin and destination are measurably critical and positive. ❖ Countries having enormous populations comparatively experience greater agricultural product trade. ❖ The proportion of agricultural's Gross domestic product to add up to GDP and the proportion of cultivable land to rural work, are negative and critical for origin nations. ❖ A more noteworthy extent of land to work in farming creation contrarily influences horticultural fare and has no measurably huge impact on import. ❖ Negative coefficient propose the worth portion of horticultural fares is more noteworthy for the work concentrated rather than the land-serious items. ❖ Cultural and separation variable have the beneficial outcomes on food exchange as on horticultural item exchange. ❖ GDP per capita effectsly affects food exchange for both fare and import. ❖ The proportion of arable land to rural work had negative and huge effects on both food imports and fares.
Simeon et al. (2017)	Qatar and trading partners	Cross-section time series data Panel data Gravity model Hausman-Taylor Estimator	<ul style="list-style-type: none"> ❖ GDP coefficient is positive as expected effect to the demand for food. ❖ The coefficient for population is not statistically significant. ❖ Coefficient of separation is negative in concurrence with the gravity model, it isn't factually critical. ❖ The pace of swelling in food trading nations is expectedly positive and exceptionally measurably critical. ❖ High debasement observation demonstrates conceivable significant expense of doing business, it is measurably critical and expected negative so defilement discourages food imports.

Author (s)	Country(s)	Methodology	Findings
			<ul style="list-style-type: none"> ❖ The coefficient on the conversion scale between the residential monetary forms with US dollar is negative yet not factually critical. ❖ Trade receptiveness coefficient is factually noteworthy and positive. ❖ Relative factor gift is pitifully measurably noteworthy and positive. ❖ The proportion of comparability of the economies of Qatar and its exchanging accomplices (SIM) is sure and firmly measurably noteworthy.
<p>Muhammad et al. (2018)</p>	<p>China-Pakistan</p>	<p>Panel data Gravity model</p>	<ul style="list-style-type: none"> ❖ Higher GDP of exporter showed higher creation potential that may prompt higher fares. Consequence of the examination shows farming fares of both China and Pakistan at the 1% level of huge and positive connection between agrarian exchange and salary of nation. ❖ The populace of a bringing in nation negatively affects its agrarian exchange. ❖ The separation between the exchange accomplices is considered as exchange cost and customarily negatively affects volume of the horticultural exchange. ❖ Exchange rate varied effectsly affect rural exchange. Higher swapping scale regularly positively affects horticultural fares. For this situation, it clarifies that if there is a deterioration in the cash of the exporter nation, it will cause a reduction in agrarian fares of the nation, this outcome demonstrate that conversion scale had a positive and noteworthy impact on farming exchange of China and Pakistan. ❖ Agricultural land is seen as positive and measurably huge at the 1% level of agrarian exchange. ❖ The coefficient of basic language is seen as negative and measurably critical at the 1% level of centrality on account of Pakistan and positive and factually huge at the 1% level on account of China.

Author (s)	Country(s)	Methodology	Findings
Marilyne et al. (2015)	North country to south country	Gravity model Ordinary least squares	<ul style="list-style-type: none"> ❖ Dummy equal to 1 for country pairs have a positive and significant direct impact on agricultural food export from North to South countries, it tend to increase the bilateral trade. ❖ Restrictiveness index have a negative impact, and not significantly on agricultural food exports from North to South countries. ❖ Higher distance between countries tends to discourage their bilateral exports and imports. ❖ Countries sharing common language or colonial links tend to trade more together.
Pascal (2015)	Greece – EU and Non-EU Countries	Gravity model Ordinary least squares	<ul style="list-style-type: none"> ❖ Separation evaluated shows that the greatness of two-sided prepared food exchange among EU part nations is higher than the size of the reference reciprocal exchange among OECD nations. ❖ The evaluated coefficient on the Greece-EU basic language and regular fringe is sure and factually critical at the 1% level, showing that the size of reciprocal exchange is of Greece-EU is higher than the extent respective exchange among EU part nations.
Won et al. (1993)	Countries export and import livestock production	Cross section data Time series data Gravity model	<ul style="list-style-type: none"> ❖ Animal number in trading and bringing in nations are utilized to speak to a proportion of domesticated animals creation limit in these nations. ❖ Farm area extra cash is utilized to speak to buyer' buying intensity of the bringing in nation. ❖ The assessed coefficient on exporters' ranch pay and creation are certain as theorized yet not contrast fundamentally at the 5% level. The evaluated coefficient on shippers' pay and domesticated animals creation are certain and negative, individually, as conjectured and vary huge from zero at the 5% level. This demonstrates the course of meat exchange

Con't

Author (s)	Country(s)	Methodology	Findings
			<p>stream is impact to a great extent by shippers pay and animals creation.</p> <ul style="list-style-type: none"> ❖ Exchange rate used to characterize the adjustments in the costs of bringing in nations' monetary forms as far as sending out nations' monetary standards. The coefficient of conversion standard is certain as theorized. The easygoing connection isn't factually noteworthy at 1% level. ❖ The separation is measure by the transportation cost. The assessed coefficient has a positive sign and is measurably noteworthy at the 1% level. For this situation, the separation variable is negative and noteworthy at 5% level. This is particularly valid for meat for which transportation costs are higher than other agrarian item.
Lopez (1997)	Ghana	<p>Cross section data</p> <p>Production function (Cobb-Douglas)</p>	<ul style="list-style-type: none"> ❖ The coefficient of biomass variable is noteworthy in any event at 10% in all relapses performed. Biomass is a significant factor of creation in Ghana. It commitment to rural yield is high. ❖ Land cultivated level will be negative and noteworthy at 5% level of essentialness. The speculation that land development choices are socially ideal is measurably dismissed. ❖ Effect of trade liberalization to labour variable and urban good are positively in agricultural. While, increase the output of farmer, the labour and urban good also will be increase.
Thomas & John (1986)	United Stated	Time series data (1951-1981)	<ul style="list-style-type: none"> ❖ Neoclassical general equilibrium theory maintains that relative prices of goods and services and that the absolute

Author (s)	Country(s)	Methodology	Findings
			<p>value level and individual ostensible costs are controlled by the communication of gracefully and interest for cash (see Patinkin, 1965; and Vining and Elwertowski, 1976). The cash cost of agrarian wares ought to have a versatility of solidarity as for the supreme value level).</p> <ul style="list-style-type: none"> ❖ The result are steady with the Law of One Price theory and the related speculation that domestics' costs are similarly flexible as for outside ostensible costs and the conversion scale (Demand Homogeneity). ❖ Neoclassical fiscal hypothesis hold that genuine monetary variable are free of absolutely ostensible elements. Since cost in agrarian part are accepted to be free rigidities related with long haul contracts.
<p>Oyakhilomen & Grace (2014)</p>	<p>Nigeria</p>	<p>Time series data (1970-2011)</p> <p>Augmented Dickey Fuller (ADF) Test Vector</p> <p>Autoregression (VAR)</p>	<ul style="list-style-type: none"> ❖ New Keynesian theory, expansion can be brought about by increment sought after or potentially increment in cost. Raising creation costs will prompt swelling. ❖ Unidirectional causality from inflationary pattern to horticultural creation, unidirectional causality from agrarian profitability to monetary development with no causality from inflationary pattern and financial development over the information time of the investigation.
<p>Puah et al. (2019)</p>	<p>Russia</p>	<p>Time series data (2008Q1–2016Q4)</p> <p>AUGUMENTED Dickey-Fuller (ADF) unit root test</p>	<ul style="list-style-type: none"> ❖ New Keynesian theory best explains the trade-off pattern between output and inflation in the short run.

Author (s)	Country(s)	Methodology	Findings
		Lagrange multiplier autoregressive conditional heteroscedasticity (ARCH-LM) test	
		Generalized autoregressive conditional heteroscedasticity (GARCH) model	
Ling & Shamim (2018)	China - EU	Gravity model	❖ Trade cost reduce overall agri-food trade growth between China – EU.
Cho et al. (2015)	10 developed countries	Panel data (1974-1995) Gravity model	❖ Exchange rate uncertainly has contrarily influenced agriculture trade. ❖ Result introduced a commitment to our comprehension of the association between swapping scale developments and global exchange streams.
Taylor (2015)	ASEAN	Theoretical studies	❖ Constraints: <ul style="list-style-type: none"> ○ Possible lack of economic incentive to producers to diversify ○ Possible infrastructural shortcomings ○ Market development for newly introduced commodities ○ Design and management of irrigation and drainage system ○ Nature of government intervention ○ Emphasis on income distribution versus economic efficiency
Liu et al. (2017)	ASEAN	Panel data (1970-2013)	❖ Sustainable power source has a negative effect, while non-sustainable power source positively affects carbon dioxide emanations, true to form over the long haul in these selected countries.

Author (s)	Country(s)	Methodology	Findings
		Unit root test Panel co-integration tests VECM granger causality	❖ Long-run bidirectional Granger causalities are found between per capita CO_2 discharges, sustainable and non-sustainable power source. Unidirectional linkages are found from horticulture and genuine GDP to emanations, to sustainable and non-sustainable power source over the long haul, individually.
Robert & Richard (1986)	United States	Theoretical framework	<ul style="list-style-type: none"> ❖ Using a general model of overabundance request and gracefully. ❖ Turning to the econometric investigations of depreciations, hardly any examinations clearly have understood the significant of the related conversion scale detail issue. ❖ Including a different conversion standard variable (including a weighted value record of other exchanged merchandise if doable) in the relapse conditions. ❖ Essentially utilize own cost balanced by conversion scale may prompt a descending predisposition on appraisals of swapping scale impacts. ❖ The consequence of this paper recommend that a significant part of the a great part of the issue of estimating conversion scale impacts in agribusiness are because of absence of fitting value lists for certain product groups.
Izuchukwu (2011)	Nigerian	Time series data (1986-2007) ANOVA	❖ ANOVA result shows that all the three variable have a significant impact on GDP.
Derek Byerlee, A. N. Halter (2015)	Nigerian	Macro-economic model	❖ Macro-economic model is useful for agricultural sector for who does not have the resources to build a detailed model of all sectors of the economy.

CHAPTER THREE

METHODOLOGY

3.0 INTRODUCTION

This study had aimed to identify the relationship of agriculture product trade balance and distance, total population, GDP per capita, and inflation rate between ASEAN-4 and China. There was a different type of test are carried out to identify the relationship between these variables. This chapter will provides explanations on methods being used for this research based on the reviews of past and current literatures. This study applied panel data analysis approach, where we can ran different methods of estimation namely, pooled OLS, random effects model and fixed effects model. It was decided that the best model to adopt for this investigation was the gravity model. This study extended the basic gravity model by including additional factor that helps in investigating our specific objectives.

3.1 EMPIRICAL MODEL

The empirical framework will be used to investigate the relationship among those variables where agriculture product trade balance between China and ASEAN-4, and independent variable are distance, where measure by using geographical distance and common language between trading countries; total population; GDP per capita; and inflation rate. The variables will form as a linear regression as bellow:

$$NR4001_{ci}^t = \beta_0 + \beta_1 TPOP_{ci}^t + \beta_2 INF_{ci}^t + \beta_3 GDP_{ci}^t + \varepsilon_{ci}^t$$

Where,

- $NR4001_{ci}^t$ = Total Import Natural Rubber (4001) of China (c) from ASEAN-4 (i) at time period t
- $TPOP_{ci}^t$ = Total Population
- INF_{ci}^t = Inflation rate
- GDP_{ci}^t = Gross Domestic Product (GDP) Per Capita
- ε_{ci}^t = Error term of regression

3.2 RESEARCH DESIGN

3.2.1 Estimation Procedure of Panel Data Analysis

The first step in panel analysis is to determine the existence of unit roots in the data series. In this study, IPS (Im, Pesaran and Shin) Panel Unit Root been selected. Because the panel unit root can investigate the possibility of panel cointegration.

IPS proposed a test for the nearness of unit establishes in boards that consolidates all the data from the time arrangement measurement with that from the cross segment measurement (less time perceptions) are required for the test to have power. As indicated by past specialist, IPS board unit root test has been found to have better test power in financial matters than investigate since quite a while ago run connections in board information, consequently, in this examination we will likewise apply this technique in this examination. IPS starts by indicating a different ADF relapse for each cross-area with singular impacts and no time pattern:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{i,t-j} + \varepsilon_{it} \quad (1)$$

where $i = 1, \dots, N$ and $t = 1, \dots, T$

IPS utilize separate unit pull tests for the N cross-area units and this test depends on the Augmented Dickey-more full (ADF) measurements found the middle value of across gatherings. Subsequent to assessing the different ADF relapses, the normal of the t-insights for from the individual ADF relapses, $t_{iT_i}(p_i)$:

$$\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^N t_{iT}(p_i \beta_i) \quad (2)$$

The \bar{t} is the standardized and it is shown the standardized \bar{t} statistic converges to the standard normal distribution as N and T $\rightarrow \infty$. IPS (1997) showed that \bar{t} test has better execution when N and T are little. They proposed a cross-sectionally belittled variant

of both test to be utilized for the situation where the blunders in various relapses contain a typical time-explicit segment.

3.2.1.1 Panel Cointegration Tests

The following stage is to test for the presence of a since quite a while ago run cointegration among farming item and the free factors utilizing board cointegration tests proposed by Pedroni (1999 and 2004). We will utilize seven board cointegrations by Pedroni (1999) in this examination, since they test decides the fittingness of the tests to be applied to evaluated residuals from a cointegration relapse in the wake of normalizing the board insights with remedy terms.

Pedroni proposed the techniques to utilize assessed leftover from the guessed since quite a while ago run relapse of the accompanying structure:

$$y_{i,t} = \alpha_i + \delta_i t + \beta_{1i} x_{1i,t} + \beta_{2i} x_{2i,t} + \dots + \beta_{Mi} x_{Mi,t} + e_{i,t} \quad (3)$$

for $t = 1, \dots, T$; $i = 1, \dots, N$; $m = 1, \dots, M$, where T is the number of observations over time period, N is number of cross-sectional units in the panel data set, and M is number of repressor. Based on this equation, α_i is the member specific intercept or fixed effects parameter which varies across individual cross-sectional units. The same is true of the slope coefficients and member specific time effects, $\delta_i t$.

3.2.1.2 Fully Modified Ordinary Least Squares (FMOLS) Estimation

After the Pedroni Cointegration test, we will apply FMOLS procedure from Liu et al. So as to get asymptotically productive steady gauges in board arrangement, non-exogeneity and sequential relationship issues are handled by utilizing completely changed OLS (FMOLS) presented by Pedroni (1996). Since the illustrative factors are cointegrated with a period pattern, and in this manner a since quite a while ago run harmony relationship exists among these factors through the board unit root test and board cointegration test, we continue to evaluate the Equation (2) by the strategy or completely adjusted OLS (FMOLS) for heterogenous cointegrated boards. This system permits predictable and effective estimation of cointegration vector and furthermore addresses the issue of non-fixed regressors, just as the issue of concurrence inclinations. It is notable that OLS estimation yields one-sided results on the grounds that the regressors are endogenously decided in the I(1) case. The starting point OLS as in the following cointegrated system for panel data:

$$y_{it} = \alpha_i + x_{it}\hat{\beta} + e_{it} \quad (10)$$

$$x_{it} = x_{i,t-1} + \varepsilon_{it}$$

The estimator will be predictable when the mistake procedure full fills the supposition of cointegration between y_{it} and x_{it} . The restricting appropriation of OLS estimator relies on disturbance boundaries. Following Phillips and Hansen (1990), a semi-parametric revision can be made to the OLS estimator that dispenses with the subsequent request predisposition brought about by the way that the regresses are endogenous.

In this paper, we utilized board bunch FMOLS test from Pedroni (1996, 2000). A significant bit of leeway of the board bunch estimators is that the structure wherein

the information is pooled takes into account more prominent adaptability within the sight of heterogeneity of the cointegrating vectors. Test statistics constructed from the panel group estimators are designed to test the null hypothesis $H_0 : \beta_i = \beta_0$ for all i against the alternative hypothesis $H_A : \beta_i \neq \beta_0$, so that the values for β_i are not constrained to be the same under the alternative hypothesis. Unmistakably, this is a significant bit of leeway for applications, for example, the current one, in light of the fact that there is no motivation to accept that, if the cointegrating slants are not equivalent to one, which they essentially take on some other subjective normal worth. Another favorable position of the board bunch estimators is that the point gauges have an increasingly valuable translation if the genuine cointegrating vectors are heterogeneous. In particular, point gauges for the board bunch estimator can be deciphered as the mean an incentive for the cointegrating vectors (Pedroni, 2001).

3.2.2 Measurement

3.2.2.1 Total Population (TPOP)

Population size, like income is another major driver of demand will give impact to trade balance (Simeon et al., 2017). Total population helps to determine a country economic of scale. On the other hand, population also can be used to explain a country's productivity. The larger the population, the grater production lines for the country to increase the trade balance. Because the larger population means larger domestic market to foreign market ratio. Thus, demand on imported product is expected to be smaller. This is supported by David and Shahera (2009), Muhammad et al. (2018), and Simeon et al. (2017).

3.2.2.2 GDP Per Capita (GDP)

GDP per capita is expected had positive relationship with trade balance (Simeon et al., 2017). GDP per capita refer of a country's economic output for number of citizen. The higher that GDP per capita means that country had a good measurement of a country's standard of living. Simply to say, the country has high GDP per capita means the country has a good purchasing power and encourage to make trade. This statement is supported by David and Shahera (2009). On the other hand, Muhammad et al. (2018) found that higher GDP of exporter country indicated higher production potential that may lead to higher exports. Higher production also stimulate on the trade balance and expected has positive relationship.

3.2.2.3 Inflation Rate (INF)

Oyakhilomen (2014) used inflation rate to determine the agriculture productivity and international trade. Keynesian theory mention that the inflation can be caused by increase in demand or increase in cost. Raising the production costs will lead inflation. When a country happen inflation, the price of product will increase and this will reduce in trade balance. According to previous researcher, they are few study used inflation rate as an explanatory variable to influence on international trade.

3.2.3 Economic Integration and Gravity Model

Based on Muhammad et al. (2018), the gravity model remain the powerful toll for analysing the international trade. The general gravity model equation can expressed as below:

$$\ln(M)_{cit} = G \frac{TGDP_c^\alpha TGDP_i^\beta}{DIST_{ci}^\theta} \quad (12)$$

Where, $\ln(M)_{cit}$ refer to the import of country c from country i in time period t . For instance, it represents total volume of import of country c from country i ; whilst $TGDP_c$ and $TGDP_i$ are represent the total GDP ($TGDP$) which related to the economic sizes of the both countries and $DIST_{ci}$ is the distance between bilateral trade partners which measured between two capital countries. For examples trade between Malaysia and China, we use the distance between Kuala Lumpur (Malaysia) and Beijing (China); trade between Bangkok (Thailand) and Beijing (China); Jakarta (Indonesia) and Beijing (China); and Manila (Philippines) and Beijing (China).

Basic gravity model involves the volume of exports between bilateral trade partner countries, which is a function of their incomes¹⁷, population, geographical distance, exchange rate, agricultural land, and a set of dummies variables (Muhammad et al., 2018). The basic formulation of the gravity equation is as below:

$$X_{ijt} = e^{(\sum a_{ij} DUM_{ij})} GDP_{ijt}^{a_1} POP_{ijt}^{a_2} DIST_{ij}^{a_3} ER_{ij}^{a_4} AL_{ij}^{a_5} v_{ijt} \quad (13)$$

As mention in Muhammad et al. (2018), we are able to taking the natural logarithm and get a linear relationship between log trade flows and the logged economic mass as well as distance. This is because of the nature of the gravity equation found to be multiplicative.

¹⁷ Incomes can used to measure real or nominal GDP. David and Shahera (2009), Simeon et al. (2017) and Muhammad et al. (2018) describes that the GDP can used as a determined on trade balance.

3.2.4 Augmented Gravity Equation with Dummy Variables

In the past few years, a lot researcher have adopted gravity method equations when investigate the trade effect of an integration (David and Shahera., 2009, Simeon et al., 2017, Muhammad, 2018, Marilynne, 2015, Ghazalian, 2015, Won et al., 1993, Ling and Shamim 2018, and Cho et al., 2015). Researcher often added in different variables with less explanation on why they chose those variables. Less evidence in support the selected variables maybe will lead bias in study. However, this is simply because previous studies had proven the success of these selected variables. The basic equation involves explanatory variables that depict economic mass of countries, such as exporting and importing countries and also distance. For an example, the augmenting variables are common language, inflation rate and GDP per capita.

3.3 DATA DESCRIPTION

The trade data of ASEAN-4 and China are estimated over the time period from year 2010 to 2018. The trade data obtained from International Trade Statistics (ITC) in US dollar. The agriculture product code is based on Food and Agriculture Organization of the United Nations (FAOSTAT). The data of independent variable is retrieve from World Bank. Next, data for geographical distances between countries were taken from distance calculator by Mapcrow.com. Besides, the data of language is by Nation-Line Organization.

In this study, the selected countries is ASEAN-4, which are Malaysia, Indonesia, Thailand, and Philippines. We attributed to only four countries is due to the data availability. These four countries are the countries founding members of ASEAN and all of them are the major market on agriculture sector. The newest ASEAN member countries such as Cambodia, Laos, Myanmar and Vietnam are being excluded in the study because there are less developed in agriculture sector compare ASEAN-4 countries. Below is the list of data features.

Table 3.2: Data Features

Variables	Symbol	Measurement	Data Sources
(1511) Palm Oil	<i>P</i>		
(4001) Natural Rubber	<i>N</i>	US Dollar Thousand	International Trade Statistics (ITC)
(1006) Rice	<i>R</i>		
Distant	<i>DIST</i>	Kilometres	Mapcrow.com
Language	<i>LANG</i>	Percentage of people who can speak Chinese	Nation-Line Organization
Total Population	<i>TPOP</i>	Million People	
GDP Per Capita	<i>GDP</i>	US Dollar	World Bank
Inflation Rate	<i>INF</i>	Rate	

3.4 CONCLUDING REMARKS

Conclusion, chapter three was explained the test to identify the determined of agriculture trade between ASEAN-4 and China with the selected variable. This study used panel analysis, thus, the specifically test include in this study were panel unit root, Pedroni Cointegration test and FMOLS Regression method. Based on previous studies, the gravity model in trade analysis have been done and they mention that gravity model is the best model to analysis the trade. Next, chapter 4 will illustrate the analysis result and discussion based on available data.

CHAPTER FOUR

EMPIRICAL RESULTS

4.0 INTRODUCTION

This chapter discusses relationships between inflation (INF), gross domestic products (GDP), and total population (TPOP) of ASEAN-4 toward China on agriculture product of Natural Rubber. In this chapter will shows the procedure of Panel Unit Root, Panel Cointegration Test, Panel Fully Modified Least Squares (FMOLS) and Panel Dynamic Least Square (DLOS).

4.1 PANEL UNIT ROOT TEST

Table 4.1 presents result of the IPS (Im, Pesaran and Shin) panel unit root test for agriculture product trade of natural rubber between ASEAN-4 countries with China.

Table 4.1: Panel Unit Root – Im, Pesaran, and Shin (IPS)

Variable	Level		First order difference	
	Constant	Constant + Trend	Constant	Constant + Trend
LNR4001	-1.43886 (0.0751)	1.34062 (0.9100)	-4.17628* (0.0000)	-4.67243* (0.0000)
LTPOP	3.16718 (0.9992)	4.45736 (1.000)	-16.7504* (0.0000)	-8.02825* (0.0000)
LINF	-0.69834 (0.2425)	-0.53006 (0.2980)	-4.62610* (0.0000)	-2.71661* (0.0033)
LGDP	-0.95959 (0.1686)	(2.79511) (0.9974)	-3.14955* (0.0008)	-2.78467* (0.0027)

*Note: *, ** indicates rejection of the null hypothesis of no-cointegration at 1% and 5%, levels of significance.*

The result of table 4.1 shows IPS panel unit root test at level indicating that all variables are $I(0)$ in the constant of the panel unit root regression. These results clearly show that the null hypothesis of a panel unit root in the level of the series cannot be rejected at various lag lengths. Thus, we assume that there is no time trend. Therefore, we test for stationarity allowing for a constant plus time trend. In the result of level form for constant plus time trend, again we found that the null hypothesis of having panel unit root is generally rejected in all series and various lag lengths. Hence, we can conclude that most of the variables are non-stationary in with and without time trend specification at level form by applying the IPS panel unit root test which is also applied for heterogeneous panel to test the series for the presence of a unit root. Conclusion, the result of IPS panel unit root test confirms that all the variables are non-stationary at level.

Moreover, table 4.1 also presents the result of the test at first difference for IPS panel unit root test in constant and constant plus time trend. According to the result of table above, we can see that for all series the null hypothesis of panel unit root test is rejected at 95% percent critical value (1 percent level). Hence, based on IPS unit root test, there is strong evidence that all series are in fact integrated of order one. We can conclude that the result of IPS panel unit root test reported in Table 4.1 supports the hypothesis of a unit root in all variables across countries, as well as the hypothesis of zero order integration in first differences. At most of the 1 percent significance level, we found that all test statistics in both with and without trend significantly confirm that all series strongly reject the unit root null. With the result given by IPS panel unit root test, it is possible to apply panel cointegration method in order to test for the existence of the stable long-run relation among the variables.

4.2 PANEL COINTEGRATION TEST

After the panel unit root, the next step is to test whether the variables are cointegrated using Pedroni's (1999, 2001, and 2004). This method is used to investigate whether long-run steady state or cointegration exist among the variables and to confirm what Coiteux and Olivier (2000) state that the panel cointegration tests have much higher testing power than conventional cointegration test. Since the variables are found to be integrated in the same order $I(1)$, thus, we continue with the panel cointegration tests proposed by Pedroni (1999, 2001, and 2004). Cointegrations are carried out for constant plus time trend and the summary of the results of cointegrations analyses are presented in Table 4.2.

Table 4.2: The Pedroni Panel Cointegration Test

Test	Constant + Trend
Panel v -Statistic	-1.221317
Panel ρ -Statistic	1.739133
Panel t -Statistic: (non-parametric)	-0.004274
Panel t -Statistic (<i>adf</i>): (parametric)	-3.839637*
Group ρ -Statistic	2.023635
Group t -Statistic: (non-parametric)	-2.438233*
Group t -Statistic (<i>adf</i>): (parametric)	-2.406822*

*Note: All statistics are from Pedroni's procedure (1999) where the adjusted values can be compared to the $N(0,1)$ distribution. The Pedroni (2004) statistics are one-sided tests with a critical value of -1.64 ($k < -1.64$ implies rejection of the null), except the v -statistic that has a critical value of 1.64 ($k > 1.64$ suggests rejection of the null). *, ** indicates rejection of the null hypothesis of no-co-integration at 1% and 5%, levels of significance.*

In the panel cointegration test for our model with constant plus trend level, the result indicate that 3 out of 7 statistics reject the null hypothesis of non-cointegration

at 1 percent and 5 percent level of significance, while there is no cointegration among the variable. For the group *adf*-statistic and group *p*-Statistic, 3 out of 4 statistics are significant at 1 percent level of significance (shown in the highlighted blue box). We can conclude that the result of the panel cointegration test in the model with constant plus trend level shows that independent variables do hold cointegration in the long run for a group of ASEAN-4 countries with respect to agriculture product of natural rubber (NR). However, since all the statistics conclude in favour of cointegration, and this, combined with the fact that according to Pedroni (1999) the panel non-parametric (*t*-statistic) and parametric (*adf*-statistic) statistics are reliable in constant plus time trend. Thus, we conclude that there is a long run cointegration among our variables in ASEAN-4 countries.

4.4 PANEL FMOLS REGRESSION

After the determination of the cointegration, we can apply panel FMOLS method. This test is applicable under the condition that existence of cointegration is determined. By this means, the magnitude and direction of the relationship between our dependent variable which is natural rubber (NR4001) and our independent variables which are Inflation rate (INF), Gross Domestic Product (GDP), and Total Population (TPOP) can be detected.

Table 4.3: Panel FMOLS Regression result for the Natural Rubber

Variable	t-statistics
LTPOP	4.749329 (1.603010)*
LINF	3.825172 (1.007433)*
LGDP	5.834553 (3.32824)*
<hr/>	
R-squared : 0.931086	Adjusted R-squared : 0.923831

*Note: The null hypothesis for the t-ratio is $H_0 = \beta_i = 0$; Figures in parentheses are t-statistics. * and ** significant with 100% and 95% confidence level.*

Based on table 4.3, we found that the estimate of the coefficient for total population (LTPOP) is positive sign and statistically significant at the 1 percent level toward agriculture product of natural rubber. This means that if one percent of total population growth up, the demand of natural rubber trade between asean-4 and china will increased 1.6%. We conclude that there is a presence of a long run relationship between China demands of natural rubber with total population for ASEAN-4. This result is support by previous researcher, because the total population represent the productivity of a country, hence increase in total population of a country will lead an increase in a country productivity. To proves that the demand on natural rubber of

China will increase, because currently China is the largest market for natural rubber, and accounts for nearly 50% of the total global consumption (Mind, 2019). Next, for the independence variable of inflation rate (LINF), it show the positive coefficient sign at 1 percent statistically significance level. Thus, this result means that one percent of inflation rate increase will lead 1 percent increase in China demand of natural rubber. This result is supported by the theory of relationship between exchange rate and inflation. When the inflation rate is high, there is a depreciation in exchange rate, while when the inflation rate decline, there is an appreciation in exchange rate, (Pettinger, 2019). These result show that there is still a long run cointegration between inflation rates with demand of natural rubber. Continuously with the third independent variable of gross domestic product (LGDP). According with the result on table 4.3, we found that LGDP has a positive coefficient sign and statistically significant at 1 percent level. This measure that gross domestic product of ASEAN-4 positively affect China demand on natural rubber and there is a long run cointegration between GDP and demand of natural rubber. The result shows 1 percent increase in GDP will lead 3.3 percent increase in demand of natural rubber of China.

The result of panel FMOLS regression conclude that total population (LTPOP), inflation rate (LINF), and gross domestic product (LGDP) have a positive coefficient sign and statistically significance at 1 percent level toward China demand of natural rubber on ASEAN-4 countries.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

In ASEAN, there are four countries is expert in agriculture sector which they grouping their self as “ASEAN-4”. ASEAN got ten countries but there are four countries which they have some same characteristics where is four of them is developing countries, four of them came from middle income country and four of them also mainly focus in agriculture sector. Four of them is came from Indonesia, Malaysia, Philippines and Thailand.

According to the 2nd International Conference on Agriculture & Horticultural Sciences, they have mention that agriculture sector plays a crucial role in the economy and especially for developing countries, (Solanki, 2014). Agriculture sector provides the main source of food, income and employment to the rural populations. Besides that, agriculture sector can help to reduce poverty, raise income and improve food security for 80% of the world’s poor, who live in rural areas and work mainly in farming department. And this result is supporting by the data from World Bank Group. Agriculture development is one of the most powerful tools to end extreme poverty, boost shared prosperity and feed a projected 9.7billion people by 2050 (The World Bank, 2020). Thus, this four country play a very important role in promoting their economic developing through the agriculture sector. Based on the South China Morning Post, China was overtakes US as No. 1 in buying power, but still clings to developing status. The World Bank Annual Report of 2017 mention that China’s gross domestic product ranked No.1 in the world when based on their purchasing power parity. Thus, due to strategy location between China and ASEAN-4, China was the

first target group for ASEAN-4 in order to make trade in agriculture product. They are many agriculture product been trade by ASEAN-4 and China, but there are three main trade product which are palm oil, natural rubber and rice. According to the research, China's demand for natural rubber is huge, therefore, the aim of this study is to determinants China total import of Natural Rubber from ASEAN-4. China is a country where mainly focusing in manufacturing sector, hence the natural rubber can consider as an important raw material for them.

Addition, panel estimation was apply in this paper. Where we estimated the panel unit root test by using IPS panel unit root test and IPS is stand for Im, Pesaran and Shin. The result of IPS panel unit root shows all the result a most of the 1 percent significance level in test statistics in both with and without trend significantly confirm that all series strongly reject the unit root null. With this result, it is possible to run panel cointegration method in order to test for the existence of the stable long-run relationship among the variable. The panel cointegration test are using the Pedroni's (1999, 2001, and 2004). The result shows there is a long-run cointegration among the variable in ASEAN-4 countries. Next, the panel FMOLS method was been apply in this study. From the estimation we found that the result shows that all these three variable are at 1 percent significance level and they have positive effect on natural rubber. This means that the increase in total population, inflation rate and gross domestic product (GDP) will lead to increased demand for natural rubber in China. As a conclusion, the result confirms that all variables serve as considerations by China to imports natural rubber from ASEAN-4.

Based on the findings, we summarize that these three variables are important determinants of China's decision to import natural rubber. As we know that planting

natural rubber needs to consider many factors, especially are cultivable land and climate problem. As a recommendation, ASEAN-4 can cooperated in innovation natural rubber planting technology. A new technology can improve the rubber productivity and also can increase the export of natural rubber. By applying can invest in a new technology might need a huge capital, but if ASEAN-4 are willing cooperated together, they can growth together because four of them are the main exporter in natural rubber. While, a good cooperation can drive this four country into a new era.

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x=43&pr.y=19&sy=2017&ey=2017&scsm=1&ssd=1&sort=country&ds=.&br=1&c=512%2C672%2C914%2C946%2C612%2C137%2C614%2C546%2C311%2C962%2C213%2C674%2C911%2C676%2C193%2C548%2C122%2C556%2C912%2C6

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APPENDIX

Appendix A: Eview Result

Null Hypothesis: Unit root (individual unit root process)

Series: LNR4001

Date: 07/12/20 Time: 22:56

Sample: 2001 2018

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Total (balanced) observations: 68

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-1.43886	0.0751

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-3.0705	0.0483	-1.517	0.894	0	3	17
2	-2.1670	0.2238	-1.517	0.894	0	3	17
3	-1.9123	0.3192	-1.517	0.894	0	3	17
4	-1.6401	0.4418	-1.517	0.894	0	3	17
Average	-2.1975		-1.517	0.894			

Null Hypothesis: Unit root (individual unit root process)

Series: LNR4001

Date: 07/12/20 Time: 22:56

Sample: 2001 2018

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Total (balanced) observations: 68

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	1.34062	0.9100

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-1.9565	0.5821	-2.167	0.827	0	3	17
2	-1.0133	0.9145	-2.167	0.827	0	3	17
3	-1.0999	0.8986	-2.167	0.827	0	3	17
4	-2.1621	0.4785	-2.167	0.827	0	3	17
Average	-1.5580		-2.167	0.827			

Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0
Total (balanced) observations: 64
Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-4.17628	0.0000

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-3.1222	0.0451	-1.516	0.909	0	3	16
2	-4.0019	0.0086	-1.516	0.909	0	3	16
3	-3.9646	0.0092	-1.516	0.909	0	3	16
4	-2.9355	0.0632	-1.516	0.909	0	3	16
Average	-3.5060		-1.516	0.909			

Null Hypothesis: Unit root (individual unit root process)
Series: D(LNR4001)
Date: 07/12/20 Time: 22:56
Sample: 2001 2018
Exogenous variables: Individual effects, individual linear trends
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0
Total (balanced) observations: 64
Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-4.67243	0.0000

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-3.9964	0.0320	-2.167	0.848	0	2	16
2	-4.9823	0.0058	-2.167	0.848	0	2	16
3	-5.6337	0.0019	-2.167	0.848	0	2	16
4	-2.6608	0.2623	-2.167	0.848	0	2	16
Average	-4.3183		-2.167	0.848			

Null Hypothesis: Unit root (individual unit root process)

Series: LINF

Date: 07/12/20 Time: 22:57

Sample: 2001 2018

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 58

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-0.69834	0.2425

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-2.6533	0.1035	-1.506	0.992	1	1	16
2	-0.7511	0.7884	-1.488	1.255	1	1	10
3	-1.5307	0.4930	-1.506	0.992	1	1	16
4	-2.5061	0.1323	-1.506	0.992	1	1	16
Average	-1.8603		-1.501	1.058			

Null Hypothesis: Unit root (individual unit root process)

Series: LINF

Date: 07/12/20 Time: 22:57

Sample: 2001 2018

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 58

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-0.53006	0.2980

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-2.8647	0.1977	-2.170	0.949	1	1	16
2	-0.9727	0.8974	-2.173	1.453	1	1	10
3	-2.8655	0.1974	-2.170	0.949	1	1	16
4	-3.0780	0.1438	-2.170	0.949	1	1	16
Average	-2.4452		-2.170	1.075			

Null Hypothesis: Unit root (individual unit root process)

Series: D(LINF)

Date: 07/12/20 Time: 22:58

Sample: 2001 2018

Exogenous variables: Individual effects

User-specified lags: 1

Total number of observations: 52

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-4.62610	0.0000

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-6.0420	0.0002	-1.503	1.011	1	1	15
2	-2.0708	0.2575	-1.530	2.091	1	1	7
3	-3.7645	0.0144	-1.503	1.011	1	1	15
4	-4.6333	0.0029	-1.503	1.011	1	1	15
Average	-4.1276		-1.510	1.281			

Null Hypothesis: Unit root (individual unit root process)

Series: D(LINF)

Date: 07/12/20 Time: 22:58

Sample: 2001 2018

Exogenous variables: Individual effects, individual linear trends

User-specified lags: 1

Total number of observations: 52

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-2.71661	0.0033

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-5.9526	0.0014	-2.169	0.975	1	1	15
2	-4.0624	0.0723	-2.347	8.897	1	1	7
3	-3.6580	0.0590	-2.169	0.975	1	1	15
4	-4.5214	0.0141	-2.169	0.975	1	1	15
Average	-4.5486		-2.214	2.955			

Null Hypothesis: Unit root (individual unit root process)

Series: LGDP

Date: 07/12/20 Time: 22:59

Sample: 2001 2018

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Total (balanced) observations: 68

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-0.95959	0.1686

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-1.7100	0.4088	-1.517	0.894	0	3	17
2	-2.2075	0.2107	-1.517	0.894	0	3	17
3	-2.6958	0.0950	-1.517	0.894	0	3	17
4	-1.2703	0.6179	-1.517	0.894	0	3	17
Average	-1.9709		-1.517	0.894			

Null Hypothesis: Unit root (individual unit root process)

Series: LGDP

Date: 07/12/20 Time: 22:59

Sample: 2001 2018

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Total (balanced) observations: 68

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	2.79511	0.9974

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-1.1980	0.8777	-2.167	0.827	0	3	17
2	-1.2678	0.8606	-2.167	0.827	0	3	17
3	-0.5898	0.9656	-2.167	0.827	0	3	17
4	-0.5316	0.9700	-2.167	0.827	0	3	17
Average	-0.8968		-2.167	0.827			

Null Hypothesis: Unit root (individual unit root process)

Series: D(LGDP)

Date: 07/12/20 Time: 22:59

Sample: 2001 2018

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Total (balanced) observations: 64

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-3.14955	0.0008

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-3.7037	0.0151	-1.516	0.909	0	3	16
2	-2.9688	0.0596	-1.516	0.909	0	3	16
3	-2.4861	0.1367	-1.516	0.909	0	3	16
4	-2.9081	0.0664	-1.516	0.909	0	3	16
Average	-3.0167		-1.516	0.909			

Null Hypothesis: Unit root (individual unit root process)

Series: D(LGDP)

Date: 07/12/20 Time: 23:00

Sample: 2001 2018

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0

Total (balanced) observations: 64

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-2.78467	0.0027

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-4.1224	0.0258	-2.167	0.848	0	2	16
2	-3.4185	0.0841	-2.167	0.848	0	2	16
3	-3.0753	0.1444	-2.167	0.848	0	2	16
4	-3.1807	0.1229	-2.167	0.848	0	2	16
Average	-3.4492		-2.167	0.848			

Null Hypothesis: Unit root (individual unit root process)

Series: L(LTPOP)

Date: 07/12/20 Time: 23:01

Sample: 2001 2018

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 2 to 3

Total number of observations: 54

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	3.16718	0.9992

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-2.4321	0.1512	-1.373	1.147	2	3	14
2	1.2703	0.9965	-1.342	1.412	3	3	13
3	2.1288	0.9996	-1.373	1.147	2	3	14
4	0.7670	0.9885	-1.342	1.412	3	3	13
Average	0.4335		-1.358	1.279			

Null Hypothesis: Unit root (individual unit root process)

Series: LTPOP

Date: 07/12/20 Time: 23:01

Sample: 2001 2018

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 2 to 3

Total number of observations: 57

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	4.45736	1.0000

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-4.5031	0.0146	-1.999	1.036	2	3	15
2	2.1202	1.0000	-1.966	1.468	3	3	14
3	3.6113	1.0000	-1.966	1.468	3	3	14
4	1.2696	0.9998	-1.966	1.468	3	3	14
Average	0.6245		-1.974	1.360			

Null Hypothesis: Unit root (individual unit root process)

Series: DTPOP

Date: 07/12/20 Time: 23:02

Sample: 2001 2018

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 2 to 3

Total number of observations: 57

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-16.7504	0.0000

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	-19.143	0.0001	-1.387	1.078	2	3	15
2	-2.0960	0.2485	-1.354	1.297	3	3	14
3	-0.1407	0.9263	-1.354	1.297	3	3	14
4	-21.404	0.0001	-1.354	1.297	3	3	14
Average	-10.696		-1.362	1.242			

Null Hypothesis: Unit root (individual unit root process)

Series: D(LTPOP)

Date: 07/12/20 Time: 23:02

Sample: 2001 2018

Exogenous variables: Individual effects, individual linear trends

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 2

Total (balanced) observations: 56

Cross-sections included: 4

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-8.02825	0.0000

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Cross section	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
1	0.1806	0.9944	-1.982	1.154	2	2	14
2	-2.6128	0.2804	-1.982	1.154	2	2	14
3	0.6848	0.9986	-1.982	1.154	2	2	14
4	-23.431	0.0001	-1.982	1.154	2	2	14
Average	-6.2945		-1.982	1.154			

Pedroni Residual Cointegration Test
 Series: LNR4001 LINF LGDP LTPOP
 Date: 07/12/20 Time: 23:14
 Sample: 2001 2018
 Included observations: 72
 Cross-sections included: 4
 Null Hypothesis: No cointegration
 Trend assumption: Deterministic intercept and trend
 Automatic lag length selection based on SIC with a max lag of 2
 Newey-West automatic bandwidth selection and Bartlett kernel

Alternative hypothesis: common AR coefs. (within-dimension)

	Statistic		Weighted	
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	-1.221317	0.8890	-1.533616	0.9374
Panel rho-Statistic	1.739133	0.9590	1.308378	0.9046
Panel PP-Statistic	-0.004274	0.4983	0.090479	0.5360
Panel ADF-Statistic	-3.839637	0.0001	-2.839949	0.0023

Alternative hypothesis: individual AR coefs. (between-dimension)

	Statistic	Prob.
Group rho-Statistic	2.023635	0.9785
Group PP-Statistic	-2.438233	0.0086
Group ADF-Statistic	-2.406922	0.0080

Cross section specific results

Phillips-Peron results (non-parametric)

Cross ID	AR(1)	Variance	HAC	Bandwidth	Obs
1	0.486	0.049239	0.059625	1.00	17
2	-0.019	0.034267	0.036714	1.00	13
3	0.323	0.139707	0.148608	1.00	17
4	0.080	0.287513	0.028736	16.00	17

Augmented Dickey-Fuller results (parametric)

Cross ID	AR(1)	Variance	Lag	Max lag	Obs
1	0.172	0.036712	1	2	16
2	-0.019	0.034267	0	2	13
3	0.188	0.061663	1	2	16
4	-0.463	0.189139	1	2	16

Dependent Variable: LNR4001
 Method: Panel Fully Modified Least Squares (FMOLS)
 Date: 07/12/20 Time: 03:54
 Sample (adjusted): 2002 2018
 Periods included: 17
 Cross-sections included: 4
 Total panel (unbalanced) observations: 64
 Panel method: Pooled estimation
 Cointegrating equation deterministics: C
 Coefficient covariance computed using default method
 Long-run covariance estimates (Bartlett kernel, Newey-West fixed bandwidth)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTPOP	1.603010	3.375234	4.749329	0.0000
LINF	1.007433	0.263369	3.825172	0.0003
LGDP	3.328424	0.570468	5.834553	0.0000
R-squared	0.931086	Mean dependent var		12.22317
Adjusted R-squared	0.923831	S.D. dependent var		2.406637
S.E. of regression	0.664199	Sum squared resid		25.14617
Long-run variance	0.682516			

Appendix B: Turnitin Report

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