Assessing Food Trade Sustainability in ASEAN-4 Countries

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Assessing Food Trade Sustainability in ASEAN-4 Countries

Izzah Syahirah Binti Jani

A thesis submitted

In fulfilment of the requirements for the degree of Master of Science (Economics)

Faculty of Economics and Business
UNIVERSITI MALAYSIA SARAWAK
2018

DECLARATION

This work described in this thesis, entitled **"Assessing Food Trade Sustainability in ASEAN-4 Countries"** is to the best of the author's knowledge that of the author except where due reference is made. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Thanks to ALLAH Almighty for the wisdom he bestowed upon me, the strength, peace of mind and good health in order to finish this research.

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ABSTRACT

The purpose of this research is to examine the sustainability and long-run relationship between food exports and imports for four ASEAN countries (Indonesia, Malaysia, Philippines and Thailand) on the aggregate and disaggregate level. This study utilises the Intertemporal Budget Constraint (IBC) model to explain the behaviour of the food trade sustainability in these countries. The analysis was carried out using various unit root and cointegration procedures for the annual observations over the period from 1996 to 2014. According to the analysis results, several conclusions could be made. First of all, the results clearly show that a long-run relationship exists between food exports and imports in ASEAN-4 countries as a group at the aggregate level. At a disaggregated level, the results reveal that a long-run relationship exists between food exports and imports only for food commodities 022, 024, 034, 042, 044, 047, 075, 081 and 091. It is evident that the macroeconomic policies in these countries have been implemented effectively. Secondly, the study found evidence that food exports and imports are cointegrated with a strong form of sustainability in aggregate level which is the coefficient of β is more than one (1.0049). For every dollar ($) increase in the import of food, exports of food increase by $1.0049. This means that the food export is growing at a faster rate than food import in ASEAN-4 countries. At disaggregated level, the results show strong sustainability for food commodities 034, 047, 075 and 091 but weak sustainability for food commodities 022, 024, 042, 044 and 081. The results suggest that first, reducing the dependence on food import may improve food trade balance in ASEAN-4 countries. Second, policymakers should review the price regulation on food commodities so that it can buffer the future risk of market speculation. Third, some measures such as R&D intensification, technology transfer and extension services have to be done consistently to improve the quantity and

quality of food production. Finally, urban agriculture is one of the better initiatives, hence, incentives should be prepared by the government of ASEAN-4 countries to improve the availability and quality of adequate food among the urban population.

Keywords: sustainability, food security, imports, exports, ASEAN-4.

Menilai Kemampanan Perdagangan Makanan di Negara-negara ASEAN-4

ABSTRAK

Tujuan penyelidikan ini adalah untuk mengkaji hubungan kelestarian dan jangka panjang antara eksport dan import makanan untuk empat negara ASEAN (Indonesia, Malaysia, Filipina dan Thailand) pada tahap agregat dan pecahan. Kajian ini menggunakan model kekangan bajet antara tempoh (IBC) untuk menjelaskan tingkah laku kelestarian perdagangan makanan di negara-negara ini. Analisis telah dilakukan dengan menggunakan pelbagai prosedur ujian unit akar dan kointegrasi untuk pemerhatian tahunan sepanjang tempoh dari tahun 1996 hingga 2014. Berdasarkan hasil analisis, beberapa kesimpulan dapat dibuat. Pertama sekali, keputusan jelas menunjukkan wujudnya hubungan jangka panjang antara eksport dan import makanan di negara-negara ASEAN-4 sebagai satu kumpulan di peringkat agregat. Pada peringkat pecahan, keputusan menunjukkan wujudnya hubungan jangka panjang antara eksport makanan dan import hanya untuk komoditi makanan 022, 024, 034, 042, 044, 047, 075, 081 dan 091. Ini membuktikan bahawa dasar makroekonomi di negara-negara ini telah dilaksanakan dengan berkesan. Kedua, kajian ini telah membuktikan bahawa eksport dan import makanan disatukan dengan bentuk kelestarian yang kukuh pada tahap agregat yang merupakan pekali β lebih dari satu (1.0049). Bagi setiap dolar ($) peningkatan pada import makanan, eksport makanan juga meningkat sebanyak $1.0049. Ini bermakna eksport makanan berkembang pada kadar yang lebih cepat daripada import makanan di negara-negara ASEAN-4. Di peringkat pecahan, hasil menunjukkan kelestarian yang kuat untuk komoditi makanan 034, 047, 075 dan 091 tetapi kelestarian yang lemah untuk komoditi makanan 022, 024, 042, 044 dan 081. Bagi kelestarian komoditi makanan yang

lemah, keputusan mencadangkan bahawa kebergantungan terhadap import makanan patut dikurangkan bagi meningkatkan keseimbangan perdagangan makanan di negara-negara ASEAN-4.

***Kata kunci**: kemampanan, keselamatan makanan, import, eksport, ASEAN-4.*

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LIST OF ABBREVIATIONS

ASEAN	Association of Southeast Asian Nations
DOLS	Dynamic Ordinary Least Squares
FAO	Food and Agriculture Organization
FMOLS	Fully Modified Ordinary Least Squares
IBC	Intertemporal Budget Constraint
OLS	Ordinary Least Squares
SITC	Standard International Trade Classification
UN	United Nations
UNCOMTRADE	United Nations Commodity Trade
UNDESA	United Nations Department of Economic and Social Affairs

CHAPTER 1

INTRODUCTION

1.1 Introduction

The world has seen a large increase of food prices in 2007-2008. The dramatic increase in food prices is due to the competing demands of consumers and industry. These demands were toppled by shortages of supply in 2007 to 2008 especially major food crops such as rice, wheat, maize and soybeans. The shortages dragged the world into the global food crisis. This crisis caused economic and political instability in both poor and developed countries. The skyrocketing cost of food is the signal that demand is outstripping supply. The poorest group which is the most vulnerable group for food security spend around 50-70% of their incomes on food (Worldbank, 2012). The rise in food prices reduces purchasing power, calorie intake and nutrition of world's poorer families. Hence, volatile food prices will exacerbate food security because people could not access food when needed.

Following the 2007 to 2008 global food crisis, food prices started to rise again in 2010 to 2011. The food price situation in 2010 to 2011 had similarities with 2007 to 2008. Firstly, the low stocks of global grain. Secondly, the impact of high oil prices on food commodities prices. Thirdly, depreciation of US Dollar against most currencies caused the prices of dollar-dominated international commodities to rise. Furthermore, financial investment in agricultural commodities remained high. However, the situation of recent global food price also differed with the situation in 2007 to 2008 in some instances. The increase of prices in food is more widespread across food commodities in recent

international price. Moreover, climate change induced a decrease in food production. Besides that, policy responses in 2011 raised the amplitude of the increase in grain price but not nearly as much as in 2008 when policy really worsen the food shortages (Development Committee, 2011).

1.2 The Increasing in Food Commodity Prices

As one of the most basic needs, food is supposed to be available all the time to everybody. A sudden increase in food prices in 2007 to 2008 and 2010 to 2011 led to an increase in food commodity prices.

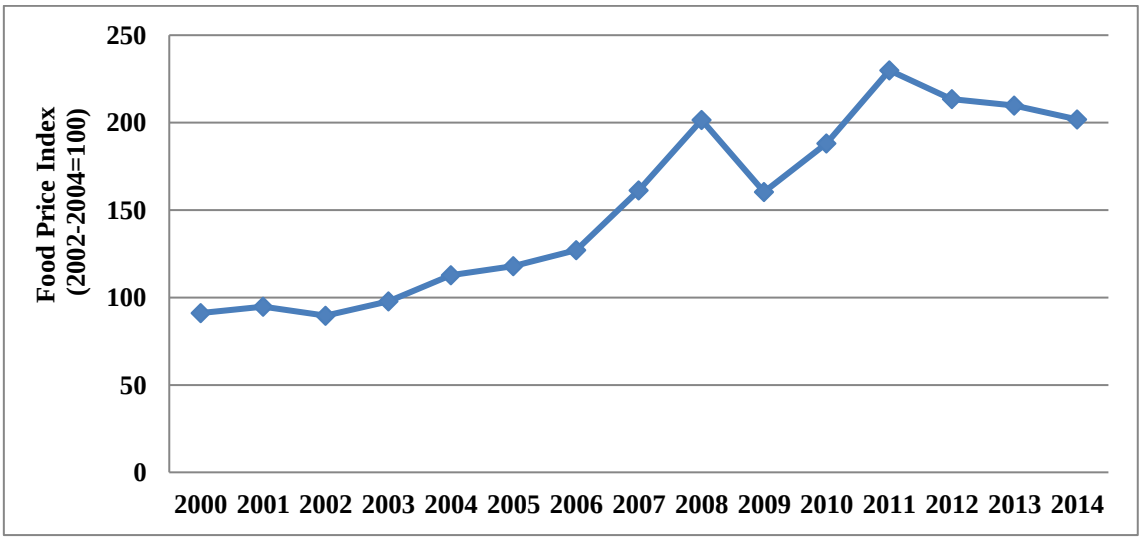


Figure 1: World Food Price Index, FAO (2014).

Figure 1 shows the world food price index from 2000 to 2014. As seen in the year 2002, food prices only started to increase slowly before suddenly increasing rapidly from the year 2004. The food prices increased rapidly and sharply in late 2007 through early 2008 in the aftermath of the global food crisis in 2008 and rose again in 2010. Between

early June 2010 and February 2011, the price of food commodities increased sharply which surpassed even the 2008 peak. The FAO food price index in 2008 averaged at 201 compared to 2007 which was at 161.4 while in 2011 the food price index was at 230 compared to 188 in 2010.

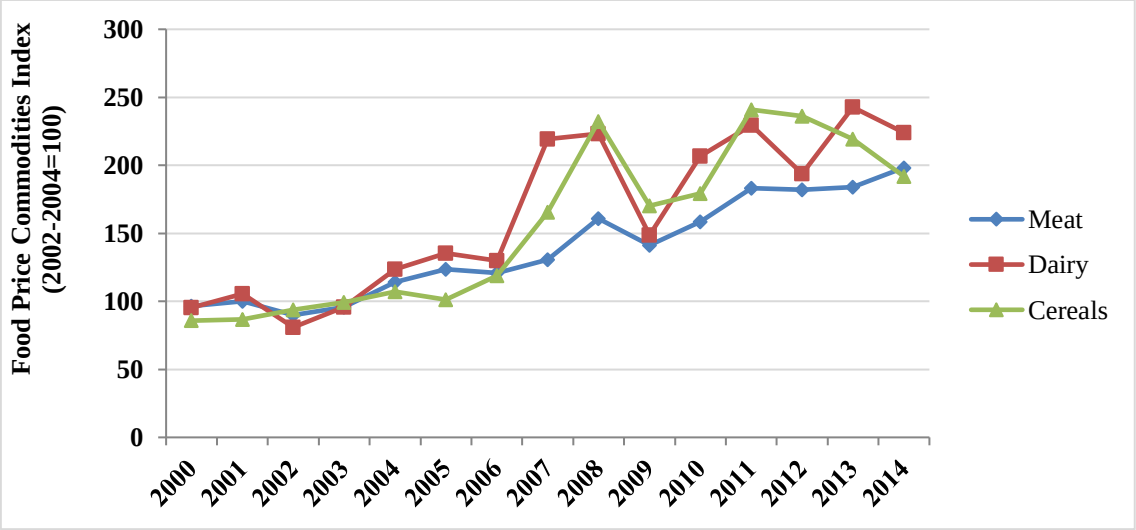


Figure 2: World Food Price Commodities Index, FAO (2014).

During the global food crisis, the world saw a large increase in prices of meat, cereals and dairy products. From Figure 2, meat price index shows up to 160.7 in 2008 compared to 2007 which was at 130.8. After a decreasing trend in 2009, meat prices eventually began to increase again in 2010 onwards. Furthermore, cereals and dairy products also showed soaring prices during the food crisis. Cereals price index was at 232.1 and dairy price index at 223.1 respectively in 2008. The prices of cereals and dairy spiked again in 2011, surpassing even the 2008 levels which were at 240.9 and 229.5. The rise of meat prices was caused by the increasing demand for meat. With higher incomes and increasing urbanisation especially in developing countries, people tend to eat less grain and more meat and dairy products.

1.3 ASEAN-4 Food Trade Balance

Figures 3, 4, 5 and 6 show the food export, food import and trade balance for ASEAN-4 (Indonesia, Malaysia, Philippines and Thailand) countries from the year 1996 to 2014. Food trade balance is the value of exported foods minus the value of imported foods. A positive food trade balance signifies a food trade surplus while a negative value signifies a food trade deficit. In Figure 3, Indonesia continuously showed a food trade surplus by exporting more than importing foods from the year 1996 to 2011. In 2011, Indonesia recorded the highest net food export at US$203 billion but then the food trade reached deficits in 2012, 2013, and 2014.

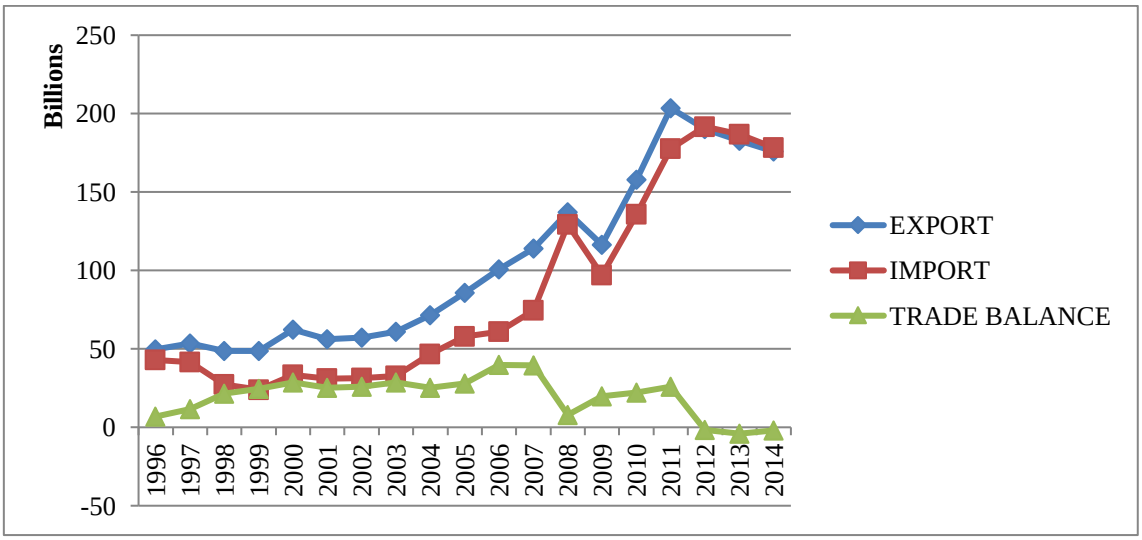
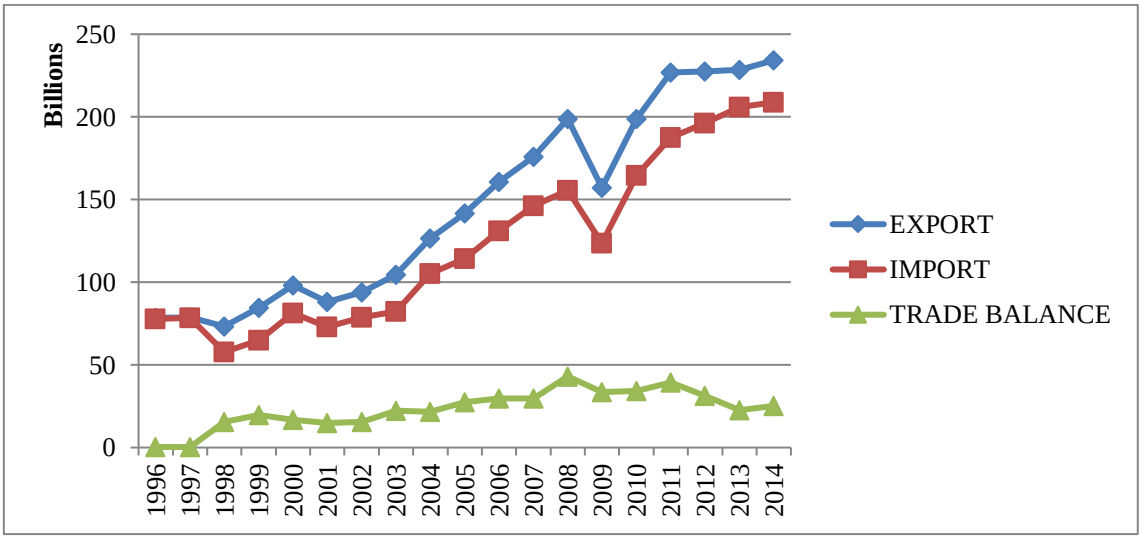


Figure 3: Indonesia Food Trade Balance, UNCOMTRADE (2015).



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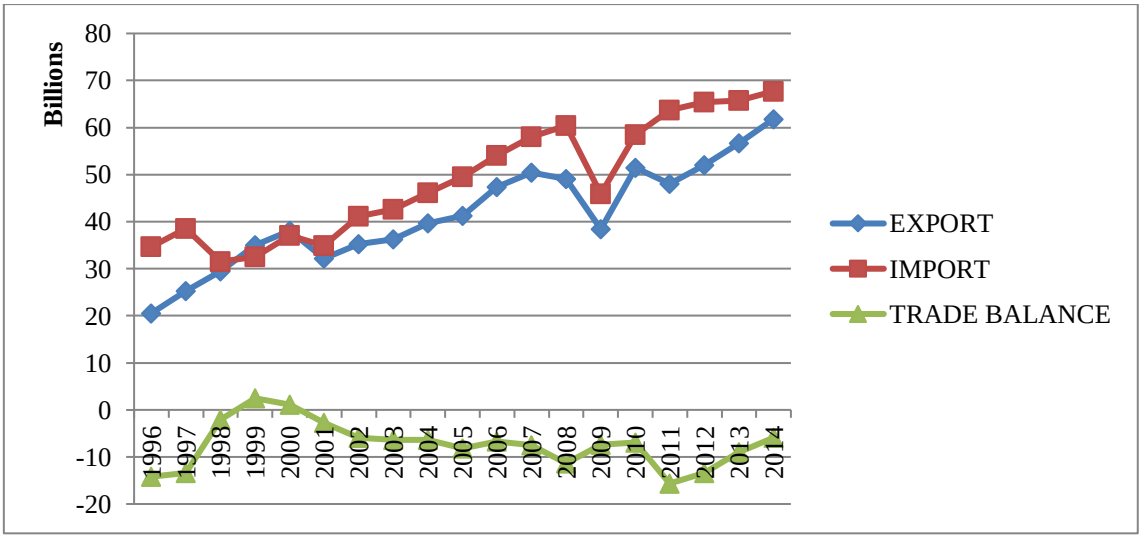

Figure 5: Philippines Food Trade Balance, UNCOMTRADE (2015).

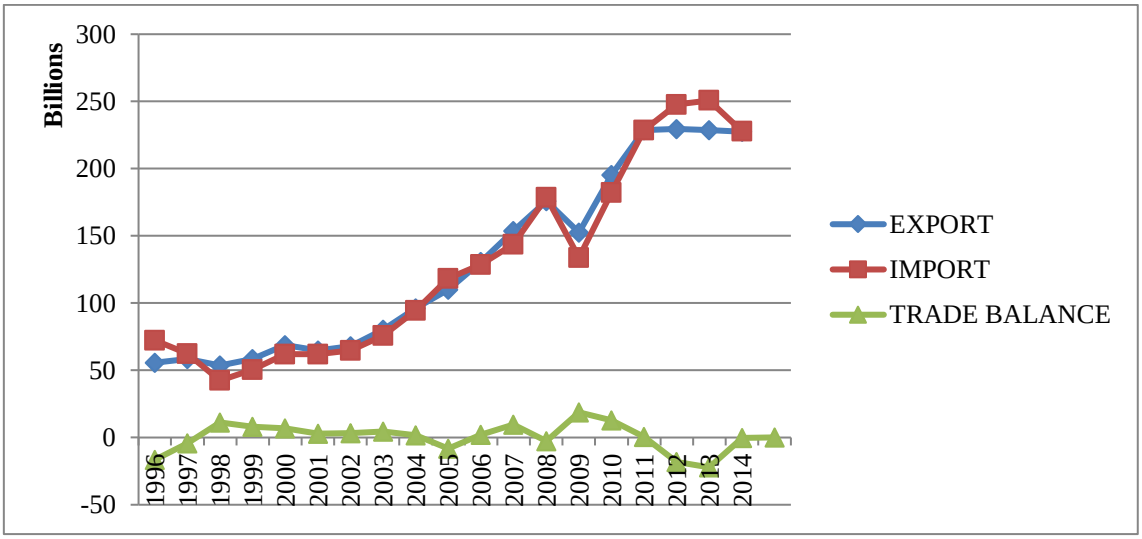

Figure 6: Thailand Food Trade Balance, UNCOMTRADE (2015).

In Figure 4, Malaysia managed to maintain a positive food trade balance from 1996 to 2014. The food trade surplus in 2008 was the largest which stood at US$43 billion as food exports grew more than food imports. Meanwhile, Philippines had a negative food trade balance since 1996 where the food imports increased more than food exports except in 1999 and 2000. The Philippines recorded its biggest food trade deficit in 2011 at US$15.7 billion. Also, “the food basket of Asia” which is Thailand also showed a food trade deficit in recent years.

Moreover, ASEAN-4 food trade surplus as a group decreased since 2010 as seen in Figure 7. In 2008, food trade balance dropped to $36.78 billion from $71.78 billion surplus in 2007. The food trade surplus increased to $64.57 billion in 2009 and then continued to decline until 2012. The food trade balance becomes deficit which was $1.80 billion in 2012 and $12.77 billion in 2013. After the food trade deficit in 2012 and 2013, the food trade balance showed a positive growth but not as much from the previous year. These indicated that food trade balance in ASEAN-4 countries declined in recent years and the food trade

deficit will lead to serious food trade imbalances and subsequently cause another food crisis and exacerbate ASEAN-4 food security.

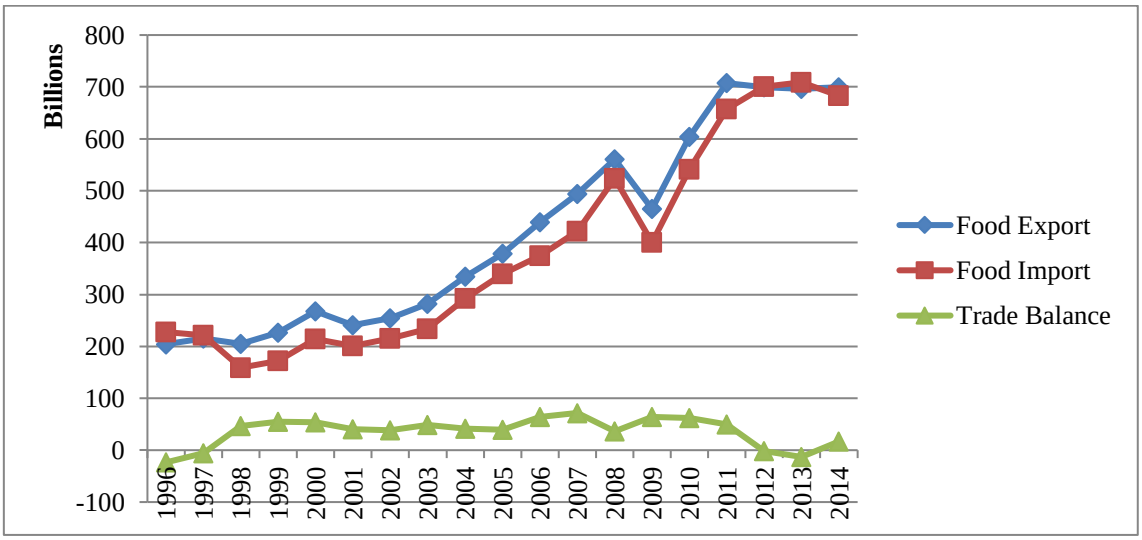

Figure 7: ASEAN-4 Food Trade Balance, UNCOMTRADE (2015).

1.4 Problem Statement

Food is our body's fuel. Without food, people would lose energy and suffer from chronic hunger. Based on the UNDESA (2009), it is predicted that population will grow from 6.9 billion in 2010 to 8.3 billion in 2030 and to 9.1 billion in 2050 while in ASEAN-4 countries the population is expected to grow to 553 million people in 2050 (UN, 2012). Along with the growth of world's population, the global food demands have increased steadily. The demand for food is increasing faster than the ability of the world to produce food and this puts pressure on natural limited resources. This has led a significant decline in global grain stocks. As a result, in 2007 to 2008, most of staple food prices surged to an unpredicted level. The price of rice tripled since September 2007 and soared by 160% between January and April 2008. The price of wheat almost doubled followed by maize

which increased by 67% since July 2007 (Panitchpakdi, 2008). This situation has been referred to as a 'global food crisis' where the rates of hunger and malnutrition people increased sharply because of increases in food prices and extreme shortage of food at local, national and global levels. After three years from the 2007 to 2008 global food prices spikes, the price of foods spiked again in 2010 to 2011 and surpassed its 2008 peak.

Food trade is important for providing food and ensuring global food security. The trade of food is constantly increasing as countries rely on each other to secure adequate and varied food supplies. Without food trades, the countries may not have enough food to feed their growing population. Food import may help in reducing food prices but it will be critical in times of natural disasters or other possible disruptions to domestic productions. Additionally, a decrease in food production will cause ASEAN-4 countries to be more reliant on import for its food. Indonesia has become a net importer of rice country and has to import rice from other rice-producing countries to meet the needs of its massive population. Malaysia has grown to be heavily reliant on rice to satisfy most of its food requirements for feeding its population (Arshad and Abdel Hameed, 2010). The largest net importer of rice countries in the world, Philippines, is also worried whether the country could secure its food supplies from the international market (Chandra and Lontoh, 2010) when the price of rice increases. Thailand, which is known as the "food basket of Asia" also showed a food trade deficit in recent years. The increasing import of food will cause a bad impact to these countries because rising imports will lead to the drawdown of the foreign exchange earnings. In other words, food supply in these countries are decreasing and they rely on international trade to meet population needs.

Furthermore, the choice of ASEAN-4 countries is primarily based on the availability of data. These countries are used in the present study for several reasons. First of all, they were affected by the global food crisis in 2007 to 2008 that caused food shortage, economic and political instability. Secondly, all these countries had experienced food trade deficits from 1996 to 2014 except for Malaysia due to the sudden increase of food prices in 2007 to 2008 and 2010 to 2011. These conditions cause the deficit to widen and lead to food trade imbalances.

The anxiety regarding food supply remains high in several countries especially in ASEAN-4 regions and this concern has led some governments to devote substantial resources to increase food production. Thus, this research study focuses on the food trade sustainability in ASEAN-4 countries where an adequate food production is essential for ensuring food availability and sustainability.

1.5 Research Objectives

In general, this study aims to assess the food trade sustainability in ASEAN-4 countries. Specifically, this study intends to achieve the following:

i. To examine the long-run equilibrium relationship of food trade in ASEAN-4 countries;
ii. To investigate the food trade sustainability condition for ASEAN-4 countries.

1.6 Significance of the Study

This section discusses the importance of the study to policy makers, the related agencies and the existing documentations. It expounds the study's probable impact to trade policies, on-going researches and contribution to the theory and practice.

To the policy makers, the results of this work may be used as the basis and the knowledge to strengthen their support in all aspects in formulating trade policies that will help to addressing food trade balance in ASEAN-4 countries.

Moreover, this study is also useful for related agencies to make appriopriate adjustments on agricultural investments, agribusiness and other areas linked to agriculture in order to improve agriculture productivity and promoting long-term growth in ASEAN-4 countries.

Lastly, this study touches on the significance of the study to the existing documentation of food related topic especially ASEAN-4 countries. This study will give some glimpse on food trade sustainability in ASEAN-4 countries by using aggregate and disaggregate data and generate more publication on this topic.

1.7 Organization of the Study

This study is organised as follows; Chapter 1 provides the background of the study. Chapter 2 highlights the theoretical framework for sustainability studies and reviews past and recent literature in other regions. Chapter 3 presents the research methodology employed in the study. It offers the description of the basic conceptual framework that provides the basis for the specification of the empirical models. It also describes the data sources. Chapter 4 will present and discuss the empirical findings and analysis of the study. In Chapter 5, summary, policy implications and limitations of the study are drawn based on empirical results.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

There are numerous empirical literatures which have appeared in the investigated links between exports and imports in various countries with mixed results. Thus, this chapter will discuss the theoretical review and summarise the empirical studies which analysed the correlation and sustainability of export and import between countries.

2.2 Theoretical Review

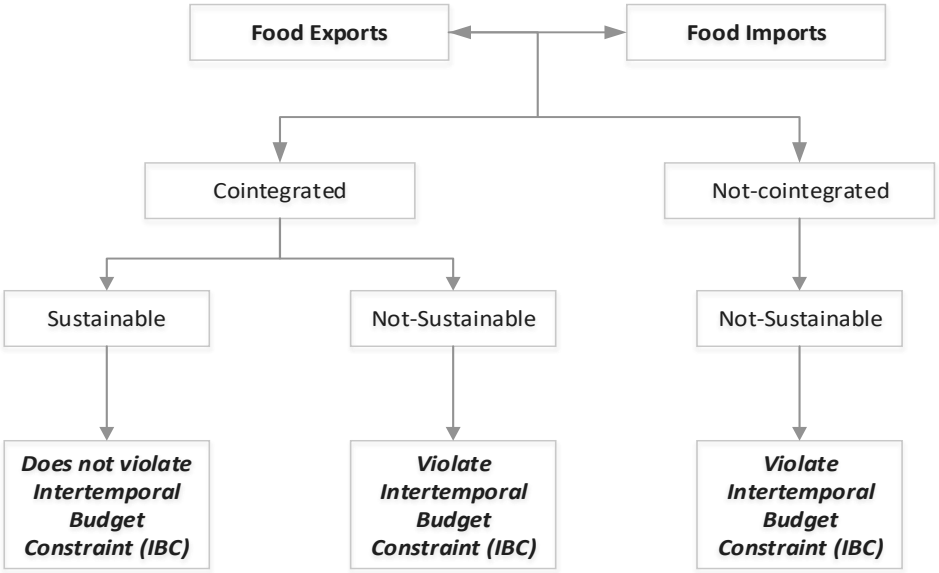

Figure 8: The Theory of Sustainability (Hakkio and Rush, 1991)

Figure 8 demonstrates the theory of sustainability. Broadly speaking, if food exports and imports are cointegrated with strong sustainability, it shows that country does

not violate its intertemporal budget constraint (IBC). This indicates that macroeconomic policies in country have been effective in bringing food exports and imports to long-run equilibrium relationship. On the other hand, if food exports and imports are cointegrated with non-sustainability, it implies that country are violating their intertemporal budget constraint (IBC) which also shows ineffective macroeconomic policies in country in bringing food exports and imports into a long-run equilibrium relationship. Clearly, it can be concluded that even though food exports and imports are cointegrated, this does not mean that country's food trade is sustainable. In contrast, if the food exports and imports are not cointegrated, then it means that food exports and imports are not sustainable and the macroeconomic policies in that country have been ineffective in bringing food exports and imports into a long-run equilibrium.

2.3 Review of Related Studies

2.3.1 Existence of Cointegration

Many of the empirical studies of cointegration between exports and imports follow the econometric model that was laid by Husted (1992). Husted's model of intertemporal budget constraint examines the long-run relationship between exports and imports in the United States by using quarterly data from 1967 to 1989. Engle-Granger's cointegration test result found evidence which supports a long-run association between exports and imports in the US economy. Following the pioneering work from Husted (1992), several researchers analysed the long-run equilibrium relationship between exports and imports in developed and developing countries. Below are some brief reviews from previous studies that investigated the cointegration relationship between exports and imports.

Among the set of studies that reported the existence of cointegration in ASEAN countries is the one conducted by Kalyoncu and Kaplan (2014) which examined the long-run relationship and sustainability of current account imbalances in five ASEAN countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand). By using annual data from 1981 to 2008, Pedroni cointegration, FMOLS and DOLS tests results indicate that a long-run association between the variables exists and found that exports and imports are sustainable for five ASEAN countries as a group. Recently, Hassan et al. (2015) examined the short and long-run dynamics of the ASEAN-4 countries (Indonesia, Malaysia, Philippines, Thailand) current account sustainability. By using annual data from 1970 to 2010, the study indicated there was evidence of cointegration between exports and imports for ASEAN-4 countries and they found strong sustainability of the current account balance in these four countries. According to Hassan et al. (2015), any policy intervention to correct the current account balance in the short-run may cause dynamic inconsistency problems.

Celik (2011) concluded that there exists a long-run relationship between exports and imports in Turkey from January 1990 to May 2010 by using Engle-Granger's cointegration test. From the analysis results, the foreign trade deficit grew due to the liberalisation policies applied after the 1980s. According to Celik (2011), the deficit will continue to increase unless convenient structural reforms are made. Kalyoncu (2005) also found a similar finding in the case of Turkey. By using quarterly data from 1987 to 2002, the results of the Johansen-Juselius' cointegration test supported the long-run causality existing between exports and imports in Turkey. Moreover, Polat (2011) explored and compared the relationship by using ARDL procedure to test the long-run performance of

exports and imports in Turkey from January 2000 to June 2010. The author suggested that Turkey is not in violation of its international budget constraint and the current account deficit has a weak sustainability for the analysed period.

Furthermore, Ali (2013) used annual data from 1972 to 2012 and found evidence of a long-run relationship between exports and imports in Pakistan. The results of both the Engle-Granger's and Johansen's cointegration tests concluded that a long-run relationship exists between exports and imports in Pakistan. This long-run relationship between the export and imports shows that Pakistan's macroeconomic policies have been implemented effectively. Annan and Acquah (2011) used the Engle-Granger's cointegration test to find out the correlation between exports and imports of Ghana economy from 1948 to 2010. The study found that exports and imports of Ghana were cointegrated. In other words, Ghana's macroeconomic policies have also been effective in bringing exports and imports into long-run equilibrium. According to Annan and Acquah (2011), even though Ghana's foreign and economic policies have been effective in bringing its imports and exports into a long run equilibrium, economic measures that would widen the current foreign account deficits can lead to a serious economic crisis since sufficient conditions were not met in the investigated period. Uddin (2009) used annual data ranging from 1972-1973 and 2007 to 2008 in Bangladesh to find the cointegration relationship between exports and imports. The results showed a long-run equilibrium relationship exists in Bangladesh. Cointegrating relationship of trade explains how Bangladesh's economy functions well and how the macroeconomic policies of Bangladesh have been effective in bringing total exports and imports into a long-run equilibrium.

By using the Gregory-Hansen's cointegration test over the period of 1961 to 2011, Kamroudi et al. (2014) confirmed the existence of a long-run relationship between Iranian agricultural exports and imports and proved that the trade of agricultural in Iran is sustainable. Using monthly data from April 1984 to March 2009, Tiwari and Pandey (2011) showed that India's exports and imports were cointegrated by exploring Johansen's cointegration test from April 1984 to March 2009. The results also showed that the Indian government plays a crucial role in stabilising the trade balance and all of India's macroeconomic policies have been effective in leading export and import into a long-run steady state equilibrium relationship. Besides that, Greenidge et al. (2011) applied Johansen's cointegration technique to analyse the long-run association between exports and imports of the Barbados economy from the year 1960 to 2006. The study concluded that a long-run relationship between exports and imports exists and the current account balance of Barbados is sustainable.

Pattichis (2010) studied the annual Cyprus trade data between 1976 to 2004 using ARDL bound test and found a long-run relationship between Cyprus exports and imports which points out that Cyprus is not in violation of its intertemporal budget constraint. The results also indicated that the current account balance is strongly sustainable in the long-run. A policy implication of these findings is that the loss of exchange rate policy following the adoption of the Euro may not be a serious cost for Cyprus. According to Pattichis (2010), this conclusion derives from the fact that even though Cyprus has not been using competitive devaluation policies over the investigated period, the current account balance is sustainable. Using the same method of ARDL bound test, Gjanci and Cereva (2014) examined the relationship between real exports and imports in Albania from

1992 to 2012. The findings showed that a long-run relationship exists between real exports and imports.

In addition, Al-Khulaifi (2013) showed a long-run equilibrium relationship exists between exports and imports in Qatar's economy. By employing annual data from 1980 to 2011, Johansen's cointegration test support the evidence that Qatar is not in violation of its international budget constraints. Similar results were reported by Pillay (2014) in a study whether trade deficit in South Africa is sustainable or not. Quarterly data from 1985 to 2015 was used. The results supported the evidence that a relationship between exports and imports exists and the trade deficit is sustainable in the long-run. Ramakrishna and Filho (2014) analysed the cointegrating relationship between exports and imports in BRICS countries. By employing annual data from 1990 to 2011, the Kao's cointegration, FMOLS and DOLS tests found that exports and imports of BRICS as a group are cointegrated and sustainable in the long-run. The empirical finding concluded that the present macro and trade policies have been effective in bringing the equilibrium between exports and imports and BRICS as a group. Moreover, Puah et al. (2012) studied the long-run relationship between government revenue and expenditure in Sarawak state from 1970 to 2008. Johansen-Juselius' (1990) cointegration test confirmed that Sarawak is not in violation of its intertemporal budget constraint but shows weak sustainability.

In another study, Herzer and Nowak-Lehman (2005) used annual data from the year 1975 to 2004 to examine the long-run relationship between exports and imports in Chile. The Engle-Granger's cointegration test revealed that Chilean exports and imports are cointegrated and shows a weak-form of sustainability. The results suggested that

Chile's macroeconomic policies have been effective in bringing exports and imports into a long-run equilibrium. Emmy et al. (2009) studied the relationship between the export and import of forestry domain in Malaysia which includes various sub-domains; (1) industrial round wood; (2) wood pulp; (3) wood fuel; (4) paper and paperboard; (5) sawn wood; (6) recovered paper and (7) wood base panel. Monthly data from the period of 1961 to 2007 was used. Johansen's cointegration test was applied and the variables are found to be cointegrated. The results also proved that the trade in the forestry domain in Malaysia is sustainable. According to Emmy et al. (2009), the findings implied that the relevant authorities in Malaysia are practising good trade policies in the forestry domain and deficits are short-term phenomena and will be corrected in the long run.

2.3.2 Mixed Results of Cointegration

There is empirical literature that investigated such relationships with mixed results. Ramadhan and Naseeb (2008) used annual data from 1965 to 2005 for four Gulf Cooperation Council (GCC) countries (Kuwait, Oman, Saudi Arabia and the United Arab Emirates) to examine the presence of a long-run relation between oil exports and imports. By applying Johansen's cointegration test, they found evidence of cointegration between oil exports and imports in three of the countries except for Kuwait. Tiwari (2012) applied the Saikkonen-Luthkepohl's cointegration test to investigate a long-run relationship between exports and imports for ASEAN-5 countries (Indonesia, Malaysia, Philippines, Myanmar and Thailand). His study periods for Indonesia, Philippines and Thailand were 1960 to 2008 while 1960 to 2007 and 1960 to 2004 for Malaysia and Myanmar respectively. The study found evidence that exports and imports are only cointegrated for

Indonesia, Myanmar and Thailand but not for Malaysia and Philippines. The results showed that trade deficit is sustainable only for Myanmar.

Baharumshah et al. (2003) tested the relationship between exports and imports for ASEAN-4 countries by using annual data from 1961 to 1999. Johansen's and Gregory-Hansen's cointegration methods confirmed that cointegration exists only in Malaysia while for Indonesia, Philippines and Thailand there is no relationship between exports and imports during the pre-crisis period (1961 to 1997). In other words, these countries were unsustainable and did not move towards external account equilibrium. They also found a strong co-movement between exports and imports in Indonesia, Philippines and Thailand during the period including post-crisis years and Malaysia was not sustainable during that era. The failure of exports and imports exhibited that the economic policies implemented prior to the crisis including the peg exchange rate system contributed to the violation of the intertemporal budget constraint. In another study,

Baharumshah et al. (2005) investigated the sustainability of current account in eight East Asia countries (Thailand, Indonesia, Malaysia, Philippines, Singapore, Taiwan, South Korea and Japan) using annual data from 1970 to 2000. By using Pedroni panel cointegration, and Kao and Chiang Dynamic OLS test, the findings indicated that in the pre-crisis period, the current account is cointegrated but weak sustain while in the post-crisis period the current account was cointegrated and had strong sustainability. In the pre-crisis period, economic policies implemented prior to the crisis including the peg exchange rate system contributed to the violation of the intertemporal budget constraint while in the

post-crisis period, the result implied that large currency depreciations and the economic recovery brought Asia-8 economies back onto a sustainable path.

Besides that, Rahman (2011) examined the presence of cointegration between exports and imports of Indonesia and Malaysia using Engle-Granger's and Johansen's cointegration tests during the period of 1960 to 2008 for Indonesia and 1960 to 2007 for Malaysia. The results revealed that both tests of cointegration confirmed there is a cointegration relationship between exports and imports for Malaysia, but not found in Indonesia. Tiwari (2011) analysed the long-run relationship between exports and imports in India and China by using monthly data from January 1992 to February 2010. Adopting the Gregory-Hansen's cointegration test, the study confirmed that trade deficit was sustainable in the case of India but not in the case of China. This implies that macroeconomic policies of India have been effective in leading exports and imports to long-run steady state equilibrium relationship unlike China's.

Using quarterly data from 1971 to 1997 and Johansen's cointegration test, Irandoust and Ericsson (2004) examined the relationship between exports and imports in United States, United Kingdom, Germany, Sweden, France and Italy. The results supported the existence of a cointegration relationship between exports and imports for Germany, Sweden and the United States while the study found the absence of cointegration between variables for the United Kingdom. The policy implications from the findings are that the countries were not in violation of their international budget constraints and there was no productivity gap between the domestic economy and the rest of the world, implying a lack of permanent technological implications to the domestic economy. Lau et al. (2013)

examined the long-run equilibrium relationship between exports and imports of the disaggregated of the food industry in Sarawak by using annual data from 1960 to 2007. Johansen's cointegration test and Dynamic OLS test results found that a long-run relationship existed during the full sample period whereas there was no cointegration relationship in the pre-crisis period and food trade was barely sustainable for the full sample.

On the contrary, several other studies provided evidence of the non-existence of cointegration between exports and imports. Konya and Singh (2008) did not find any cointegration between Indian exports and imports during 1949 to 1950 and 2004 to 2005 by allowing a structural break in 1992 to 1993 using Johansen's and Saikkonen-Lutkepohl cointegration tests. The exogenously determined structural break in 1992 to 1993 incorporated the potential impact of the March 1993 switch from a fixed exchange rate regime to a free-floating exchange rate policy. According to Konya and Singh (2008), the lack of cointegration implied that Indian macroeconomic policies have been ineffective in bringing exports and imports into long-run equilibrium and in violation of its international budget constraint. Perera and Varma (2008) examined the long-run relationship and sustainability of exports and imports in Sri Lanka. Annual data from 1950 to 2006 was employed. Gregory and Hansen (1996) ran cointegration test which found the absence of cointegration between exports and imports in Sri Lanka and not sustainable in the long-run. According to Perrera and Varma (2008), the lack of cointegration suggests that there are fundamental policy problems due to the challenge in the current globalised economic environment.

2.4 Chapter Summary

In this study, the study adopted the theoretical model from Hakkio and Rush (1991) as well as Husted (1992) and used the data of ASEAN-4 countries to test for the relationship and sustainability of food exports and imports. The intertemporal budget constraint approach looks at the long-run relationship and sustainability between exports and imports. The advantages of this model in explaining the behaviour of the relationship of exports and imports have already been explored by numerous authors. Prior studies have generally found a cointegration of exports and imports in various countries. However, there are also studies where such a relationship was not found. One of the reasons might be that the existing studies used time series data and ignored the heterogeneity across countries. Furthermore, the previous studies also lacked empirical evidence based on the disaggregated data and panel study. To the best of the study's knowledge, there are no other studies focusing on investigating the relationship and sustainability of food exports and imports in ASEAN-4 countries. As a result, this present study is an attempt in this direction.

Table 1: Summary of Literature Review

No.	Author (Year)	Objective	Theory	Methods	Findings
1.	Husted (1992)	The study analyzed the long-run equilibrium relationship between exports and imports in United States.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Quarterly data from 1967-1989 • Augmented Dickey-Fuller (ADF), Phillips and Perron unit root test • Engle-Granger cointegration test	• The results support of a long-run relationship between exports and imports in United States.
2.	Kalyoncu and Kaplan (2014)	The study examines the sustainability of current account imbalances in five ASEAN countries (Indonesia, Malaysia, Philippines, Singapore and Thailand).	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1981-2008 • Im, Pesaran and Shin (IPS) unit root test • Pedroni cointegration test • Fully Modified Ordinary Least Square (FMOLS) and Dynamic OLS (DOLS)	• The results show long-run relationship between exports and imports and ASEAN-5 are sustain as group.
3.	Hassan et al. (2015)	The study examines the current account sustainability in four ASEAN countries (Indonesia, Malaysia, Philippines, and Thailand)	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data 1970-2010 • Pesaran (2007) and Maddala and Wu (1999) unit root test • Westerlund (2007) cointegration test • Panel DOLS	• The result shows that exports and imports are cointegrated in the long run and found strong sustainability in these four countries.

Table 1 continued

No.	Author (Year)	Objective	Theory	Methods	Findings
4.	Jiranyakul (2012)	The study analyzed the relationship between manufacturing exports and imports in Thailand.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Monthly data from January 2000 to July 2011 • ARDL bound test	• The results found cointegration between exports and imports in Thailand.
5.	Jain and Sami (2012)	The study analyzed the long-run relationship between exports and imports in Singapore.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1976-2009 • KPSS and ERS unit root test • Pesaran's bound test • Fully Modified Ordinary Least Square (FMOLS) test	• The results indicate that the cointegration of exports and imports are existed and Singapore is not violation of the intertemporal budget constraint.
6.	Celik (2011)	The study investigated the long-run relationship between exports and imports in Turkey.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Monthly data from January 1990 to May 2010 • Phillips-Perron unit root test • Engle-Granger cointegration test • Engle-Granger causality test	• The results found long-run relationship between exports and imports in Turkey.
7.	Kalyoncu (2005)	The study analyzed the long-run relationship and sustainability of current account for Turkey.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Quarterly data from 1987-2002 • Augmented Dickey-Fuller and KPSS unit root test • Johansen-Juselius Maximum Likelihood cointegration test	• The results found that there is exist of long-run relationship between exports and imports and current account in Turkey is sustainable and does not violate its intertemporal budget constraint in the long-run.

Table 1 continued

No.	Author (Year)	Objective	Theory	Methods	Findings
8.	Polat (2011)	The study investigated the long-run relationship and sustainability of current account deficits in Turkey.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Monthly data from January 2000 to June 2010 • Zivot and Andrews unit-root test • ARDL bound test	• The results found that the current account deficit of Turkey was sustainable in the weak form, but not in the strong form.
9.	Ali (2013)	The study examines the long-run relationship between exports and imports in Pakistan.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1972-2012 • Augmented Dickey-Fuller (ADF), Phillips-Perron unit root test • Engle-Granger, and Johansen cointegration test	• The results revealed that there exist of long-run relationship between exports and imports in Pakistan for the period analyzed.
10.	Annan and Acquah (2011)	The study investigated the long-run relationship between exports and imports in Ghana.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1948-2010 • Augmented Dickey-Fuller (ADF), Phillips-Perron unit root test • Engle and Granger cointegration test	• The results concluded that there exist of long-run relationship between exports and imports in Ghana.
11.	Uddin (2009)	The study examined the long-run relationship between exports and imports in Bangladesh.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1972-1973 to 2007-2008 • Augmented Dickey-Fuller (ADF), Phillips-Perron unit root test • Johansen cointegration test	• The results show a long-run relationship between exports and imports and Bangladesh is not in violation of its international budget constraint.

Table 1 continued

No.	Author (Year)	Objective	Theory	Methods	Findings
12.	Komroudi et al. (2014)	The study investigates the long-run equilibrium of foreign trade in Iran's agricultural sector.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1961-2011 • Zivot-Andrews test • Gregory-Hansen (1996) cointegration test	• The results indicate that long-run relationship exists and proved that the trade of agricultural in Iran is sustainable.
13.	Tiwari and Pandey (2010)	The study examines the long-run relationship and sustainability of trade deficits in India.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Monthly data from April 1984 to March 2009 • Hylleberg et al (1990) (HEGY), unit root test • Johansen cointegration test	• The results show a long-run relationship existed between exports and imports in India and proved that India does not violate her international budget constraint.
14.	Greenidge et al. (2011)	The study investigates the long-run relationship and sustainability of the exports and imports in Barbados.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1960-2006 • Augmented Dickey-Fuller (ADF), Phillip-Perron (PP) and KPSS, and ERS unit root test • Johansen trace cointegration test • Dynamic OLS test	• The evidence suggests that the current account of Barbados is sustainable and does not violate its intertemporal budget constraint.
15.	Pattichis (2010)	The study analyzed the long-run relationship between imports and exports in Cyprus.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1976-2004 • Augmented Dickey-Fuller (ADF), DF-GLS unit root test • ARDL bound test	• The results indicate the existence of long-run relationship between exports and imports in Cyprus and confirmed the current account balance in Cyprus is strongly sustainable in the long-run.

Table 1 continued

No.	Author (Year)	Objective	Theory	Methods	Findings
16.	Gjanci and Cereva (2014)	The study examined the long-run relationship between exports and imports in Albania.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1992-2012 • ARDL bound test	• The results confirmed that a long-run relationship exists between exports and imports in Albania.
17.	Al-Khulaifi (2013)	The study examined the long-run relationship between exports and imports in Qatar.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1980-2011 • Augmented Dickey-Fuller (ADF), Phillips-Perron unit root test • Johansen cointegration test • Error Correction Model	• The results found a long-run relationship exists between exports and imports and Qatar not in violation of its international budget constraints.
18.	Puah et al. (2012)	The study examined the long-run relationship between government revenue and expenditure in Sarawak state.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data 1970-2008 • Augmented Dickey-Fuller (ADF) unit root test • Johansen and Juselius cointegration test • Dynamic OLS test	• The results found a long-run relationship exists between government revenue and expenditure and Sarawak is not in violation of its international budget constraints.

Table 1 continued

No.	Author (Year)	Objective	Theory	Methods	Findings
19.	Pillay (2014)	The study investigated the sustainability and long-run relationship between exports and imports in South Africa.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Quarterly data from 1985-2012 • • Augmented Dickey-Fuller (ADF) unit root test • • Johansen cointegration test	• The results confirmed the existence of long-run relationship between exports and imports in South Africa and trade deficit is sustainable in the long-run.
20.	Ramakrishna and Filho (2014)	The study examined the long-run relationship between exports and imports in BRICS (India, Brazil, Russia and South Africa) countries.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1990-2011 • • Panel unit root test (Levin, Lin and Chu; Im, Pesaran and Shin; ADF-Fisher; and PP-Fisher) • • Kao cointegration test • • Fully Modified Ordinary Least Square (FMOLS) and Dynamic OLS (DOLS) test	• The study found that exports and imports of BRICS as a group are cointegrated and sustainable in the long-run.
21.	Herzer and Nowak-Lehmann (2005)	The study analyzed the long-run relationship between exports and imports in Chile.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1960-2000 • • Perron unit root test • • Engle-Granger cointegration test • • DOLS test	• The study found that Chilean exports and imports are cointegrated and show a weak-form of sustainable.
22.	Ramadhan and Naseeb (2008)	The study investigated the long-run relationship between oil exports and imports in four Gulf Cooperation Council (GCC) countries (Kuwait, Oman, Saudi Arabia and the United Arab Emirates).	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1967-2005 • • Augmented Dickey-Fuller (ADF), Phillips-Perron unit root test • • Johansen cointegration test	• The result shows a long-run relationship between oil exports and imports in three members except Kuwait.

Table 1 continued

No.	Author (Year)	Objective	Theory	Methods	Findings
23.	Tiwari (2012)	The study investigated the long-run relationship and sustainability of ASEAN5 countries which are Indonesia, Malaysia, Philippines, Myanmar and Thailand.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data (Indonesia, Philippines and Thailand is 1960-2008), Malaysia (1960-2007) and Myanmar (1960-2004) • Saikkonen and Lutkepohl unit root test • Saikkonen and Lutkepohl cointegration test	• The results show a long run relationship between exports and imports for Indonesia, Myanmar and Thailand and finds sustainable long-run trade deficit only for Myanmar.
24.	Baharumshah et al. (2003)	The study examines the long-run relationship and sustainability of the exports and imports for four ASEAN countries (Indonesia, Malaysia, Philippines and Thailand).	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1961-1999 • Augmented Dickey-Fuller (ADF), Phillip-Perron and KPSS unit root test • Johansen Multivariate and Gregory-Hansen cointegration test • Dynamic OLS (OLS) estimation	• The results found that for all countries, except Malaysia, current account deficits were not on the long-run steady state in the pre-crisis (1961-1997) era and unsustainable.
25.	Baharumshah et al. (2005)	The study investigated the sustainability of the current account in eight East Asia countries (Thailand, Indonesia, Malaysia, Philippines, Singapore, Taiwan, South Korea and Japan)	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1970-2000 • Im, Pesaran and Shin unit root test • Pedroni panel cointegration test • Kao and Chiang DOLS test	• The findings indicate that in the pre-crisis period, the current account is cointegrated but weak sustain while in the post-crisis period the current account is cointegrated and strong sustain.

Table 1 continued

No.	Author (Year)	Objective	Theory	Methods	Findings
26.	Rahman (2011)	The study examined the long-run relationship between exports and imports in Indonesia and Malaysia.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data. 1960-2008 for Indonesia and 1960-2007 for Malaysia • Augmented Dickey-Fuller (ADF) unit root test • Engle-Granger and Johansen cointegration test	• The results indicate that both tests of cointegration confirmed the existence of cointegration between exports and imports for Malaysia, but were not found in the case of Indonesia.
27.	Tiwari (2011)	The study analyzed the long-run relationship between exports and imports in India and China.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Monthly data from January 1992 to February 2010 • Lee-Strazicich (2003, 2004), Narayam amd Poop (2010) unit root test • Gregory-Hansen (1996) cointegration test	• The results confirmed that trade deficit is sustainable in case of India but not in case of China. • This implies that macroeconomic policies of India but not of China have been effective in bringing exports and imports to long-run equilibrium relationship.
28.	Irandoust and Ericsson (2004)	The study examined the long-run relationship between exports and imports in USA, UK, Germany, Sweden, France and Italy.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Quarterly data France, UK, Italy, and USA (1971-1997). Germany and Sweden (1971-1994) • Augmented Dickey-Fuller (ADF) unit root test • Johansen and Juselius Maximum Likelihood test	• The results show that long-run relationship existed between exports and imports of some developed economies for Germany, Sweden, and the United States. But the study did not found any cointegration between the variables for the UK.

Table 1 continued

No.	Author (Year)	Objective	Theory	Methods	Findings
29.	Emmy et al. (2009)	The study examined the long-run relationship between the exports and import in the category of forestry domain for Malaysia which includes sub domain (1)industrial round wood; (2)wood pulp; (3)wood fuel; (4) paper and paper board; (5) sawn wood; (6) recovered paper and (7)wood base panel.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1961-2007 • Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root test • Johansen cointegration test	• The results show that cointegrated existed between exports and imports of forestry domain in Malaysia and confirmed that the trade in the forestry domain in Malaysia is sustainable.
30.	Lau et al. (2013)	This study examined the long-run relationship between total exports and imports of the food industry in Sarawak.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1961 -2007 • Augmented Dickey-Fuller (ADF), KPSS and GFGLS unit root test • Johansen cointegration test • Dynamic OLS	• The results indicate that long-run relationships exists in the full sample period while absent in the pre-crisis period and study found that food trade is weakly sustainable in Sarawak for the period analyzed.
31.	Konya and Singh (2008)	The study investigated the long-run equilibrium relationship between exports and imports in India.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1949/50 to 2004/05 • Augmented Dickey-Fuller (ADF), Phillips and Perron (PP), DF-GLS, KPSS, SLUR unit root test • Johansen, and Saikkonen-Lutkepohl cointegration test	• The results show no- cointegration between exports and imports in India and proved that Indian macroeconomic policies have been ineffective in bringing exports and imports into long-run equilibrium and in violation of its international budget constraint.

Table 1 continued

No.	Author (Year)	Objective	Theory	Methods	Findings
32.	Perera and Varma (2008)	The study analyzed the long-run relationship and sustainability of exports and imports in Sri Lanka.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Annual data from 1950-2006 • Augmented Dickey-Fuller (ADF), and Phillips-Perron (PP) unit root test • Gregory and Hansen (1996) cointegration test	• The results found no-cointegration between exports and imports and Sri Lanka is in violation of its intertemporal budget constraint and not sustainable in the long-run.
33.	Dumitriu et al. (2009)	The study investigated the long-run equilibrium relationship between the exports and imports in Romania.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Monthly data from January 2005 to March 2009 • Augmented Dickey-Fuller (ADF) unit root test • Engle-Granger, Johansen trace test, and Breitung cointegration test	• The results failed to prove a cointegration between exports and imports and Romanian current account is not sustainable in the long-run.
34.	Stilianos and Jyh-Lin (1999)	The study examined the long-run relationship between exports and imports in United States.	Theoretical model of international budget constraint by Hakkio and Rush (1991) and Husted (1992).	• Quarterly data from 1967-1994 • Phillip-Perron (PP), and Zivot-Andrews unit root test • Engle-Granger, Gregory-Hansen cointegration test	• The results found long-run relationship is not existed between exports and imports in the case of United States.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the research methods which used in analysing the long-run equilibrium relationship and sustainability of food trade in ASEAN-4 countries. The research method consists of a theoretical framework, research design and methodology. Im, Pesaran and Shin (2003) unit root test, Kao (1999) cointegration test, and Kao and Chiang (2000) Dynamic OLS (DOLS) test will be discussed in methodologies sections.

3.2 Research Design

The food exports and imports are significant variables to examine the long-run relationship and food trade sustainability. The secondary data was used in this study. This study used panel data which are a combination of time series and cross-sectional data. Panel data were chosen as the panel models since they can help capture the dynamic behaviour of the parameters and provide a more efficient estimation of the parameters (Ramakrishna and Filho, 2014). The panel data has obvious advantages over cross-sectional data on time-series dataset. First of all, panel data usually gives more information data sets which should yield more precise estimates. Secondly, it can increase the degrees of freedom. Not only that, it can also reduce the collinearity among explanatory variables (Hsiao, 1986).

The study has used annual data for exports and imports of selected specific food in ASEAN-4 countries, namely Indonesia, Malaysia, Philippines and Thailand for the period beginning from 1996 to 2014. ASEAN-4 countries have been negatively affected by the recent global food crisis. The shortage of food production and soaring prices of food increase the ASEAN-4 countries fears regarding food sustainability. 25 types of food commodities were selected from the United Nations Commodity Trade Statistics (UNCOMTRADE, 2015) and can be referred to in Table 2. Standard International Trade Classification (SITC) Revision 2 (3-digit) for food exports and imports were employed in this study. This study adopted aggregate and disaggregate data to determine the co-movement and sustainability of the food exports and imports. All these nominal variables were measured in USD$ and were converted into natural logarithms (ln) format before the estimation process. Also, this study used E-views software to run the results.

Table 2: List of Food Commodities

SITC 3	Descriptions
001	Live animals other than animals of division 03
022	Milk and cream and milk products other than butter or cheese
024	Cheese and curd
025	Eggs, birds', and egg yolks, fresh, dried or otherwise preserved, sweetened or not; egg albumin
034	Fish, fresh (live or dead), chilled or frozen
035	Fish, dried, salted or in brine; smoked fish (whether or not cooked before or during the smoking process); flours, meals and pellets of fish, fit for human consumption
036	Crustaceans, molluscs and aquatic invertebrates, whether in shell or not, fresh (live or dead), chilled, frozen, dried, salted or in brine; crustaceans, in shell, cooked by steaming or boiling in water, whether or not chilled, frozen, dried, salted or in brine; flours, meals and pellets of crustaceans or of aquatic invertebrates, fit for human consumption
037	Fish, crustaceans, molluscs and other aquatic invertebrates, prepared or preserved
042	Rice
044	Maize (not including sweet corn), unmilled
047	Other cereal meals and flours
048	Cereal preparations and preparations of flour or starch of fruits or vegetables
054	Vegetables, fresh, chilled, frozen or simply preserved (including dried leguminous vegetables); roots, tubers and other edible vegetable products, fresh or dried
056	Vegetables, roots and tubers, prepared or preserved
057	Fruit and nuts (not including oil nuts), fresh or dried
058	Fruit, preserved, and fruit preparations (excluding fruit juices)
061	Sugars, molasses, and honey
062	Sugar confectionery
071	Coffee and coffee substitutes
072	Cocoa
073	Chocolate and other food preparations containing cocoa
075	Spices
081	Feeding stuff for animals (not including unmilled cereals)
091	Margarine and shortening
098	Edible products and preparations

3.3 Theoretical Framework

In the present study, the study applied the theoretical model from Hakkio and Rush (1991) as well as Husted (1992) to examine for the food trade sustainability in ASEAN-4 countries. Moreover, this model also looked at the long-run equilibrium relationship between food exports and imports. The model started with the budget constraint of an individual who can borrow and lend freely in the international market. The current-period budget constraint of this representative household was;

$$C_0 = Y_0 + B_0 - I_0 - (1 + ir_0)B_{-1} \quad (1)$$

where C_0 is the current consumption, Y_0 is the output, B_0 was the magnitude of the international borrowing (which could be positive or negative), I_0 is investment, ir_0 is the world interest rate and $(1 + ir_0)B_{-1}$ is the initial debt of the representative household, corresponding to the country's external debt.

As equation (1) is valid for all time period, thus the intertemporal budget constraint was obtained by the summation of all individuals budget constraint expressed as;

$$B_0 = \sum_{t-1}^{\infty} \delta_t TB_t + \lim_{n\to\infty} \delta_n B_n \quad (2)$$

where $TB_t = EX_t - MM_t = Y_t - C_t - I_t$. TB_t represents the trade balance of food in period t (income minus absorption) while EX_t refers to food exports and MM_t refers to food imports. $\partial_t = \prod_{s=1}^{t} B_s$ where $B_s = \frac{1}{1+ir_s}$ and ∂_t is the discount factor. The

fundamental element in equation (2) is the last term lim $\delta_n B_n$, where the limit is taken as n→∞. When this limit term equals zero, the amount that a country borrows (lends) in international markets is exactly the same as the present value of the future trade surpluses (deficits). The country is 'bubble-financing' its external debt if B_0 is positive. On the other hand, if B_0 is negative and the limit term is non-zero, then the country is making a Pareto-inferior decision which is welfare could be improved by lending less (Husted, 1992).

Assuming that the world interest rate was stationary with unconditional mean *ir*, equation (1) can be stated as;

$$Z_t + (1 + ir)B_{t-1} = EX_t + B_t \tag{3}$$

where Z_t=MM_t+ $(ir_t - ir)B_{t-1}$. Solving equation (3) by forward substitution, Hakkio and Rush (1991), and Husted (1992) obtained the following relationship;

$$MM_t + ir_t B_{t-1} = EX_t + \sum_{j=0}^{\infty} \emptyset^{j-1}[\Delta EX_{t+j} - \Delta Z_{t+j}] + \lim_{j\to\infty} \emptyset^{t+j} B_{t+j} \tag{4}$$

where ∅=1/(1+ir) and Δ represents the first difference operator. The left-hand side of equation (4) denotes spending on imports and interest payments (receipts) on net foreign debt (assets). Subtracting EX_t from both sides of equation (4) and multiplying the result by (-1), we observe that the left-hand side of equation (4) represents the current account of an economy. Furthermore, by assuming the limit term that appeared in equation (4) was to equal zero and adding the residual term to equation (4), the following regression model was obtained;

$$EX_t = \alpha + \beta MM_t^* + e_t \quad (5)$$

where MM_t^*=$(MM_t + ir_t B_{t-1})$ measures the total imports of food plus net unilateral transfers from the world and EX measures the total exports of food to the world. The necessary condition (weak form) for the economy to satisfy its intertemporal budget constraint was the existence of a stationary error structure so e_t in equation (5) should be an *I(0)* process. On contrary, failure to detect cointegration relationship between food exports and imports would indicate that the economy is not functioning properly and fails to satisfy its budget constraint (Hakkio and Rush, 1991). According to Irandoust and Ericsson (2004), cointegration or lack of cointegration between exports and imports has a crucial bearing on economic policy. If the trade flows are not cointegrated, it is possibly due to the permanent technological implications or productivity gap to the domestic economy. On the other hand, finding cointegration for the external accounts rejects the assumption of a permanent technological implication or productivity gap between the economy and the rest of the world (Irandoust and Sjöö, 2000).

According to Baharumshah et al. (2003), the sufficient condition (strong form) for the intertemporal budget constraint model is the existence of a vector (a, β) such that e_t is a stationary process and (a, β) = (0, 1). The economy is said to satisfy its strong form of the intertemporal budget constraint in the long-run if the food exports and imports are cointegrated with cointegrating vector β=(1, -1). In summary of this model, we can conclude;

a) If the *I(1)* process of food exports and imports are cointegrated with the cointegration vector [1, -1] or with $\beta=1$, this indicates the deficit is a strong form of sustainability.
b) If food exports and imports are cointegrated with $0< \beta<1$, it shows that the deficit is only weakly sustainable.
c) If food exports and imports are cointegrated with $\beta\leq0$, it indicates that the deficit is non-sustainable.
d) If food exports and imports are cointegrated with the condition of $\beta>1$, it shows that it is not consistent with a deficit.

3.4 Methodology

This study used the Eviews software to analyse the data collected. The Im, Pesaran and Shin unit root test, Maddala and Wu unit root test, Pedroni cointegration test, Kao cointegration test, Westerlund cointegratiion test, OLS, DOLS and FMOLS tests were used to examine the relationship and sustainability between the variables under this study.

3.4.1 Im, Pesaran and Shin (IPS) Unit Root Test

In order to examine the panel cointegration, it is crucial to investigate the existence of unit roots in the data series first. In order to avoid the spurious regression, the study chose the Im, Pesaran and Shin (2003) unit root test to investigate the existence of unit roots in the panels. Im et al. (2003) proposed two-panel data unit root tests based on the mean group approaches which were the LM-bar and t-bar statistics. According to Im et al. (2003), the t-bar tends to perform better than the LM-bar as Monte Carlo experiments

proved that in the absence of autocorrelation when N→∞, it achieved more accurate size and higher power relative to the Levin and Lin (1993) test by allowing for a greater degree of heterogeneity (Baharumshah et al., 2005). In short, the test statistics of t-bar is given as;

$$\Gamma_{\bar{t}} = \frac{\sqrt{N}\{\bar{t}_{NT} - E(t_T|\beta_i = 0)\}}{\sqrt{Var}(t_T|\beta_i = 0)} \Rightarrow N(0,1), where \bar{t}_{NT} = \frac{1}{N}\sum_{i=1}^{N} t_{it} \quad (6)$$

such that $\bar{t}_{NT}$ is the average of the Augmented Dickey-Fuller (ADF) t-statistics for individual countries. The terms $E(t_T \mid \beta_i = 0)$ and $Var(t_T \mid \beta_i = 0)$ are the common mean and variance of t_{it} respectively. The test statistics converge to the standard normal distribution as T (time periods dimension) and N (cross-sectional dimension of the panel) tend to infinity and N/T tends to zero under the null hypothesis of unit roots, β_i=0, i=1,2...N.

3.4.2 Maddala and Wu Unit Root Test

Maddala and Wu (1999) suggested using a panel unit root test developed by Fisher (1932). Basically, the test combines the p-values of the test statistic for a unit root in each residual cross-sectional unit. The test is non-parametric and has a chi-square distribution with 2N degrees of freedom, where N is the number of cross-sectional units or countries. The test statistic was computed as below;

$$\lambda = -2\sum_{i=1}^{N} \log_e \pi_i \quad (7)$$

where π_i is the p-value of the test statistic for unit i and λ is distributed as x^2 with $2N$ degrees of freedom as $T_i \rightarrow \infty$ for all N. Furthermore, the Maddala and Wu (1999) test has the advantage that it does not depend on different lag lengths in the individual ADF regressions.

3.4.3 Pedroni Cointegration Test

The next step is to examine the long-run cointegration between food exports and food imports using panel cointegration test suggested by Pedroni (1999, 2004). Pedroni (1999) proposed the following time series panel regression;

$$y_{it} = a_{it} + \partial_{it} t + X_{it}\beta_{it} + e_{it} \quad (8)$$

where y_{it} and X_{it} are the observable variables with dimension of (N*T) x 1 and (N*T) x m, respectively. The Pedroni test is based on the null hypothesis of no cointegration and the alternative hypothesis that suggests the variables form a cointegrating relationship. The test allows for heterogeneity among individual members of the panel including heterogeneity in both the long-run cointegrating vectors and in the dynamics.

There were two types of tests suggested by Pedroni. The first type was based on the within-dimension approach which included four statistics. They were panel v-statistic, panel ρ-statistic, panel PP-statistic and panel ADF-statistic. All of these statistics pooled the autoregressive coefficients across different members for the unit root tests on the estimated residuals. The second test by Pedroni was based on the between-dimension approach, which included three statistics. They were group ρ-statistic, group PP-statistic

and group ADF-statistic. These statistics were based on estimators that simply average the individually estimated coefficients for each member. The heterogeneous panel and heterogeneous group mean panel cointegration statistics were calculated as follows;

Panel *v*-statistic:

$$Z_v = \left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,\hat{e}_{it-1}^{2}\right)^{-1} \quad (9)$$

Panel ρ-statistic:

$$Z_\rho = \left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,\hat{e}_{it-1}^{2}\right)^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\left(\hat{e}_{it-1}\Delta\hat{e}_{it} - \hat{\lambda}_i\right) \quad (10)$$

Panel PP-statistic:

$$Z_t = \left(\hat{\sigma}^2\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,\hat{e}_{it-1}^{2}\right)^{-1/2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\left(\hat{e}_{it-1}\Delta\hat{e}_{it} - \hat{\lambda}_i\right) \quad (11)$$

Panel ADF-statistic:

$$Z_t^* = \left(\hat{s}^{*2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,\hat{e}_{it-1}^{*2}\right)^{-1/2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,\hat{e}_{it-1}^{*}\Delta\hat{e}_{it}^{*} \quad (12)$$

Group ρ-statistic:

$$\tilde{Z}_\rho = \sum_{I=1}^{N}\left(\sum_{t=1}^{T}\hat{e}_{it-1}^{2}\right)^{-1}\sum_{t=1}^{T}\left(\hat{e}_{it-1}\Delta\hat{e}_{it} - \hat{\lambda}_i\right) \quad (13)$$

Group PP-statistic:

$$\tilde{Z}_t = \sum_{i=1}^{N}(\hat{\sigma}^2 \sum_{t=1}^{T} \hat{e}_{it-1}^2)^{-1/2} \sum_{t=1}^{T}(\hat{e}_{it-1}\Delta\hat{e}_{it} - \hat{\lambda}_i) \quad (14)$$

Group ADF-statistic:

$$\tilde{Z}_t^* = \sum_{i=1}^{N}(\sum_{t=1}^{T} \hat{s}_i^2 \hat{e}_{it-1}^{*2})^{-1/2} \sum_{t=1}^{T}(\hat{e}_{it-1}^{*}\Delta\hat{e}_{it}^{*}) \quad (15)$$

$\hat{e}_{it}$ is the estimated residual from equation (8) and $\hat{L}_{11i}^{-2}$ is the estimated long-run covariance matrix for $\Delta\hat{e}_{it}$ while $\hat{\sigma}_i^2$ and $\hat{s}_i^2$ ($\hat{s}_i^{*2}$) are the long-run and contemporaneous variances for individual i respectively. All seven tests are distributed as being standard normal asymptotically. Under the alternative hypothesis, panel *v*-statistics diverge to positive infinity. Therefore, it is a one-sided test where large positive values reject the null of no cointegration and the remaining statistics diverge to negative infinitely which means that large negative values also reject the null hypothesis.

3.4.4 Kao Cointegration Test

Following the study from Ramakrishna and Filho (2014), we used Kao's (1999) panel cointegration test which is the Engle-Granger's (1987) two steps residual-based test. In his paper, Kao (1999) described two tests under the null hypothesis of no cointegration for panel data. One was a Dickey-Fuller (DF) type test and another was an Augmented Dickey-Fuller (ADF) type test. The test started with the panel regression model as follows;

$$Y_{it} = X_{it}B_{it} + Z_{it\gamma_0} + \varepsilon_{it} \quad (16)$$

where Y and X were assumed to be non-stationary as given by;

$$\hat{e}_{it} = p\hat{e}_{it-1} + v_{it} \quad (17)$$

where $\hat{e}_{it} = Y_{it} - X_{it}\hat{\beta}_{it} + Z_{it}\hat{y}$ are the residuals from estimating equation (9). To test the null hypothesis of no cointegration against the alternative hypothesis that y and X are cointegrated, it may be written as;

$$H_0 : p = 1$$

$$H_1 : p < 1$$

For further calculations for DF and ADF test statistics, Kao (1999) developed both DF-type (4 types) test statistics and ADF test statistics as follows;

$$DF_p = \frac{T\sqrt{N}(\hat{p}-1)+3\sqrt{N}}{\sqrt{10.2}} \sim \text{N (0,1)}$$

$$DF_t = \sqrt{1.25t_p} + \sqrt{1.875N} \sim \text{N (0,1)}$$

$$DF_p^* = \frac{\sqrt{N}T(\hat{p}-1)+3\sqrt{N}\hat{\sigma}_V^2/\sigma_{ov}^2}{\sqrt{3+36\hat{\sigma}_V^4/(\hat{\sigma}_{OV}^4)}}, \sim \text{N (0,1)}$$

$$DF_t^* = \frac{t_p+\sqrt{6N}\hat{\sigma}_v/(2\hat{\sigma}_{ov})}{\sqrt{\hat{\sigma}_{ov}^2/(2\hat{\sigma}_v^2)+3\hat{\sigma}_v^2/(10\hat{\sigma}_{ov}^2)}}, \sim \text{N (0,1)}$$

$$ADF = \frac{t_{ADF}+\sqrt{6N}\hat{\sigma}_V/(2\hat{\sigma}_{OV})}{\sqrt{\hat{\sigma}_{OV}^2/(2\hat{\sigma}_V^2)+3\hat{\sigma}_V^2/(10\hat{\sigma}_{OV}^2)}} \sim \text{N (0, 1)}$$

where:

N : cross-section data

T : time series data

$\hat{p}$: coefficient of equation (9)

t_p : $[(\hat{p}-1)\sqrt{(\sum_{i=1}^{N}\sum_{t=2}^{T}\hat{e}_{it-1}^{*2})}]$/Se

Se : (1/NT) $\sum_{i=1}^{N}\sum_{t=2}^{T}(\hat{e}_{it}^{*}-\hat{p}\hat{e}_{it-1}^{*})^2$

$\sigma_{u}^{\wedge 2}$: variance of u

$\sigma_{v}^{\wedge 2}$: variance of v

$\sigma_{u}^{\wedge}$: standard deviation of u

$\sigma_{v}^{\wedge}$: standard deviation of v

t_{ADF} : $[(\hat{p}\text{-}1) - (\sum_{l=1}^{N}(eQ_i e_i))^{1/2}] / S_v$

3.4.5 Westerlund Cointegration Test

For the disaggregated study, a relatively new cointegration test proposed by Westerlund (2007) was applied due to the mixture of *I*(0) and *I*(1). Unlike residual-based cointegration tests, this test is free from the common factor restriction. Common factor restriction is the requirement that the long-run cointegrating vector for the variables in their levels is equal to the short-run adjustment process for the variables in their first differences (Kremers et al, 1992).

For this new cointegration test, four test statistics were proposed with two designed to test the alternative that the panel is cointegrated as a whole. These are referred to as group mean statistics. The other two were designed to test the alternative that variables in

at least one cross-section unit are cointegrated and are referred to as panel statistics. The data generating process in this test was assumed as;

$$y_{it} = \phi_{1i} + \phi_{2i}t + z_{it} \tag{18}$$

$$x_{it} = x_{it-1} + v_{it} \tag{19}$$

where *t* and *i* represent time and space dimensions of data, respectively. From this formulation, the vector x_{it} is modelled as a pure random walk, and y_{it} is modelled as the sum of the deterministic term $\phi_{1i} + \phi_{2it}$. A stochastic term z_{it} was modelled as;

$$a_i(L)\Delta z_{it} = a_i(z_{it-1} - \beta_i' x_{it-1}) + \gamma_i(L)' v_{it} + e_{it} \tag{20}$$

where

$$a_i(L) = 1 - \sum_{j=1}^{p_i} a_{ij}L^j \text{ and } \gamma_i(L) = \sum_{j=0}^{p_i} \gamma_{ij}L^j$$

Now, substituting equation (10) into equation (12) gave the error correction model for y_{it} as;

$$a_i(L)\Delta y_{it} = \delta_{1i} + \delta_{2i}t + a_i(y_{it-1} - \beta_i' x_{it-1}) + \gamma_i(L)' v_{it} + e_{it} \tag{21}$$

where

$$\delta_{1i} = a_i(1)\phi_{2i} - a_i\phi_{1i} + a_i\phi_{2i} \text{ and } \delta_{2i} = -a_i\phi_{2i}$$

From equation (13), the vector β_i defines a long-run equilibrium relationship between x_{it} and y_{it}. However, in the short run, there might be disequilibrium which is corrected by a proportion -2 < $a_i \leq 0$ in each period. a_i is the error correction parameter. If $a_i < 0$, there is error correction and the variables are cointegrated; if $a_i = 0$, there is no error correction and the variables are not cointegrated. The test statistics are given as below;

Group test statistics:

$$G_\tau = \frac{1}{N}\sum_{i=1}^{N} \frac{\hat{a}_i}{SE(\hat{a}_i)} \quad (22)$$

$$G_a = \frac{1}{N}\sum_{i=1}^{N} \frac{T\hat{a}_i}{\hat{a}_i(1)} \quad (23)$$

Panel test statistics:

$$P_\tau = \frac{\hat{a}}{SE(\hat{a})} \quad (24)$$

$$P_a = T\hat{a} \quad (25)$$

3.4.6 OLS, DOLS and FMOLS Tests

After confirming that the null hypothesis of no cointegration was rejected, the study used Ordinary Least Square (OLS), Dynamic Ordinary Least Square (DOLS) and Fully Modified Ordinary Least Square (FMOLS) tests in order to test the coefficients of the

long-run relationships of food exports and imports. The standard pooled OLS panel estimator is given as below;

$$\hat{\beta}_{NT} = (\sum_{i=1}^{N}\sum_{t=1}^{T}(x_{i,t} - \bar{x}_i)^2)^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T}(x_{i,t} - \bar{x}_i)\,(y_{i,t} - \bar{y}_i) \quad (26)$$

According to Chen et al. (1999), the bias-corrected OLS estimator is not an improvement over the OLS estimator in general. To overcome the weakness of the standard OLS, Phillips and Hansen (1990) proposed an estimator which employs a semi-parametric correction to eliminate the problems caused by the long-run correlation between the cointegrating equation and stochastic regressors innovations. The fully modified OLS (FMOLS) considered the following cointegrated system for a panel of i=1,...., N members.

$$y_{it} = a_i + \beta x_{it} + \mu_{it}$$

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

where ξ_{it} =[μ_{it} , e_{it}] is stationary with long-run covariance matrix Ω_i comfortable with u_{it}. The variables y_{it}, x_{it} are integrated of order one and the term, a_i, specifies the fixed effects. The FMOLS estimator as a modification of standardised OLS is given as;

$$\hat{\beta}_{FM} = (\sum_{i=1}^{N}\hat{L}_{22i}^{-1}\sum_{t=1}^{T}(x_{i,t} - \bar{x}_i)^2)^{-1}\sum_{i=1}^{N}\hat{L}_{11i}^{-1}\hat{L}_{22i}^{-1}(\sum_{t=1}^{T}(x_{i,t} - \bar{x}_i)y_{i,t}^{*} - T\delta_i) \quad (27)$$

where $y_{i,t}^{*} = (y_{i,t} - \bar{y}_i) - \left(\frac{\hat{L}_{21i}}{\hat{L}_{22i}}\right)\Delta x_{i,t} + \left(\frac{\hat{L}_{21i}-\hat{L}_{22i}}{\hat{L}_{22i}}\right)\beta(x_{i,t} - \bar{x}_i)$ and $\hat{\delta}_i = \hat{\Gamma}_{21i} + \hat{\Omega}_{21i}^{0} - \left(\frac{\hat{L}_{21i}}{\hat{L}_{22i}}\right)(\hat{\Gamma}_{22i} + \hat{\Omega}_{22i}^{0})$. According to Phillips and Hansen (1990), the FMOLS estimator was

asymptotically unbiased and had fully efficient mixture normal asymptotic allowing for standard Wald tests using asymptotic Chi-square statistical inference.

Kao and Chiang (2000) suggested the DOLS estimator be used as an extension of Stock and Watson's (1993) estimator. The main purpose of this estimator is to correct endogeneity bias and serial correlation as well as allow standard normal inference. The DOLS estimator can be derived from the following equation:

$$EX_{it} = \alpha_i + XM_{it}\beta + \sum_{j=-q1}^{j=q2} cij\Delta XM_{it+j} + v_{it} \quad (28)$$

where *EX* is the food exports and *XM* is the food imports. Equation (28) includes the c_{ij} which is the coefficient of leads or lags of first difference explanatory variables (XM_{it+j}) in order to produce asymptotically unbiased estimators and to avoid the problem of estimating nuisance parameters (Baharumshah et al., 2005). According to Kao and Chiang (2000), adding the number of leads and lags will reduce the bias of the DOLS significantly. Furthermore, the Monte Carlo simulations presented in Kao and Chiang (2000) showed that the DOLS estimator outperformed the OLS and FMOLS estimators in estimating cointegrated panel regressions for both the homogenous and heterogeneous panels. Thus, the DOLS estimation method provides a robust correction of endogeneity in the explanatory variables.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents and discusses the results of the analysis. The countries selected for this analysis are four countries in ASEAN which are Indonesia, Malaysia, Philippines and Thailand. Variables of exports and imports of selected food commodities were conducted under this analysis. The long and balance panel has been used because of the study periods (T) is larger than the number of countries (N) and each country has year observations. Moreover, the study used aggregate and disaggregates data of 25 selected food commodities to verify the relationship and sustainability between food exports and imports in ASEAN-4 countries. A few methods were used to investigate the relationship and sustainability between these variables as below;

i. Im, Pesaran and Shin (2003) and Maddala and Wu (1999) unit root tests were used to detect the existence of unit root whether the variables were stationary or not within the period of observations.
ii. Pedroni (1999), Kao (1999) and Westerlund (2007) cointegration test were used to investigate the existence of a long-run relationship among the variables.
iii. Ordinary Least Square (OLS), Dynamic OLS (DOLS) and Fully Modified OLS (FMOLS) tests were used to verify the sustainability between food exports and imports.

4.2 Aggregate Data Results

4.2.1 Panel Unit Root Tests

The empirical analysis started with an examination of the unit root of the two variables which were food exports (EX) and food imports (MM) during the period of observation. In order to identify possible unit roots, this study applied the Im, Pesaran and Shin (2003), and Maddala and Wu (1999) panel unit root tests for levels and first differences. The test results are reported in Table 3.

Table 3: Panel Unit Root Tests

Im, Pesaran and Shin				
Variable	**Level**		**First Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend
LEX	4.7206 (1.0000)	-0.4655 (0.3208)	-4.9179** (0.0000)	-1.6833** (0.0462)
LXM	3.8073 (0.9999)	-1.5167 (0.0647)	-5.8783** (0.0000)	-5.1562** (0.0000)
Maddala and Wu ADF- Fisher Chi-square				
Variable	**Level**		**First Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend
LEX	0.1219 (1.0000)	8.1335 (0.4205)	36.2126** (0.0000)	23.0181** (0.0000)
LXM	0.3149 (1.0000)	13.0188 (0.1112)	43.5787** (0.0000)	35.7680** (0.0000)
Maddala and Wu PP- Fisher Chi-square				
Variable	**Level**		**First Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend
LEX	0.1049 (1.0000)	13.5658 (0.0938)	36.1628** (0.0000)	42.1746** (0.0000)
LXM	0.2377 (1.0000)	24.2659** (0.0021)	43.6572 (0.0000)	38.0853** (0.0000)

Notes:

1.The null hypothesis in each variable is integrated of order 1 I(1).
2.** indicate statistically significant at 5% level.
3.Δ denotes first difference operator.

Table 3 presents the results of the Im, Pesaran and Shin (IPS), and Maddala and Wu panel unit root tests at level and first difference. The results at level indicate that log of export (LEX) is integrated of order 0, *I*(0) at constant only and at constant with time trend in the study period of the panel unit root regression. The null hypothesis of a panel unit root in the level of the series cannot be rejected at 5% significance level. Furthermore, log of import (LXM) also shows the results of integrated of order 0, *I*(0) at constant only and at constant with time trend in all three unit root tests except for the LXM in PP-Fisher chi-square at constant with time trend where it was found the null hypothesis was rejected at 5% significance level. For these reasons, the study confirmed that all of the variables are non-stationary in with and without time trend specifications at level except for LXM in PP-Fisher chi-square.

Further examination based on the first difference for IPS, Maddala and Wu tests of both variables in constant without time trend and constant with time trend revealed that all series of the unit root test can be rejected at 5% significance level. The results pointed out that there is strong evidence that all the series are integrated of orders one, *I*(1). It can be concluded that the results of IPS and Maddala and Wu unit root tests reported in Table 3 supported the hypothesis of a unit root in both variables across countries in first differences. The study found that all tests in both with and without time trends strongly reject the null hypothesis of unit root.

4.2.2 Panel Cointegration Tests

Next, after confirming the presence of unit root in both variables, the study proceeded to panel cointegration tests which were Kao (1999) and Pedroni (1999)

cointegration tests. Kao and Pedroni cointegration tests were used in order to verify the cointegration between food exports and imports. The results are presented in Table 4 and 5.

Table 4: Kao Cointegration Test

Included observations: 76		
Trend assumption: No deterministic trend		
Null hypothesis: No cointegration		
Automatic lag length selection based on SIC with a maximum lag of 4		
Newey-West automatic bandwidth and Barlett Kernel		
ADF	t-stat -3.157766	Probability 0.0008**

Notes:

1. The figure in the parentheses indicates that the number lags of selected is based on SIC.
2. ** denote statistical significance at the 5% level of significance, respectively.
3. Bandwidth selected is based on Newey-West using Barlett Kurnel estimation.

Table 5: Pedroni Cointegration Test

Test statistics	
Panel cointegration statistics (within dimension)	
Panel v-statistics	1.9915**
Panel rho-statistics	-1.8881**
Panel *pp*-statistics	-2.3003**
Panel *adf*-statistics	-3.6294**
Group mean panel cointegration statistics (between dimension)	
Group rho-statistics	-0.8680
Group *pp*-statistics	-6.9096**
Group *adf*-statistics	-4.0608**

Notes: 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 that statistic is significant at 5% significance level.

Kao's (1999) cointegration test results presented in Table 4 indicates that the t-statistics of -3.157766 (0.0008) reject the null hypothesis of no cointegration at the 5% level of significance showing cointegration exists between food exports and imports for ASEAN-4 countries as a group. Also with the same result in Table 5, Pedroni cointegration

test provides strong evidence against the null of no cointegration for six out of seven test statistics. As noted by Irandoust and Ericsson (2004), the presence of cointegration between exports and imports may suggest that the country is not in violation of its intertemporal budget constraint and trade imbalance is just a short-run phenomenon which is sustainable in the long-run. This implies a well-functioning economy because deficits are temporary phenomena that will be balanced by future surpluses. From this context, it can be concluded that the ASEAN-4 countries macroeconomic policies have been effective in bringing food exports and imports of into a long-run equilibrium.

4.2.3 OLS, DOLS and FMOLS Tests

Given the fact that food exports and food imports are cointegrated for food commodities in Pedroni's cointegration test, the study estimated equations (26, 27 and 28) by using the method of OLS, DOLS and FMOLS. The study tested whether the cointegration coefficient of β is significantly different from 0 and insignificantly different from 1. The results are presented in Table 6.

Table 6: OLS, DOLS and FMOLS Tests

Model	**Coefficient β**	**F-statistics for testing H_0: β = 1**	**F-statistics for testing H_0: β = 1**
OLS	1.0086	5.3497** (0.0235)	74400.12** (0.0000)
DOLS	1.0049	0.6921 (0.4086)	28310.24** (0.0000)
FMOLS	1.0096	54.4305** (0.0000)	606829.1** (0.0000)

Notes:

1. ** indicate reject the null hypothesis at 5% significant level.
2. Estimation of DOLS is based on pooled data with 1 lags and 1 leads of first differenced explanatory variables.
3. Estimation of FMOLS is based on a group-mean panel of first differenced explanatory variables.

Findings from Table 6 indicate that the null hypothesis of $\beta=0$ and $\beta=1$ are both rejected at 5% significance level for the estimates from OLS and FMOLS. These empirical results show that food exports and food imports are cointegrated with the cointegrating coefficient of $0<\beta<1$, implying that the food trades are weakly sustainable in ASEAN-4 countries. Meanwhile, DOLS test shows that the null hypothesis of $\beta=1$ cannot be rejected and the null hypothesis of $\beta=0$ can be rejected at 5% significance level. Thus, it can be concluded that food exports and food imports are cointegrated with the cointegrating coefficient of $\beta=1$, suggesting the food trade for these food commodities are strongly sustainable. There are mixed results from these three model tests for the null hypothesis of $\beta=1$. Kao and Chiang (1998) pointed out that the OLS estimator has a non-negligible bias in finite samples and the DOLS estimator may be more promising than OLS or FMOLS estimators in estimating panel regressions. According to Kao and Chiang (2000), DOLS method is a more robust test in which it can correct for possible simultaneity bias among the regressors by the inclusion of lagged and lead values of the first difference in the regressors. Therefore, it can be concluded that food exports and imports are cointegrated with the cointegrating coefficient of $\beta=1$, implying that the food trade conditions in ASEAN-4 are strongly sustainable.

The food crisis has become one of the threats towards ASEAN-4 regions. The panic over increase in food prices and shortage of food supplies in recent years growing fears about the ASEAN-4 food trade sustainability. From the results of aggregated data results, it can be concluded that ASEAN-4 food trade condition is strongly sustain where the adequate food production is enough for the population needs, where the food exports is larger than the food imports. Thailand's position as a major producer and exporter of food

may present proportionally greater opportunities for the traders and exporter to export their food to the country's that lacking in food production.

4.3 Disaggregate Data Results

4.3.1 Panel Unit Root Tests

Before performing cointegration test, it is crucial to identify possible unit roots. This study applied Im, Pesaran and Shin (2003), and Maddala and Wu (1999) ADF and PP unit root tests. The results of unit root tests are reported in Table 7.

Both tests with constant only and a constant with trend were used to determine the stationarity of each series. The food commodities of 001, 036, and 075 indicate that the null hypothesis of a panel unit root at the level of the series cannot be rejected at 5% significance level for all tests. In first difference, the null hypothesis of LEX and LXM series have a unit root is rejected at 5% significance level. The results show that there is strong evidence that both of the variables are integrated of orders one, $I(1)$ in all tests.

For food commodities 022, 034, 047, 057 and 071, the LXM in Im, Pesaran and Shin, ADF and PP test statistics with a constant and trend reject the null hypothesis of a panel unit root at the level indicate that LXM are integrated of order 0, $I(0)$. For other test statistics at level significantly confirm that LEX and LXM cannot be rejected at 5% significance level. In first difference, all series of the unit root can be rejected at 5% significance level and the series are integrated of order 1, $I(1)$ in all tests.

For food commodities 024 and 037, the null hypothesis of a panel unit root of the LEX cannot be rejected at 5% significance level both at constant and a constant with trend at level for all tests. For LXM at level, the null hypothesis of a panel unit root can be rejected at 5% significance level at constant with trend for Im, Pesaran and Shin and PP tests, indicating that the LXM is integrated of order 0, *I*(0). In first difference, the results reveal that all series of the unit root tests can be rejected at 5% significance level and the series are integrated of order one, *I*(1).

Food commodities 025 and 061 show that LEX and LXM at level in a constant for all tests reveal that the null hypothesis of the series having unit root cannot be rejected at 5% significance level. However, LEX and LXM at constant with trend are stationary at the level and integrated of order 0, *I*(0) for Im, Pesaran and Shin, ADF and PP tests except for LEX at constant with trend in PP test. In first difference, the results reveal that all series of the unit root test can be rejected at 5% significance level and the series are integrated of order one, *I*(1).

For food commodity 035, at 5% significance level LEX and LXM at level in a constant for all tests show that the null hypothesis of the series having unit root cannot be rejected at 5% significance level. However, LEX and LXM at constant with trend are stationary at the level and integrated of order 0, *I*(0) for Im, Pesaran and Shin, ADF and PP tests except for LXM at constant with trend in PP test. In first difference, the results reveal that all series of the unit root test can be rejected at 5% significance level and the series are integrated of order one, *I*(1).

For food commodity 042, the null hypothesis of a panel unit root of the LEX can be rejected at 5% significance level both at constant and a constant with trend at level for all tests show that the series are integrated of order 0, *I*(0). For LXM at level, the null hypothesis of a panel unit root cannot be rejected at 5% significance level at constant and constant with trend for all tests. In first difference, the results reveal that all series of the unit root tests can be rejected at 5% significance level and the series are integrated of order one, *I*(1).

For food commodities 044, LEX at level for constant and constant with trend except for PP test reject the null hypothesis of panel having unit root, indicating that the series are integrated of order 0, *I*(0). For LXM at level for constant and constant with trend except for PP test at constant with trend, the null hypothesis of panel having unit root cannot be rejected at 5% significance level. In first difference, the results reveal that all series of the unit root tests can be rejected at 5% significance level and the series are integrated of order one, *I*(1).

For food commodities 048, 054, 058, 062 and 081, at 5% significance level except for LEX and LXM of the level in a constant with trend, other statistics significantly confirm that LEX and LXM have a panel unit root. The null hypothesis of having unit root cannot be rejected at 5% significance level for all tests. However, the null hypothesis of panel having unit root can be rejected at 5% significance level for all tests in constant with trend at level, indicating that the series are integrated of order 0, *I*(0). In first difference, the results reveal that all series of the unit root test can be rejected at 5% significance level and the series are integrated of order one, *I*(1).

For food commodities 056, LEX at level shows that at constant, the null hypothesis of having panel unit root can be rejected at 5% significance level at ADF and PP tests. Also, in PP test at level for constant with trend. For LXM at level, the null hypothesis of having panel unit root can be rejected at constant with trend for Im, Pesaran and Shin and ADF tests. The results indicate that the series are integrated of order 0, *I*(0). In first difference, the results reveal that all series of the unit root test can be rejected at 5% significance level and the series are integrated of order one, *I*(1).

For food commodity 072, the null hypothesis of a panel unit root of the LEX cannot be rejected at 5% significance level both at constant and a constant with trend at level for all tests. For LXM at level, the null hypothesis of having a panel unit root can be rejected at 5% significance level at constant with trend for Im, Pesaran and Shin and ADF tests, indicating that the series are integrated of order 0, *I*(0). In first difference, the results reveal that all series of the unit root tests can be rejected at 5% significance level and the series are integrated of order one, *I*(1).

For food commodity 073, LEX and LXM at level in a constant for all tests show that the null hypothesis of the series having unit root cannot be rejected at 5% significance level for all tests. However, LEX and LXM at constant with trend are stationary at the level and integrated of order 0, *I*(0) for Im, Pesaran and Shin, ADF and PP tests except for LXM at constant with trend in Im, Pesaran and Shin test. In first difference, the results reveal that all series of the unit root test can be rejected at 5% significance level and the series are integrated of order one, *I*(1).

For food commodity 091, LEX at level in a constant and constant with trend for all tests show that the null hypothesis of the series having unit root cannot be rejected at 5% significance level except for PP test at constant with trend where the null hypothesis is rejected at 5% significance level, indicating the series is integrated of order 0, *I*(0). For LXM at level, the null hypothesis of panel having unit root is rejected at 5% significance level at constant with trend for all tests, indicating that LXM is integrated of order 0, I(0). In first difference, the results reveal that all series of the unit root test can be rejected at 5% significance level and the series are integrated of order one, *I*(1).

For food commodity 098, LEX and LXM at level in a constant for all tests show that the null hypothesis of the series having unit root cannot be rejected at 5% significance level. However, LEX and LXM at constant with trend are stationary at the level and integrated of order 0, *I*(0) for Im, Pesaran and Shin, ADF and PP tests except for LEX at constant with trend in Im, Pesaran and Shin test. In first difference, the results reveal that all series of the unit root test can be rejected at 5% significance level and the series are integrated of order one, *I*(1).

Table 7: Panel Unit Root Test

Food Commodity: 001												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	0.7952 (0.7868)	-0.8886 (0.1871)	-5.9031** (0.0000)	-4.9864** (0.0000)	3.9519 (0.8614)	10.0107 (0.2643)	43.8025** (0.0000)	34.4288** (0.0000)	3.7919 (0.8754)	10.7639 (0.2154)	50.7360** (0.0000)	43.0718** (0.0000)
LXM	1.2097 (0.8868)	0.0813 (0.5324)	-6.3342** (0.0000)	-4.7606** (0.0000)	2.7957 (0.9465)	7.2999 (0.5047)	46.6016** (0.0000)	33.3907** (0.0001)	2.6679 (0.9534)	14.4289 (0.0712)	46.2350** (0.0000)	47.2111** (0.0000)
Food Commodity: 022												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	-0.2064 (0.4182)	0.3649 (0.6424)	-5.7215** (0.0000)	-4.8367** (0.0000)	8.7662 (0.3624)	5.1540 (0.7410)	42.3620** (0.0000)	35.2991** (0.0000)	14.1226 (0.0786)	4.3764 (0.8217)	41.4593** (0.0000)	54.9835** (0.0000)
LXM	2.1228 (0.9831)	-3.1751** (0.0007)	-8.8357** (0.0000)	-4.8449** (0.0000)	1.6051 (0.9908)	25.7292** (0.0012)	66.6508** (0.0000)	35.7793** (0.0000)	0.9414 (0.9986)	28.5587** (0.0004)	66.2876** (0.0000)	74.2542** (0.0000)
Food Commodity: 024												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	-0.1629 (0.4353)	-1.5551 (0.0600)	-5.7946** (0.0000)	-5.2023** (0.0000)	7.5524 (0.4784)	13.8506 (0.0857)	44.2513** (0.0000)	37.4301** (0.0000)	7.3471 (0.4997)	13.7106 (0.0896)	105.3670** (0.0000)	53.7689** (0.0000)
LXM	3.5893 (0.9998)	-1.8107 (0.0351)	-4.4479** (0.0000)	-4.1579** (0.0000)	0.5230 (0.9998)	14.8476 (0.0622)	36.2366** (0.0000)	32.2354** (0.0000)	0.3513 (1.0000)	30.7820** (0.0002)	60.4839** (0.0000)	62.5247** (0.0000)

Notes:

** indicates rejection of the null hypothesis of no cointegration at 5% levels of significance.

Table 7 continued

Food Commodity: 025												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	2.2018 (0.9862)	-2.2932 (0.0109)	-7.8672** (0.0000)	-8.8887** (0.0000)	1.5039 (0.9926)	17.790 (0.0229)	61.4278** (0.0000)	58.5639** (0.0000)	3.3170 (0.9129)	15.4122 (0.0516)	84.7009** (0.0000)	74.6383** (0.0000)
LXM	-0.1247 (0.4504)	-3.6263** (0.0001)	-7.9432** (0.0000)	-6.2960** (0.0000)	7.6291 (0.4705)	26.491** (0.0009)	60.8089** (0.0000)	45.9500** (0.0000)	8.5529 (0.3814)	17.2739 (0.0274)	224.603** (0.0000)	56.0538** (0.0000)
Food Commodity: 034												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	1.0940 (0.8630)	0.1008 (0.5402)	-5.3567** (0.0000)	-4.0818** (0.0000)	5.7684 (0.6731)	5.5339 (0.6993)	39.7532** (0.0000)	29.3443** (0.0003)	1.2236 (0.9964)	4.1463 (0.8437)	38.8185** (0.0000)	28.7771** (0.0000)
LXM	2.1649 (0.9848)	-3.0444** (0.0012)	-5.5464** (0.0000)	-4.1763** (0.0000)	1.2803 (0.9958)	24.1965** (0.0021)	41.2915** (0.0000)	29.3355** (0.0003)	1.0985 (0.9975)	19.3669 (0.0130)	43.8462** (0.0000)	44.5632** (0.0000)
Food Commodity: 035												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	0.5632 (0.7134)	-3.0550** (0.0011)	-5.5552** (0.0000)	-4.0523** (0.0000)	4.8950 (0.7687)	21.7700** (0.0054)	41.4610 (0.0000)	29.1130 (0.0000)	4.9285 (0.7652)	28.0256** (0.0005)	95.3802** (0.0000)	68.5075** (0.0000)
LXM	-0.7058 (0.2401)	-1.9629 (0.0248)	-7.0108** (0.0000)	-5.2331** (0.0000)	12.2749 (0.1394)	15.9639 (0.0429)	52.2082 (0.0000)	38.0295 (0.0000)	10.7359 (0.2171)	13.3094 (0.1016)	292.717** (0.0000)	39.1493** (0.0000)

Notes:

** indicates rejection of the null hypothesis of no cointegration at 5% levels of significance.

Table 7 continued

Food Commodity: 036												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	0.5929 (0.7234)	1.6503 (0.9506)	-4.5919** (0.0000)	-4.2516** (0.0000)	6.5371 (0.5873)	2.9745 (0.9359)	33.9798** (0.0000)	30.3843** (0.0002)	5.6483 (0.6866)	2.0151 (0.9805)	37.7670** (0.0000)	37.6741** (0.0000)
LXM	1.5416 (0.9384)	-0.6372 (0.2620)	-6.9411** (0.0000)	-5.7517** (0.0000)	2.6257 (0.9556)	11.2651 (0.1871)	51.1419** (0.0000)	39.2043** (0.0000)	1.8576 (0.9851)	11.1259 (0.1947)	90.2334** (0.0000)	64.8281** (0.0000)
Food Commodity: 037												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	2.4882 (0.9936)	-0.9408 (0.1734)	-4.6394** (0.0000)	-3.4904** (0.0002)	1.1206 (0.9974)	10.6109 (0.2247)	34.3220** (0.0000)	24.7799** (0.0017)	1.2210 (0.9964)	8.4013 (0.3953)	30.1370** (0.0002)	21.2074** (0.0066)
LXM	2.8226 (0.9976)	-1.6821** (0.0463)	-8.9003** (0.0000)	-8.5944** (0.0000)	0.6609 (0.9996)	15.4604 (0.0508)	65.8343** (0.0000)	57.1007** (0.0000)	0.9304 (0.9987)	33.6320** (0.0000)	55.3639** (0.0000)	51.2542** (0.0000)
Food Commodity: 042												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	-2.4446** (0.0073)	-2.9671** (0.0015)	-5.9053** (0.0000)	-4.6048** (0.0000)	24.6139** (0.0018)	24.2345** (0.0021)	43.3556** (0.0000)	31.5071** (0.0001)	17.5343** (0.0250)	19.8830** (0.0108)	61.6618** (0.0000)	48.8374** (0.0000)
LXM	-0.0497 (0.4802)	0.0295 (0.5118)	-7.7040** (0.0000)	-6.8838** (0.0000)	6.1450 (0.6310)	6.5498 (0.5859)	56.8277** (0.0000)	45.9199** (0.0000)	10.4390 (0.2356)	7.9601 (0.4374)	75.5659** (0.0000)	54.6582** (0.0000)

Notes:

** indicates rejection of the null hypothesis of no cointegration at 5% levels of significance.

Table 7 continued

Food Commodity: 044												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	-2.3853** (0.0085)	-2.8826** (0.0020)	-4.8637** (0.0000)	-3.4116** (0.0003)	20.0696 (0.0101)	21.1090** (0.0069)	37.2405** (0.0000)	26.0656** (0.0010)	14.3628 (0.0728)	14.9421 (0.0603)	275.712** (0.0000)	48.9504** (0.0000)
LXM	-0.0357 (0.4857)	-1.1558 (0.1239)	-6.3859** (0.0000)	-3.9273** (0.0000)	7.7787 (0.4554)	11.3787 (0.1811)	48.4656** (0.0000)	31.4830** (0.0001)	7.71022 (0.4623)	19.2797 (0.0134)	69.2401** (0.0000)	56.8701** (0.0000)
Food Commodity: 047												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	1.0932 (0.8629)	-0.6082 (0.2715)	-6.7155** (0.0000)	-5.1321** (0.0000)	4.7023 (0.7889)	8.6521 (0.3725)	49.4800** (0.0000)	37.1780** (0.0000)	4.9114 (0.7670)	9.3608 (0.3128)	51.7300** (0.0000)	56.9295** (0.0000)
LXM	1.7335 (0.9585)	-2.1510 (0.0157)	-4.6078** (0.0000)	-5.1406** (0.0000)	3.0880 (0.9287)	20.3560** (0.0091)	35.2836** (0.0000)	36.0172** (0.0000)	3.1827 (0.9224)	27.7328** (0.0005)	66.9180** (0.0000)	55.4411** (0.0000)
Food Commodity: 048												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	3.6263 (0.9999)	-3.2909** (0.0005)	-6.4751** (0.0000)	-5.3072** (0.0000)	0.4462 (0.9999)	24.4831** (0.0019)	47.6974** (0.0000)	36.9123** (0.0000)	0.1912 (1.0000)	32.2495** (0.0001)	101.443** (0.0000)	58.7473** (0.0000)
LXM	2.4381 (0.9926)	-3.7297** (0.0001)	-4.0732** (0.0000)	-2.5471** (0.0000)	1.8584 (0.9850)	28.8388** (0.0003)	31.4298** (0.0001)	20.3387** (0.0091)	0.7072 (0.9995)	63.4336** (0.0000)	41.4848** (0.0000)	35.6784** (0.0000)

Notes:

** indicates rejection of the null hypothesis of no cointegration at 5% levels of significance.

Table 7 continued

Food Commodity: 054												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	-0.0106 (0.4957)	-3.2914** (0.0005)	-7.4539** (0.0000)	-6.8381** (0.0000)	7.9565 (0.4377)	25.3856** (0.0013)	54.8442** (0.0000)	46.5947** (0.0000)	5.0165 (0.7558)	26.3266** (0.0009)	61.8507** (0.0000)	51.8486** (0.0000)
LXM	3.3084 (0.9995)	-2.9397** (0.0016)	-5.6541** (0.0000)	-4.1833** (0.0000)	0.6687 (0.9996)	22.7673** (0.0037)	42.9784** (0.0000)	31.8375** (0.0001)	0.5718 (0.9998)	33.3388** (0.0001)	42.2072** (0.0000)	33.5407** (0.0000)
Food Commodity: 056												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	-1.0912 (0.1376)	-1.3952 (0.0815)	-6.7502** (0.0000)	-5.8086** (0.0000)	17.2890 (0.0272)	13.0992 (0.1085)	49.8875** (0.0000)	39.8784** (0.0000)	18.5025 (0.0178)	30.5320** (0.0002)	58.9760** (0.0000)	47.5928** (0.0000)
LXM	3.3700 (0.9996)	-2.7050** (0.0034)	-6.8683** (0.0000)	-6.5236** (0.0000)	0.9306 (0.9986)	21.0989** (0.0069)	50.4848** (0.0000)	43.5380** (0.0000)	0.9015 (0.9988)	15.3218 (0.0532)	51.4503** (0.0000)	46.3329** (0.0000)
Food Commodity: 057												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	4.4475 (1.0000)	-0.2951 (0.3839)	-6.3134** (0.0000)	-6.8680** (0.0000)	0.3639 (1.0000)	9.6222 (0.2925)	48.1343** (0.0000)	49.2100** (0.0000)	0.3509 (1.0000)	6.7604 (0.5627)	50.2536** (0.0000)	58.0036** (0.0000)
LXM	3.4393 (0.9997)	-2.1549 (0.0156)	-4.2299 (0.0000)	-2.8876** (0.0019)	0.6341 (0.9997)	17.6366 (0.0241)	31.7985** (0.0001)	22.6857** (0.0038)	0.5394 (0.9998)	30.5604** (0.0002)	34.2647** (0.0000)	28.6924** (0.0004)

Notes:

** indicates rejection of the null hypothesis of no cointegration at 5% levels of significance.

Table 7 continued

Food Commodity: 058												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	2.6476 (0.9959)	-4.2594** (0.0000)	-8.6103** (0.0000)	-8.0167** (0.0000)	2.3412 (0.9687)	30.5183** (0.0002)	72.4417** (0.0000)	49.0025** (0.0000)	2.8581 (0.9429)	39.3063** (0.0000)	238.855** (0.0000)	47.9447** (0.0000)
LXM	2.2078 (0.9864)	-1.9328 (0.0266)	-5.2273** (0.0000)	-3.9711** (0.0000)	1.6163 (0.9906)	19.3937 (0.0129)	40.1230** (0.0000)	30.3375** (0.0002)	1.4104 (0.9941)	23.6894** (0.0026)	52.2435 (0.0000)	47.0774** (0.0000)
Food Commodity: 061												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	1.8085 (0.9647)	-2.1623 (0.0153)	-7.4767** (0.0000)	-6.6628** (0.0000)	1.9662 (0.9820)	16.9597 (0.0305)	55.7857** (0.0000)	45.3567** (0.0000)	5.7902 (0.6707)	12.9211 (0.1146)	61.6826** (0.0000)	55.0590** (0.0000)
LXM	1.7030 (0.9557)	-1.8942 (0.0291)	-6.8273** (0.0000)	-5.5876** (0.0000)	4.4134 (0.8180)	16.1547 (0.0402)	51.6601** (0.0000)	40.3282** (0.0000)	4.3999 (0.8194)	29.1428** (0.0003)	62.4024** (0.0000)	54.0164** (0.0000)
Food Commodity: 062												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	1.7086 (0.9562)	-2.1693 (0.0150)	-5.3913** (0.0000)	-4.0530** (0.0000)	2.7128 (0.9511)	16.8728 (0.0315)	40.0396** (0.0000)	28.8694** (0.0003)	1.6287 (0.9904)	16.3451 (0.0377)	77.6643** (0.0000)	33.7629** (0.0000)
LXM	2.0309 (0.9789)	-4.4543** (0.0000)	-5.6974** (0.0000)	-4.8215** (0.0000)	1.5268 (0.9923)	32.1671** (0.0001)	43.3293** (0.0000)	34.8485** (0.0000)	1.3213 (0.9953)	17.2461 (0.0276)	52.2438** (0.0000)	38.0232** (0.0000)

Notes:

** indicates rejection of the null hypothesis of no cointegration at 5% levels of significance.

Table 7 continued

Food Commodity: 071												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	0.9854 (0.8378)	-0.4994 (0.3087)	-3.5539** (0.0002)	-2.1756 (0.0148)	3.8838 (0.8674)	9.1697 (0.3282)	26.2233** (0.0010)	16.8503** (0.0317)	3.3521 (0.9104)	4.6197 (0.7973)	25.4523** (0.0013)	16.3474** (0.0377)
LXM	2.1334 (0.9836)	-5.0649** (0.0000)	-6.1374** (0.0000)	-4.6297** (0.0000)	1.3260 (0.9952)	36.1183** (0.0000)	46.5800** (0.0000)	33.9252** (0.0000)	6.3813 (0.6046)	47.0546** (0.0000)	423.593** (0.0000)	67.7869** (0.0000)
Food Commodity: 072												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	1.0873 (0.8616)	0.1286 (0.5512)	-3.9053** (0.0000)	-3.0372** (0.0012)	3.8373 (0.8715)	7.6003 (0.4735)	29.3118** (0.0003)	22.5038** (0.0041)	3.7143 (0.8819)	3.6298 (0.8889)	27.1615** (0.0007)	19.9638** (0.0105)
LXM	-0.4684 (0.3197)	-1.7782 (0.0377)	-4.0094** (0.0000)	-2.6861** (0.0036)	8.8111 (0.3585)	16.4034 (0.0370)	29.9249** (0.0002)	21.8992** (0.0051)	7.8869 (0.4446)	9.1493 (0.3299)	29.2284** (0.0003)	19.7104** (0.0115)
Food Commodity: 073												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	1.3868 (0.9173)	-2.1237 (0.0168)	-4.6965** (0.0000)	-3.4911** (0.0002)	3.83985 (0.8713)	18.6857** (0.0166)	35.1831** (0.0000)	25.6100** (0.0012)	4.1619 (0.8422)	17.7082** (0.0235)	88.2944** (0.0000)	42.2007** (0.0000)
LXM	1.9528 (0.9746)	-0.1974 (0.4217)	-7.3745 (0.0000)	-6.3762 (0.0000)	3.9703 (0.8598)	20.0899 (0.0100)	55.5004** (0.0000)	37.6903** (0.0000)	4.9840 (0.7593)	33.4793** (0.0001)	49.5144** (0.0000)	38.3193** (0.0000)

Notes:

** indicates rejection of the null hypothesis of no cointegration at 5% levels of significance.

Table 7 continued

Food Commodity: 075												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	1.0626 (0.8560)	-0.5906 (0.2774)	-5.9660** (0.0000)	-3.8127** (0.0000)	3.3660 (0.9093)	9.9035 (0.2719)	43.9606** (0.0000)	27.5288** (0.0006)	2.9595 (0.9369)	3.6941 (0.8836)	52.0261** (0.0000)	55.0666** (0.0000)
LXM	1.4030 (0.9197)	-0.6234 (0.2665)	-7.7001** (0.0000)	-5.8375** (0.0000)	3.2161 (0.9201)	10.2429 (0.2484)	56.7204** (0.0000)	40.0310** (0.0000)	2.5822 (0.9578)	10.3109 (0.2439)	79.5422** (0.0000)	75.0846** (0.0000)
Food Commodity: 081												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	3.3220 (0.9996)	-2.0296 (0.0212)	-5.1712** (0.0000)	-4.3191** (0.0000)	0.7239 (0.9995)	16.2408 (0.0391)	38.7130** (0.0000)	31.7606** (0.0001)	0.6761 (0.9996)	48.0766** (0.0000)	49.9209** (0.0000)	58.8308** (0.0000)
LXM	4.7031 (1.0000)	-6.1063** (0.0000)	-6.5734** (0.0000)	-5.6411** (0.0000)	0.0930 (1.0000)	34.0913** (0.0000)	48.7055** (0.0000)	38.5723** (0.0000)	0.1576 (1.0000)	34.1853** (0.0000)	45.6232** (0.0000)	48.1400** (0.0000)
Food Commodity: 091												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	1.0339 (0.8494)	-1.2866 (0.0991)	-5.9190** (0.0000)	-4.4159** (0.0000)	3.4089 (0.9061)	11.6095 (0.1695)	43.9525** (0.0000)	31.0562 (0.0001)	8.1488 (0.4191)	18.2866 (0.0192)	83.8742** (0.0000)	47.7996** (0.0000)
LXM	2.7239 (0.9968)	-1.9236 (0.0272)	-6.0060** (0.0000)	-5.9788** (0.0000)	4.0933 (0.8486)	15.7885** (0.0455)	44.5988** (0.0000)	42.7730** (0.0000)	3.6428 (0.8878)	15.9635 (0.0429)	53.9739** (0.0000)	42.1644** (0.0000)

Notes:

** indicates rejection of the null hypothesis of no cointegration at 5% levels of significance.

Table 7 continued

Food Commodity: 098												
Im, Pesaran and Shin					**ADF- Fisher Chi-square**				**PP- Fisher Chi-square**			
Variable	**Level**		**1st Difference**		**Level**		**1st Difference**		**Level**		**1st Difference**	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
LEX	2.7077 (0.9966)	-1.4773 (0.0698)	-4.1486** (0.0000)	-1.9989** (0.0228)	4.2376 (0.8351)	16.4096 (0.0369)	30.7039** (0.0002)	17.8156** (0.0227)	0.0761 (1.0000)	34.0966** (0.0000)	21.6104** (0.0057)	15.3220 (0.0532)
LXM	3.0843 (0.9990)	-2.5129** (0.0060)	-5.4833** (0.0000)	-4.3852** (0.0000)	0.6202 (0.9997)	19.1063 (0.0143)	40.3951** (0.0000)	31.2590** (0.0001)	0.4438 (0.9999)	26.7491** (0.0008)	88.1696** (0.0000)	40.6997** (0.0000)

Notes:

** indicates rejection of the null hypothesis of no cointegration at 5% levels of significance.

4.3.2 Westerlund Cointegration Test

The next step in the analysis was to apply the cointegration test. In the disaggregate study, there was a mixture of stationarity of $I(0)$ and $I(1)$ in panel unit root tests. Due to the different integrations among variables, the study applied the four new panel cointegration tests developed by Westerlund (2007).

Table 8: Westerlund's cointegration tests

Food commodities	G_τ		G_a		P_τ		P_a	
	value	p-value	value	p-value	value	p-value	value	p-value
001	-1.343	0.241	-2.258	0.751	-0.830	0.565	-0.918	0.530
022	-2.023	0.022**	-3.746	0.510	-4.270	0.003**	-3.069	0.079
024	-1.299	0.267	-3.647	0.527	-2.874	0.056	-3.904	0.023**
025	-0.924	0.540	-3.152	0.613	-0.565	0.652	-0.495	0.643
034	-1.711	0.079	-2.754	0.678	-3.018	0.044**	-1.295	0.426
035	-1.163	0.360	-1.857	0.804	-2.293	0.138	-1.500	0.372
036	-0.321	0.896	0.307	0.965	-2.039	0.192	-0.771	0.570
037	-1.154	0.366	-2.718	0.683	-1.265	0.417	-0.558	0.627
042	-1.549	0.135	-4.257	0.421	-2.993	0.046**	-3.758	0.030**
044	-1.483	0.165	-4.462	0.386	-3.248	0.028**	-4.838	0.004**
047	-1.393	0.212	-2.566	0.707	-2.814	0.062	-3.469	0.046**
048	-0.345	0.888	-0.491	0.927	0.474	0.900	0.562	0.864
054	-1.291	0.272	-1.612	0.832	-2.319	0.133	-1.420	0.393
056	-0.562	0.787	-0.991	0.892	-0.565	0.652	-0.374	0.674
057	-1.708	0.080	-1.623	0.831	-2.703	0.075	-1.654	0.332
058	-0.677	0.718	-0.943	0.896	-1.047	0.491	-0.656	0.601
061	-1.135	0.380	-2.677	0.690	-2.057	0.187	-2.352	0.180
062	-1.040	0.452	-2.475	0.720	-1.931	0.218	-2.893	0.099
071	-1.783	0.060	-2.675	0.690	-2.277	0.141	-1.178	0.458
072	-1.686	0.086	-1.620	0.831	-2.935	0.051	-1.401	0.398
073	-1.834	0.050	-4.934	0.309	-2.647	0.082	-2.689	0.125
075	-1.578	0.124	-3.282	0.590	-3.384	0.022**	-4.110	0.017**
081	-2.177	0.011**	-8.254	0.025**	-4.566	0.001**	-8.019	0.000**
091	-1.268	0.288	-3.546	0.545	-2.767	0.067	-3.699	0.033**
098	-0.722	0.688	-2.255	0.752	-1.887	0.229	-2.762	0.115

Notes:

1. The Westerlund and Edgerton (2007) tests take no cointegration as the null, and the test regression is fitted with a constant and one lag and lead.
2. G_τ and G_a are group mean statistics that test the null hypothesis of no cointegration against the alternative hypothesis of cointegration among some of the selected countries. P_τ and P_a are the panel statistics that test the null of no cointegration against the alternative hypothesis of cointegration among all of the selected countries.
3. ** statistically significant at 5% level.

Table 8 summarises the panel cointegration results. The results show that all of the tests statistics cannot reject the null of no cointegration at 5% significance level except for the food commodities of 022, 024, 034, 042, 044, 047, 075, 081 and 091. Some of the tests statistics reject the null hypothesis of no cointegration at 5% significance level. This implies that there is a long-run equilibrium relationship between food exports and imports for food commodities 022, 024, 034, 042, 044, 047, 075, 081 and 091.

4.3.3 OLS, DOLS and FMOLS Tests

After confirming that food exports and imports of food commodities 022, 024, 034, 042, 044, 047, 075, 081 and 091 are cointegrated in Westerlund's cointegration tests, the study estimated equations (26, 27 and 28) by using the method of OLS, DOLS and FMOLS. The study tested whether the cointegration coefficient of β is significantly different from 0 and insignificantly different from 1. The results are presented in Table 9.

For food commodities 022, 024, 042, 044 and 081, findings from Table 9 indicate that the null hypothesis of $\beta=0$ and $\beta=1$ are both rejected at 5% significance level for the estimations from OLS, DOLS and FMOLS. These empirical results show that food exports and food imports are cointegrated with the cointegrating coefficient of $0<\beta<1$, implying that the food trade for these food commodities are weakly sustainable in ASEAN-4 countries.

Table 9: OLS, DOLS and FMOLS Tests

Food Commodities	Test statistics	OLS	DOLS	FMOLS
022	Coefficient	0.9059	0.9097	0.9025
	H_0: β = 1	179.2435**	68.1174**	195.5637**
	H_0: β = 0	16614.23**	6914.146**	16766.24**
024	Coefficient	0.7696	0.7697	0.7660
	H_0: β = 1	1351.962**	334.9085**	1022.485**
	H_0: β = 0	15100.37**	3744.700**	10967.18**
034	Coefficient	1.0127	1.0280	1.0242
	H_0: β = 1	1.5164	2.5936	17.4804**
	H_0: β = 0	9596.513**	3494.251**	31296.40**
042	Coefficient	0.7803	0.7662	0.8726
	H_0: β = 1	33.0357**	14.0035**	59.3578**
	H_0: β = 0	416.9775**	150.4264**	2785.979**
044	Coefficient	0.8267	0.8491	0.8462
	H_0: β = 1	104.3212**	21.1786**	286.7649**
	H_0: β = 0	2375.472**	671.0053**	8680.833**
047	Coefficient	0.9529	0.9853	0.9680
	H_0: β = 1	4.4564**	0.1389	13.1814**
	H_0: β = 0	1826.065**	627.3140**	12116.92**
075	Coefficient	1.0000	1.0159	0.9983
	H_0: β = 1	5.1448	0.3835	0.0587
	H_0: β = 0	6826.625**	1562.888**	21210.93**
081	Coefficient	0.9379	0.9391	0.9373
	H_0: β = 1	238.15**	75.64**	1807.15**
	H_0: β = 0	54440.52**	18007.28**	403641.70**
091	Coefficient	1.0527	0.9780	1.0650
	H_0: β = 1	7.5089**	0.3492	140.5256**
	H_0: β = 0	2990.955**	690.1002**	37664.55**

Notes:

1. ** indicate reject the null hypothesis at 5% significant level.
2. Estimation of DOLS is based on pooled data with 1 lag and 1 lead of first differenced explanatory variables.
3. Estimation of FMOLS is based on a group-mean panel of first differenced explanatory variables.

However, the results of the tests from OLS, DOLS and FMOLS for food commodity 075 cannot reject the null hypothesis of β=1 and the null hypothesis of β=0 at 5% significance level. Thus, it can be concluded that food exports and food imports for food commodities 075 is cointegrated with the cointegrating coefficient of β=1, suggesting the food trade for this food commodities are a strong form of sustainability.

Furthermore, for food commodity 034, the results show that only the FMOLS test rejects the null hypothesis of $\beta=1$ while the null hypothesis of $\beta=0$ is rejected for all of the tests at 5% significance level. For food commodities 047 and 091, the study found that OLS and FMOLS tests reject both the null hypothesis of $\beta=1$ as well as the null hypothesis of $\beta=0$ at 5% significance level for all of the three tests. There are mixed results from these three tests for the null hypothesis of $\beta=1$. As pointed by Kao and Chiang (1998), the OLS estimator has a non-negligible bias in finite samples and the DOLS estimator may be more promising than OLS or FMOLS estimators in estimating panel regressions. From the DOLS test, it can be concluded that food exports and food imports for food commodities 034, 047, 075 and 091 are cointegrated with the cointegrating coefficient of $\beta=1$, implying that the food trade conditions for these food commodities are strongly sustainable.

CHAPTER 5

CONCLUSION

5.1 Introduction

The objectives of the study are to examine the long-run equilibrium relationship of food exports and imports and to investigate the food trade sustainability in ASEAN-4 countries. Therefore, this chapter summarises and concludes the findings of the study during the period from 1996 to 2014. Further, it will also discuss the policy recommendations and limitations of the study.

5.2 Conclusion

Food trade is vitally important for food security in ASEAN-4 countries as food trade not only has the potential to promote economic growth and eliminate hunger, it can also increase the quantity and varieties of food available. However, the two food price hikes in 2007 to 2008 and 2010 to 2011 affected people's ability to buy enough healthy food. The unprecedented increase in prices of food commodities, particularly of rice, wheat, soy and maize in the world market resulted in an increase in the cost of food imports and import bills especially for countries that relies on the food imports. Therefore, the purposes of this study are to examine the long-run equilibrium relationship of food trade and investigate the food trade sustainability condition for ASEAN-4 countries.

In contrast to most previous empirical analyses, this study used panel data to test the long-run relationship and sustainability of exporting and importing of food for

ASEAN-4 countries. The advantage of the panel data approach is that it can combine information from time series and cross-section data. Secondly, it can increase the degrees of freedom and thirdly, it can reduce the collinearity among explanatory variables (Hsiao, 1986). In this study, the study adopted the theoretical model from Hakkio and Rush (1991) and Husted (1992) on 4 selected ASEAN countries (Indonesia, Malaysia, Philippines, Thailand) for the period from 1996 to 2014. Secondary data is used in this study. 25 food commodities of Standard International Trade Classification (SITC) Revision 2 (3-digit) for food exports and imports are selected from United Nations Commodity Trade Statistics (UNCOMTRADE) for aggregate and disaggregate study.

In the aggregate study, the model proposed by Husted (1992) was estimated using Kao (1999) and Pedroni (1999) cointegration tests to analyse the long-run relationship between food exports and imports while OLS, DOLS and FMOLS approaches were applied to examine the sustainability of the food trade of ASEAN-4 countries. Before performing the cointegration test, the stationary status of all variables should be tested to verify their order of integration. First, the study tested the unit root by using the root tests by Im, Pesaran and Shin (1997), and also Maddala and Wu (1999) to confirm the stationary of both variables before the cointegration test can be performed. The study found that all tests in both with and without time trends strongly reject the null of unit root at first difference for study periods.

Next, after confirming that both variables are non-stationary at level and stationary at first difference, the study continued with the panel cointegration approaches by Kao (1999) and Pedroni (1999). Both tests were performed to explore the existence of the long-

run relationship between food exports and imports. In Kao's cointegration test results, the coefficient of variables is statistically significant at 5% significance level with the value of -3.157766 (0.0008). Also with the similar results, Pedroni cointegration test provides strong evidence against the null of no cointegration for six out of seven test statistics at 5% significance level. Therefore, it can be concluded that there is a long-run cointegration between food exports and imports for ASEAN-4 countries at the aggregate study. In the sense of Husted (1992), ASEAN-4 food trade is not in violation of its international budget constraint and trade imbalance is a short-run phenomenon which means it is sustainable in the long-run. In other words, although food exports and imports may diverge in the short-run, the equilibrium conditions in the long-run will be achieved due to several macroeconomic adjustments and policies to ensure sustainability. In addition, the present macroeconomic policies have been implemented effectively in bringing food exports and imports into a long-run equilibrium.

Meanwhile, in order to confirm the Husted's hypothesis of sustainability of the variables, the study applied the method of OLS, DOLS and FMOLS. The results indicate that the null hypothesis of $\beta=0$ and $\beta=1$ are both rejected at 5% significance level for the estimates from OLS and FMOLS. These empirical results show that food exports and food imports are cointegrated with the cointegrating coefficient of $0<\beta<1$, implying that the food trades are weakly sustainable in ASEAN-4 countries. Meanwhile, DOLS test shows that the null hypothesis of $\beta=1$ cannot be rejected and the null hypothesis of $\beta=0$ can be rejected at 5% significance level. Thus, it can be concluded that food exports and food imports are cointegrated with the cointegrating coefficient of $\beta=1$, suggesting the food trades for these food commodities are a strong form of sustainability. There are mixed

results from these three model tests for the null hypothesis of β=1. Kao and Chiang (1998) pointed out that the OLS estimator has a non-negligible bias in finite samples and the DOLS estimator may be more promising than OLS or FMOLS estimators in estimating panel regressions. According to Kao and Chiang (2000), DOLS method is a more robust test in which it can correct for possible simultaneity bias among the regressors by the inclusion of lagged and lead values of the first difference in the regressors. Therefore, it can be concluded that food export and import at aggregate study are cointegrated with the cointegrating coefficient of β=1, implying that the food trade conditions in ASEAN-4 are strongly sustainable.

In the disaggregate study, the study applied Im, Pesaran and Shin (1997), and Maddala and Wu (1999) unit root tests to test the order of integration at level and first differences of the variables. The results reveal that there is a mixture of stationarity for both variables at most of the food commodities. Due to the different integrations among variables, the study applied the four new panel cointegration tests developed by Westerlund (2007). Unlike residual-based cointegration tests, these tests are free from common factor restriction. Common factor restriction is the requirement that the long-run cointegrating vector for the variables in their levels is equal to the short-run adjustment process for the variables in their first differences (Kremers et al, 1992). The results show that all of the tests statistics cannot reject the null of no cointegration at 5% significance level except for the food commodities of 022, 024, 034, 042, 044, 047, 075, 081 and 091. Some of the tests statistics reject the null hypothesis of no cointegration at 5% significance level. This implies that there is a long-run equilibrium relationship between food exports and imports for food commodities 022, 024, 034, 042, 044, 047, 075, 081 and 091.

After confirming that food exports and imports of food commodities 022, 024, 034, 042, 044, 047, 075, 081 and 091 are cointegrated in Westerlund's cointegration tests, the study applied the method of OLS, DOLS and FMOLS.to test whether the cointegration coefficient of β is significantly different from 0 and insignificantly different from 1. The findings indicate that the null hypothesis of β=0 and β=1 are both rejected at 5% significance level for the estimations from OLS, DOLS and FMOLS for food commodities 022, 024, 042, 044 and 081. These empirical results show that food exports and food imports are cointegrated with the cointegrating coefficient of $0<\beta<1$, implying that the food trades for these food commodities are weakly sustainable in ASEAN-4 countries.

Meanwhile, for food commodity 075, the results of the tests from OLS, DOLS and FMOLS cannot reject the null hypothesis of β=1 and reject the null hypothesis of β=0 at 5% significance level. Thus, it can be concluded that food exports and food imports for food commodity 075 are cointegrated with the cointegrating coefficient of β=1, suggesting the food trades for this food commodities are a strong form of sustainability.

Furthermore, for food commodity 034, the results of the null hypothesis of β=1 is only rejected for the FMOLS test while the null hypothesis of β=0 is rejected for all of the tests at 5% significance level. For food commodities 047 and 091, the study found that OLS and FMOLS tests reject the null hypothesis of β=1 and the null hypothesis of β=0 at 5% significance level for all of the three tests. There are mixed results from these three tests for the null hypothesis of β=1. As pointed by Kao and Chiang (1998), the OLS estimator has a non-negligible bias in finite samples and the DOLS estimator may be more promising than OLS or FMOLS estimators in estimating panel regressions. From the

DOLS test, it can be concluded that food exports and food imports for food commodities 034, 047, 075 and 091 are cointegrated with the cointegrating coefficient of $\beta=1$, implying that the food trade conditions for these food commodities are strongly sustainable.

5.3 Policy Recommendations

From the results of this study, ASEAN-4 shows a weak form of food trade sustainability. Weak sustainability in food trade worsens the effects of food trade sustainability which will be visible at some point in the future. Therefore, a range of effective policies can be established to improve the opportunities of trade imbalances in these countries.

Firstly, trade is vital in ensuring regional food security. Relying on the market to meet food needs is an unreliable strategy because of the volatility of food prices. Thus, the policymakers should make an effort to reduce the dependency of production on imported food and develop strategies that will ensure self-sufficiency such as food policy and regulations that could improve the level of economic efficiency in food production to curb food crisis. Additionally, policymakers should also review the price regulation on food commodities so that it can buffer the future risk of market speculation. For example, reorganising the food market to regulate food prices and also provide food safety nets aimed at reducing the impacts of rising food prices and food shortage.

Secondly, to improve the quantity and quality of food production, measures such as R&D intensification, technology transfer, and extension services have to be conducted consistently. These investments will, directly and indirectly, help the food producers and

overall ensure food supply. It is crucial for the government to subsidies and identify the weaknesses in the agricultural supply chain. Proactive action is also necessary for the farmers to move from subsistence farming to commercial farming which will improve the income and food production of ASEAN-4 nations in the long-run.

Finally, urban agriculture is one of the initiatives and incentives that can be done by the ASEAN-4 governments to improve the availability and quality of adequate food among the urban population. Furthermore, urban agriculture could provide green space as well as balance the ecosystem and the heat of the city. This will indirectly reduce the impacts of climate change on agricultural.

5.4 Limitations of the Study

Based on the findings and discussions of this study, several limitations and shortcomings were identified. First of all, this research was designed to focus only on the four ASEAN countries namely Indonesia, Malaysia, Philippines and Thailand. The main underlying reason for choosing these four countries is due to its similarity in term of socio-economic development progress since the 1970s. Other countries of ASEAN such as Singapore, Brunei, Laos, Cambodia, Vietnam and Myanmar were not included because of two reasons.

Firstly, Singapore and Brunei have small populations, high per capita income and economic structure dominated by industry and trade. Secondly, Vietnam, Laos, Cambodia and Myanmar were not included because of incomplete data available for the study period.

As this study used disaggregates data which is SITC Revision 2 (3-digit), there are a few food commodities which were dropped from this study due to the lack of data available for certain periods.

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