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Assessing the Role of Trade and Reserve Cooperation in the Food Price Dynamics: Indonesia in the Regional and Global Economic Architecture

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Abstract

The dissertation discusses the potential roles of trade and food reserve cooperation among countries in pursuing more stable food prices, with a special focus on Indonesia. The study starts by analyzing food price movements in Indonesia and proposes a new approach in detecting food price crisis in the country. Using monthly retail rice prices from the 25 major markets in Indonesia, the key markets whose price movements can help to forecast price movements in all other markets are identified using granger-causality tests that are conducted under the vector error correction model framework. The relevance of monitoring the key markets in detecting price crisis is tested using Probit and Poisson models. The study found that albeit not all of alert phases lead to crises, monitoring the key markets can help to forecast price movements in all markets across the country.

The dissertation continues by reviewing the role of the Association of Southeast Asian Nations (ASEAN) cooperation in stabilizing food prices. The study found that reserve-based price stabilization policy has been an integral part of the development agenda of countries in Southeast Asia for decades and contributed to price stability which is associated with economic successes in the region. However, the operational cost for such policy is high and may result in economic inefficiency. Simulation shows that regional cooperation through risk sharing can significantly reduce the required stocks which will definitely reduce the costs of holding them. When transportation cost is considered due to decentralized storage in different countries, the study found that participating countries are still benefited from the cooperation.

Further, the dissertation investigates the role of the World Trade Organization (WTO) and Regional Trade Agreements (RTAs) in enhancing food trade at the global and regional market. The study employs the gravity model of international trade that is developed in a large panel data setting, which consists nearly all countries in the world. Empirical results suggest that the WTO and RTAs indeed have enhanced trade among the members, but not yet on the food sector. Only RTAs are found to have increased food trade among their member countries, whereas no evidence can be found that the WTO has also enhanced food trade among the members. Nevertheless, the study found that the WTO has promoted trade as well as food trade of the developing countries more than of the developed ones.

Zusammenfassung

Diese Dissertation diskutiert die möglichen Rollen von Handel und der Kooperation bei Nahrungsmittelreserven zwischen Staaten, mit dem Ziel die Nahrungsmittelpreise zu stabilisieren. Dabei liegt ein spezieller Fokus auf Indonesien. Diese Studie analysiert zunächst die Bewegungen von Nahrungsmittelpreisen in Indonesien und schlägt einen neuen Ansatz vor, um Nahrungsmittelpreiskrisen in dem Land frühzeitig zu erkennen. Für die Analyse werden monatliche Daten von Einzelhandelspreisen der 25 größten Märkte in Indonesien verwendet. Anhand der Daten von den wichtigsten Märkten können Preisbewegungen in allen anderen Märkten vorher gesagt werden. Dafür werden Granger Causality Tests in einem Vector Error Correction Model (VECM) durchgeführt. Die Relevanz der wichtigsten Märkte für die Erkennung von Preiskrisen wird durch Probit- und Poisson-Modelle getestet. Diese Studie kommt zu dem Resultat, dass, obwohl nicht jede Warnung zu einer Preiskrise geführt hat, die Überwachung der wichtigsten Märkte sehr wohl dabei helfen kann die Preisbewegungen in allen Märkten des Landes zu beobachten.

Die Dissertation setzt durch die Überprüfung der Rolle der Vereinigung Südostasiatischer Staaten (ASEAN) die Zusammenarbeit bei der Stabilisierung der Lebensmittelpreise. Die Studie fand heraus, dass Preisstabilisierungsstrategien basierend auf Nahrungsmittelreserven sind schon seit Dekaden wichtige Säulen in der Entwicklungsagenda Südostasiatischer Staaten und tragen zur Preisstabilität und damit auch zu der ökonomischen Entwicklung in der Region bei. Jedoch sind die operativen Kosten dieser Strategie sehr hoch und es können ökonomische Ineffizienzen entstehen. Simulationen zeigen, dass das Teilen von Risiken durch regionale Kooperationen signifikant die im Notfall benötigten Lagermengen reduzieren kann und damit auch die Lagerhaltungskosten senkt. Selbst wenn die Transportkosten durch dezentrale Lagerhaltung in den jeweiligen Ländern hinzu gezogen werden, profitieren teilnehmende Staaten.

Zudem untersucht diese Dissertation die Rolle die World Trade Organization (WTO) und Regional Trade Agreements (RTAs) bei der Verbesserung von Nahrungsmittelhandel auf dem globalen und regionalen Markt. Diese Studie bedient sich dabei an einem Gravitätsmodell für internationalen Handel und analysiert. Das Modell wurde anhand eines umfangreichen Panel Datensatzes erstellt, der nahezu sämtliche Staaten der Welt umfasst. Die empirischen Ergebnisse legen nahe, dass die WTO und RTAs durchaus einen handelsverstärkenden Effekt zwischen den jeweiligen Mitgliedern haben, was jedoch noch nicht für den Nahrungsmittelsektor gilt. Nur die RTAs erhöhen den Nahrungsmittelhandel zwischen ihren Mitgliedern. Für die WTO konnten diese Ergebnisse nicht bestätigt werden. Nichtsdestotrotz, diese Studie zeigt dass die WTO sowohl den Handel als auch den Nahrungsmittelhandel in Entwicklungsländer stärker fördert als in entwickelten Ländern.

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Abbreviations

AERR	ASEAN Emergency Rice Reserve
AFSR	Agreement on Food Security Reserve
AFTA	ASEAN Free Trade Area
APEC	Asia Pacific Economic Cooperation
APTERR	ASEAN plus three emergency rice reserve
ASEAN	Association of Southeast Asian Nations
BPS	*Badan Pusat Statistik* (Statistics Indonesia)
BULOG	*Badan Urusan Logistik* (National Logistics Bureau)
EAERR	East Asia Emergency Rice Reserve
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Statistic Division
FTA	Free Trade Agreement
GATT	General Agreements on Tariffs and Trade
GDP	Gross Domestic Product
GIEWS	Global Information and Early Warning System
HIC	High Income Countries
HLPE	High-Level Panel of Experts on Food Security and Nutrition
IGC	International Grains Council
IJEPA	Indonesia Japan Economic Partnership Agreement
ILOSTAT	International Labor Organization Statistic Division
IMF	International Monetary Foundation
LIC	Low Income Countries
LMIC	Lower Middle Income Countries
NFA	National Food Authority
NGA	National Grain Authority
RCA	Rice and Corn Administration
RCEP	Regional Comprehensive Economic Partnership
RICOB	Rice and Corn Board

RTA	Regional Trade Agreement
TPP	Trans Pacific Partnership
TRAINS	Trade Analysis Information System
UR	Uruguay Round
UMIC	Upper Middle Income Countries
UNCTAD	United Nations Conference on Trade and Development
UN DESA	United Nations Department of Economic and Social Affairs
UNICEF	United Nations Children's Fund
USDA	United States Department of Agriculture
WHO	World Health Organization
WITS	World Integrated Trade Solutions
WTO	World Trade Organization

Chapter 1. Introduction

1.1. Background

After enjoying relatively stable food prices for many years since the last global crisis in the mid-1970s, the world has been experiencing rapid food price increases, coupled with several spikes in recent years. Starting to rise in the mid-2007, reaching a twin peak in mid-2008 and in early-2011, global food prices have been relatively more volatile since then (von Braun and Tadesse, 2012). Uncertainty as a result of the excessive price volatility poses major challenges to policy makers, especially those in the developing countries who are facing increasing potential food and nutrition insecurity as well as political and economic risks in their countries. The food price crises encumbered economic growth in many poor countries (Jacks et al., 2011), weakened peoples' food and nutrition security (Tiwari and Zaman, 2010), and drove an additional 105-150 million people into poverty (de Hoyos and Medvedev, 2011). Furthermore, an unanticipated price crisis can induce political instability by the incidence of political riots and civil conflicts (Arezki and Brückner, 2014).

The responses of many countries, however, are often met with uncoordinated national policy adjustments with international implications that may destabilize prices further (Martin and Anderson, 2012; von Braun et al., 2014). Among the fundamental factors that have been observed as drivers of the excessive food price volatility such as climate change, bio-fuel policies, and speculation in commodity markets (see for example von Braun and Tadesse, 2012; Gilbert 2010; Abbot et al., 2011), export restrictions and aggressive imports introduced by countries' concern about food security are believed also to be among the main key drivers of the excessive food price volatility, especially in the 2007/2008 food price crises (World Bank, 2010).

Trade policy is often used as a means to reduce high and volatile international commodity prices. However, a number of studies have shown that the results are often the contrary. Brahmbhatt and Christiaensen (2008) who investigated the rising food prices in East Asia found that upward pressure on grain prices from bio-fuel policies, rising energy costs, and the falling US dollar have been exacerbated by export restrictions introduced by rice-exporting countries concerned

about food security. Anderson and Nelgen (2012) show that export restrictions by food-exporting countries are a means to reduce high food prices were often accompanied by 'panic buying' within numerous food-importing countries, resulting in even higher international prices.

The crisis has shown that shocks in one part of the world spread easily to the other parts and disrupt the entire global food system. Policy responses imposed by one country also have impacts on many other countries. In this sense, food price volatility is an international issue requiring international actions. Strengthening national policies alone is not sufficient to achieve more stable food prices. Enhancement of regional and international collaboration to prevent food prices from extreme volatility is critical. However, it remains unknown to what extent the coordination and cooperation among countries can be achieved as well as their effectiveness to address the problem. This dissertation aims to address this issue by assessing the role of cooperation among countries in pursuing more stable food prices with the case study of Indonesia and its cooperation in the regional and global economic architecture.

1.2. Indonesia in the Regional and Global Economic Architecture

Indonesia is the largest economy in Southeast Asia and a member of the G-20. Trade plays a significant role in the economy, contributing roughly 15 percent to GDP[1]. The country can be considered an open economy, with the average most favored tariff of 7 percent[2]. Exports have grown from USD 120 billion in 2009 to USD 203.6 billion in 2011[3]. However, Indonesia's weak export performance resulted in a trade deficit in 2012, its first annual deficit since the late 1960s[4].

Indonesia is examining its future economic diplomacy options to accomplish more gains from trade. In addition to multilateral negotiations under the World Trade Organization (WTO), Indonesia is engaging in the bilateral and regional trade cooperation. Bilaterally, Indonesia has an agreement with Japan in the framework of the Indonesia-Japan Economic Partnership (IJEPA). At the regional level, Indonesia is part of the ASEAN Free Trade Area (AFTA),

[1] 2011 figure based on 2000 constant price. BPS, 2012
[2] 2011 figure, http://stat.wto.org/CountryProfiles/ID_E.htm accessed on May 1, 2013
[3] www.kemendag.go.id accessed on March 1, 2013
[4] The Economist, February 23 – March 1, 2013

ASEAN-China FTA, ASEAN-India FTA, ASEAN-Korea FTA, and ASEAN-Australia-New Zealand FTA.[5]

Indonesia is also in various stages of bilateral negotiations with many other countries, such as India, Korea, Australia, and the European Union. Furthermore, in the margins of the East Asia Summit in Phnom Penh, Cambodia, in November 2012, together with other ASEAN countries and their six partners, Indonesia launched Regional Economic Comprehensive Partnership (RCEP)[6] negotiations. With a combined market of more than 3 billion people and a GDP of about USD 20 trillion[7], RCEP would be the largest regional trade cooperation in the world. RCEP is an ASEAN-led process and would be open to accession by other countries after the completion of negotiations with its 6 partners[8].

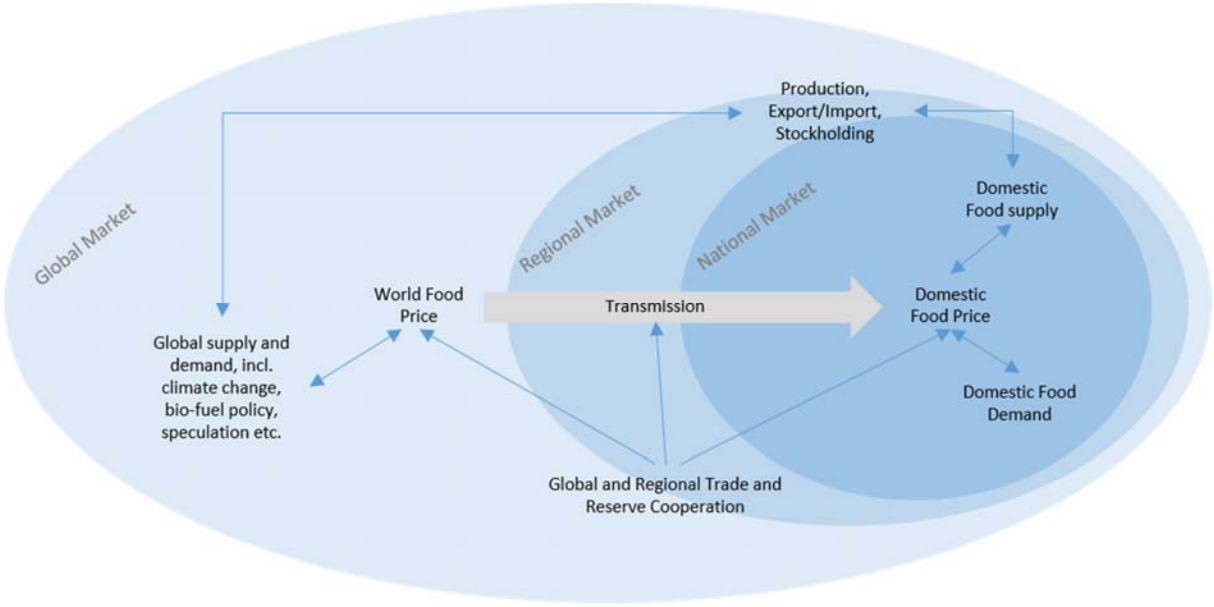
Another trade talk that may offers potential for Indonesia is the Trans Pacific Partnership (TPP), which links Pacific countries in the Americas and the Asia Pacific through international trade. The original signatories were Brunei, Chile, Singapore, and New Zealand. The United States, Australia, Peru, and Vietnam joined the negotiations in 2008, Malaysia in 2010, Mexico and Canada in 2012, and Japan in 2013. Several other countries have also announced their interest in joining the TPP negotiations, namely Colombia, the Philippines, Thailand, Taiwan, and South Korea. However, although participating countries set the goal to conclude the agreement in 2012, the negotiation continues today[9]. Nevertheless, with some of the RCEP participating countries involved in TPP negotiations, both processes provide possible pathways to a free trade area of the Asia Pacific and might inspire global trade talks[10]. However, observers often put TPP and RCEP in competing camps, with the former favored by the United States and the latter by China (Hiebert, 2012).

[5] www.kemendag.go.id accessed on March 1, 2013
[6] RCEP participating countries are ASEAN countries (Brunei, Burma, Cambodia, Indonesia, Laos, Malaysia, Singapore, Thailand, Philippines, Vietnam) plus their six partners (Australia, China, India, Japan, New Zealand and South Korea)
[7] Based on 2011 figures
[8] www.asean.org, accessed on March 1, 2013
[9] August 2015
[10] After several years of deadlock to conclude the Doha Development Agenda, the 9th WTO ministerial meeting in Bali, Indonesia December 2013 was successful in delivering the first trade agreement in the history of the WTO, as agreed by all member countries.

1.3. Objectives of the Study

The dissertation aims to analyze the roles of trade and food reserve cooperation in mitigating the excessive food price volatility and pursuing more stable food prices. The conceptual framework of the study is shown as follows:

Figure 1.1. Conceptual Framework



Source: Own illustration

As shown above, domestic food prices are fundamentally determined by domestic food demand and supply. Food supply comes from production and trade, including food reservation through government and private stockholding. The national market is part of bigger markets: regional and global. Therefore, domestic price is also connected to the world price through international trade. This world food price is influenced by many factors. In addition to global food demand and supply, studies found that other factors such as climate change, bio-fuel policy, trade policy, and speculation may also drive prices (von Braun and Tadesse, 2012; Gilbert 2010; Abbot et al., 2011).

The focus of the study is analyzing the relation between international trade and food prices. It investigates whether global and regional trade cooperation can help to facilitate more stable food

prices. In order to achieve this objective, the investigation is conducted at three levels of analytical inquiry: national, regional, and international levels. The study aims to answer the following research questions:

1. What are the characteristics of food price movements in terms of volatilities, spikes, and trends in the different markets in Indonesia? Can the price crisis in the different markets in Indonesia be detected through an efficient approach?
2. To what extent can regional trade and reserve cooperation help in pursuing more stable regional food prices?
3. To what extent do multilateral and regional trade agreements contribute to enhance food trade in the global and regional markets?

1.4. Structure of the Dissertation

The dissertation begins with an analysis at the national level. Following this introduction chapter, Chapter 2 presents the analysis of food price dynamics in Indonesia and proposes a new approach in monitoring food price movement in many different markets in the country, including forecasting potential price crises that may occur. The study applies the concept of price transmission and market integration across Indonesian provinces. Price crisis is defined from the consumer point of view, which is the price above a certain level of price that can be considered as normal. Using the monthly retail rice prices from the 25 major markets in Indonesia, the key markets whose price movements can help to forecast price movements in all other markets are identified using Granger causality tests that are conducted under the vector error correction model framework. The relevance of monitoring the key markets in detecting price crisis is tested using Probit and Poisson models.

Chapter 3 follows by reviewing the storage-based price stabilization policy in Southeast Asia and discussing its prospect in the current new era of price instability. The chapter provides information on ASEAN market structure and describes food reserve policy at the national and regional levels in ASEAN. Simulations are provided to show how countries can benefit from regional cooperation. The chapter also provides a brief discussion on public stockholding in the WTO framework.

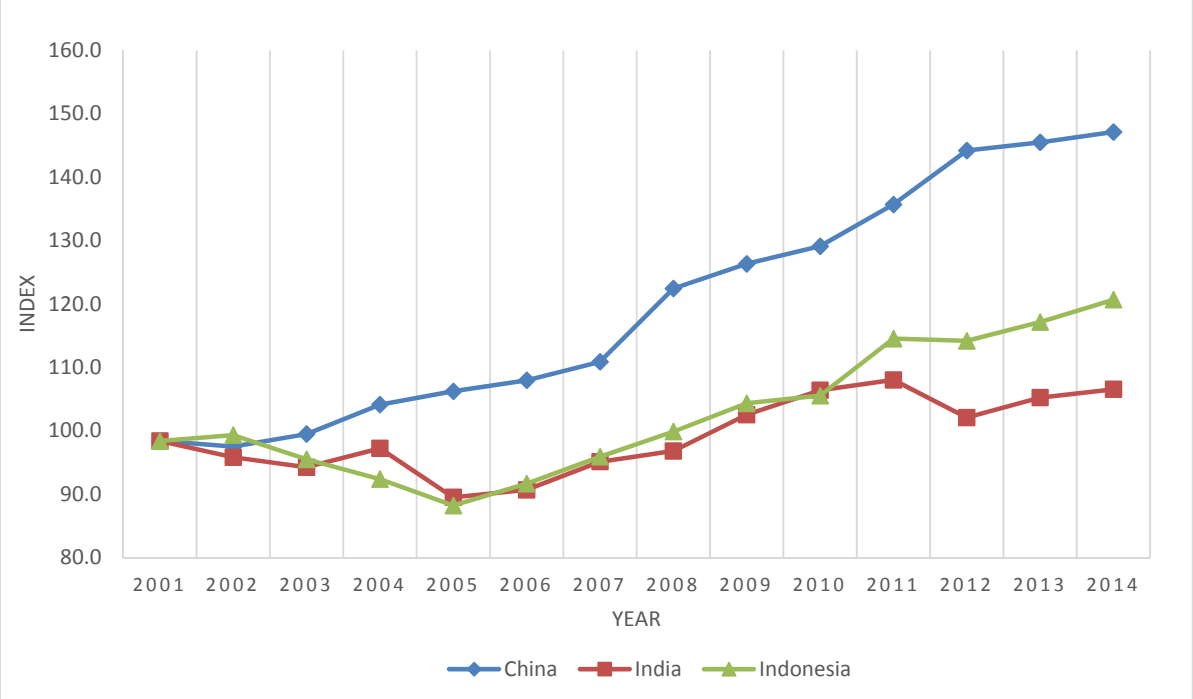
Chapter 4 investigates the contribution of the enormous number of trade agreements in bringing the world into a freer flow of food. The study employs the gravity model of international trade to analyze whether the World Trade Organization (WTO) and Regional Trade Agreements (RTAs) have enhanced member countries' food trade. The model is developed in a large panel data setting consisting of 162 countries within the time period from 1990-2012. The analysis also differentiates countries by their level of development and by region. In addition, the analysis of selected regional trade agreements around the globe is also provided. The last chapter in the dissertation provides a general conclusion.

Chapter 2. Food Price Movements in Indonesia: Detecting Crisis from the Key Markets

2.1. Background

The recent waves of the global food price crisis affect almost all countries in the world. Indonesia is no exception. It is among many countries that have experienced a steep increase in food prices in the recent years (Figure 2.1). Moreover, Indonesia has experienced high food price volatility accompanied by high risk of food and nutrition insecurity. Using the food price index data from ILOSTAT combined with anthropometric data from WHO, UNICEF, and the World Bank, Mujahid and Kalkuhl (2014) show that Indonesia is among countries that experience "high" or "very high" food price volatility as well as "high" or "very high" chronic and acute malnutrition.

Figure 2.1. Food price index of selected countries 2001 – 2014 (2000=100, real price)



Source: FAOSTAT, http://faostat3.fao.org/home/E accessed on August 18, 2015.

Notwithstanding the high economic growth in the past decade, Indonesia is still home to 30 million people living under the poverty line and an additional 65 million people vulnerable to poverty (World Bank, 2012). These poor households, who are like many others in developing countries, spend more than half of their income on food (von Braun and Tadesse, 2012). Thus, soaring food prices in recent years have reduced the purchasing power of a large part of the Indonesian population, thus threatening their food and nutrition security. In addition, although high food prices may have different impacts on poverty in different countries, studies have found that the increase of food prices raises the rate of poverty in Indonesia (Ivanic et al., 2012; Warr and Yusuf, 2013).

Furthermore, Indonesia is the largest archipelagic country in the world consisting of more than 13,000 islands; around 6,000 of them are inhabited[11]. Food markets in the country are spread in its archipelago at considerable distances. In this context, international food price dynamics might not be directly observable in all markets in the country. Thus, it is highly important to test the market integration of Indonesia to analyze how connected food prices among domestic markets are as well as their linkages with international food markets. In addition, given the peculiar geographic characteristic of the country, a sound and efficient approach to monitoring food price movements in many different markets in Indonesia is needed to better anticipate any potential occurrence of abnormal food prices in the country.

Using the concepts of price transmission and market integration, the study aims to investigate whether price movements in the many different markets in Indonesia can be monitored by focusing only on the key markets. Furthermore, the relevance of monitoring the key markets in detecting potential price crisis events in Indonesia is also investigated. The approach is based on the information provided by market price. A market is said to be efficient when its prices reflect all available information not only on the current food availability but also on agents' expectations about future scarcity (Deaton and Laroque, 1992; Ravallion, 1985). Similar to this approach, Araujo et al. (2012) use price signals to detect potential price crises in Mali, Burkina Faso, and Niger.

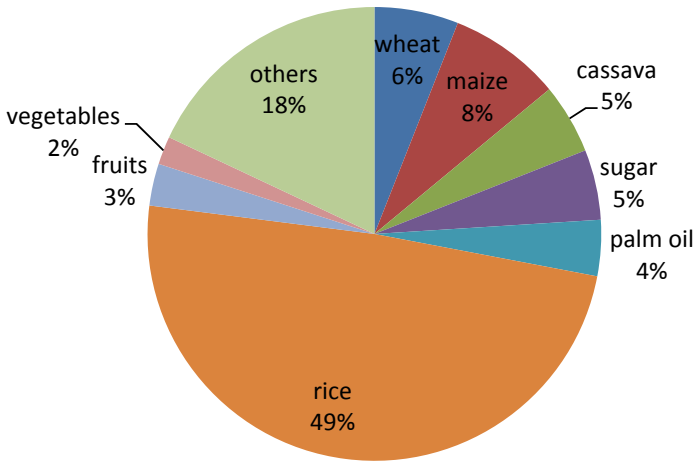
[11] *Badan Informasi Geospasial*/Geospatial Information Body http://www.bakosurtanal.go.id/ accessed December 5th, 2014.

The rest of this chapter is organized as follows: the next section provides the context of the analysis and description of price data that will be used. Section 2.3 explores the prices in the 25 markets in Indonesia to further define price crises. Section 2.4 aims to identify the key markets whose prices can be used to forecast the price movements in all other markets. In Section 2.5, the relevance of using the key markets to detect price crises is investigated. Section 2.6 concludes.

2.2. Context and Data Description

Indonesia is the largest economy in Southeast Asia and the fourth most populous country in the world[12] (UN DESA, 2013). Food supply in Indonesia mostly comes from its own production. Rice, sugar, and palm oil are the three most important agricultural commodities being produced in the country. Nevertheless, supplies of some food commodities are not met by own production, including rice, Indonesians' main staple food, which accounts for nearly half of its citizens' caloric intake[13]. Indonesia is still importing around 3 to 6 percent of its domestic rice supply to meet the country's demand (FAOSTAT, 2014).

Figure 2.2. Indonesian's per capita calorie intake 2011

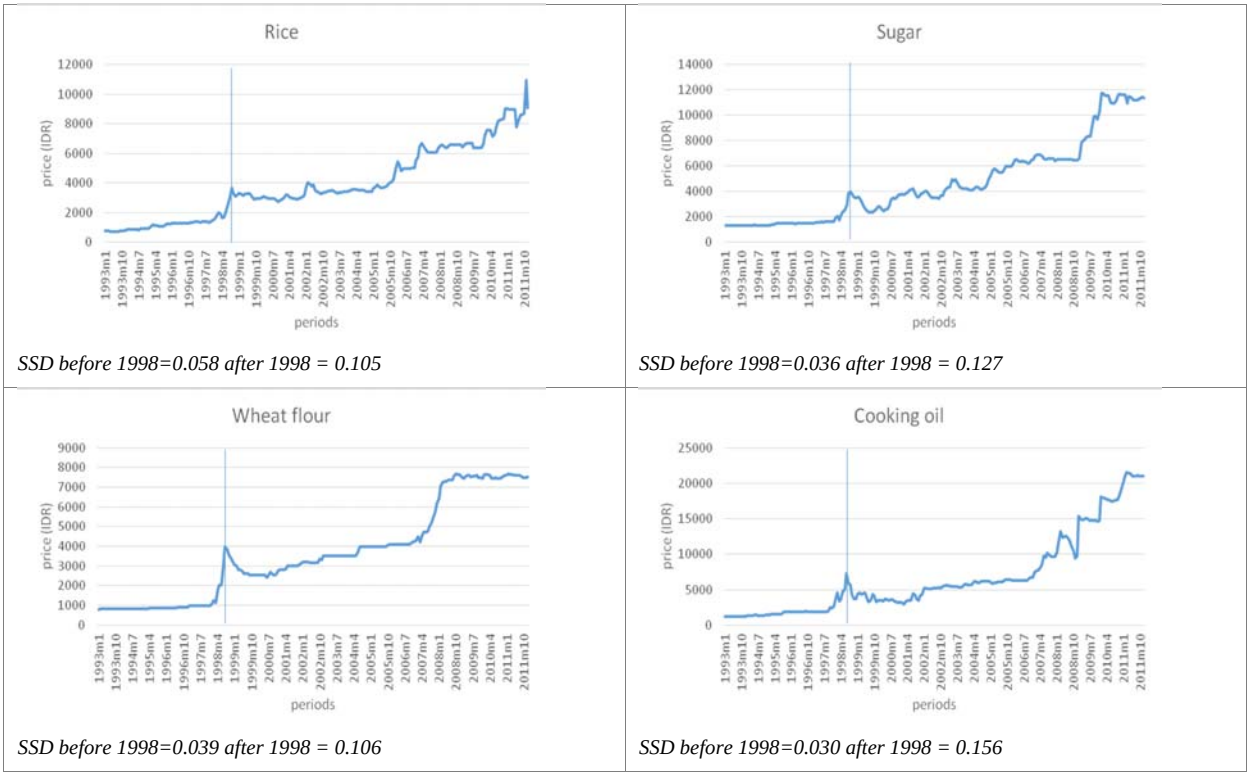


Source: own elaboration based on FAOSTAT

[12] After China, India, and USA
[13] Own estimation based on FAOSTAT.

For many years, food price stabilization in Indonesia was managed by *Badan Urusan Logistik* (BULOG), a national food reserve agency created in 1968 with a special objective to protect domestic markets from sharp fluctuations of prices in the world markets. The end of the New Order regime in the late 1990s was the emerging era of a more open trade policy in Indonesia. The country loosened its monopoly structure and created competition within the domestic market. BULOG lost its domestic power to monopolize sugar and rice trade, because Indonesia was required to comply with the IMF Letter of Intent to make the market more efficient. After finishing the engagement with IMF, Indonesia decided to shift to a more managed trade policy and started to impose tariffs on sugar and rice imports.

Figure 2.3. Prices of food commodities in Indonesia before and after major reform



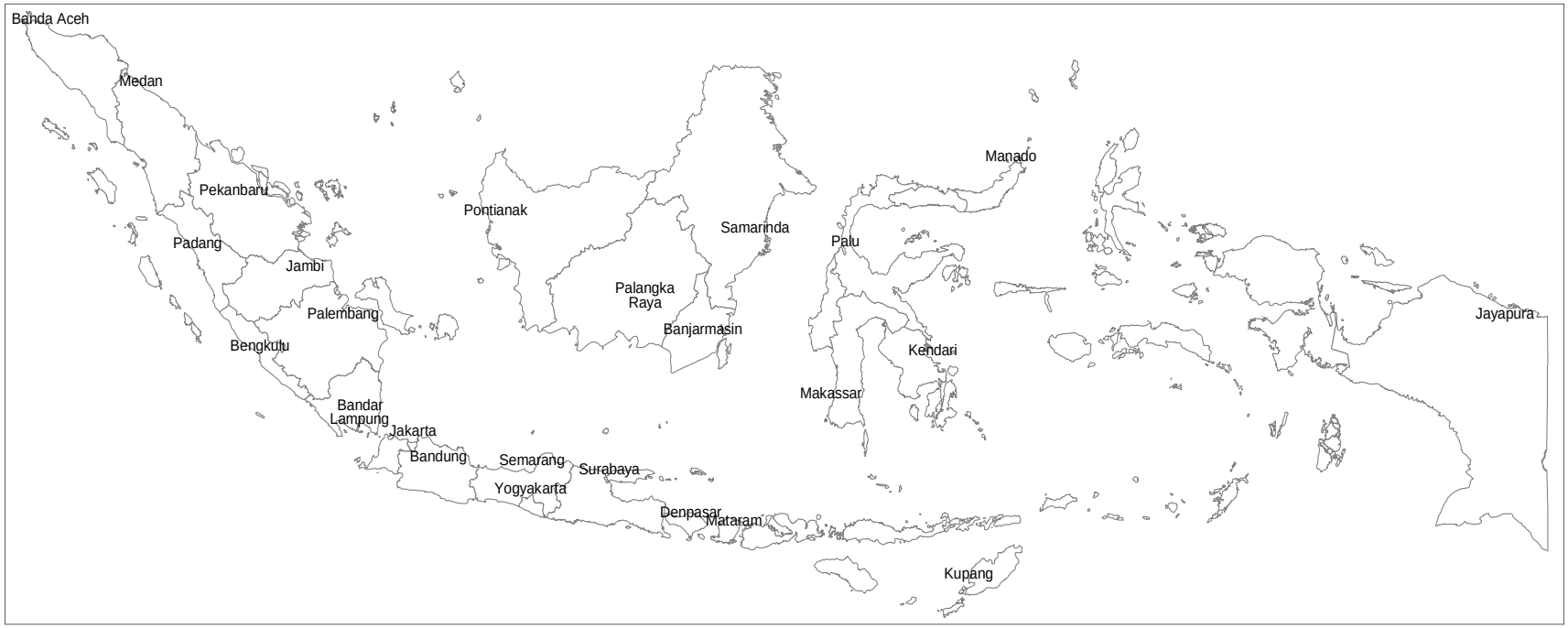
Note: SSD=Standard deviations of log of prices in difference (volatility)
Source: Own estimations based on BPS/Statistics Indonesia data

The policy was not in place long, as Indonesia started to create a more liberal economy by reducing tariffs. Since then, export-oriented policies have permeated Indonesia's agricultural trade policy. Agricultural exports increased by 16 percent on average annually during 2004-2009

(Octaviani et al., 2010). However, during this 'Reform Era' in which the market was relatively open, food prices were also relatively higher and more volatile than they were before, when BULOG had strong power to intervene in the market (Figure 2.3). Calculating the volatility using standard deviations of log of prices in difference (SSD) for some commodities including rice, sugar, wheat flour, and cooking oil shows that the SSD are much higher for the periods after 1998 compared to the periods before 1998. Nevertheless, BULOG ran at high fiscal costs. A financial audit report by Arthur Anderson covering the period from April 1993 to March 1998 suggests that the total deficit of BULOG was about 400 million USD per year (Arifin, 2008).

The focus of this study is rice, the main staple food for Indonesians. The analysis uses monthly retail rice prices from 25 major markets in Indonesia for the periods of 2000-2013. The sample markets in this study are among the 33 main markets of the capital city provinces in Indonesia, which spread in its five main islands and 30 other smaller islands (Figure 2.4). The data come from *Badan Pusat Statistik* (BPS), the national bureau of statistics of Indonesia. BPS regularly publishes the weighted average of several different types of rice that are sold in all major retail markets in Indonesia.

Figure 2.4. Sample markets



Source: Own elaboration

2.3. Analysis of Food Price Movement: How to Define Crisis

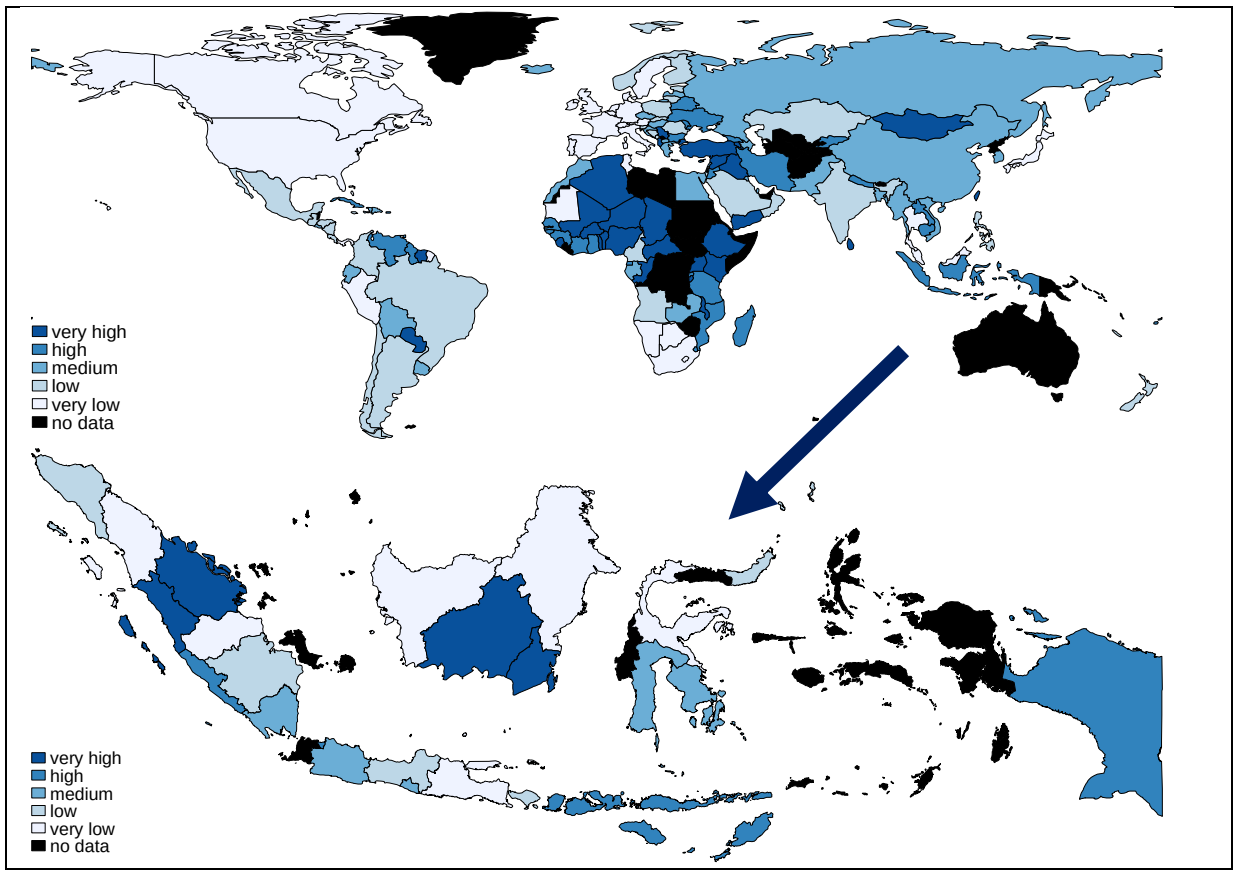
Despite the presence of a relatively well-established concept of food security[14], no common definition of food price crisis can be found in the literature (Cuesta et al., 2014). In fact, without any clear concept, the term *food price crisis* is widely known and used for analytical and operational purposes, especially in explaining the global excessive price volatility and spike events in 2008 and 2011. At this point, it is important to understand the different terms that are commonly used to explain price dynamics. Von Braun and Tadesse (2012) observed that most studies on food price dynamics focus on high food prices. They argue, however, that price movements should be distinguished in terms of *trend, volatility,* and *spike*.

A price trend is a smooth, long-term average movement of prices over time that shows the general tendency of prices for a certain period of time. Price volatility refers to frequent short-term fluctuations of the prices around a rather stable long-term price or price trend. It measures the strength and frequency of the price changes. In general, both positive and negative variations affect price volatility. Sets of methods are available in the literature to analyze price volatility. Common methods include (i) the coefficient of variation from mean or trend (Huchet-Bourdon, 2011), (ii) changes of log returns (Gilbert and Morgan, 2010), and (iii) GARCH models (Roache, 2010; Karali and Power, 2013). Price spike is another concept that is used to explain price dynamics. While volatility measures the price fluctuation (in either direction) over a certain period, price spikes are usually measured as relative changes of prices over two consecutive periods. The most common way to measure price spike is to use the logarithm of the rate of period-over-period prices.

Figure 5 shows food price volatility in global and Indonesia's food markets, estimated using the coefficient of variation from trend. The upper map shows the rate of food price volatility in different countries in the world using data from ILO for the period of 2000-2012. The countries are divided into quintiles to describe the rate of volatility, which range among the categories of very low, low, medium, high, and very high. In this map, Indonesia can be seen as among the high rates of volatility compared to all other countries.

[14] FAO concept of food security: "food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food for a healthy and active life" is considered to be widely accepted.

Figure 2.5. Food price volatility in the global and Indonesia markets



Note: The global market (upper map) uses the monthly food price index for the periods 2000 – 2012 taken from ILO database. The Indonesia market (lower map) uses monthly retail rice price data for the periods 2000 – 2013 taken from Statistics of Indonesia.
Source: Mujahid and Kalkuhl (2014) and own elaboration.

The lower map shows the food price volatility in the different markets in Indonesia using the price data taken from Statistics of Indonesia for the periods of 2000-2013. As in the upper map for the global market, the major markets in Indonesia are divided into quintiles. The map shows that Padang, Pekanbaru, Banjarmasin, and Palangkaraya experience the highest volatility among all major markets in Indonesia. Padang and Pekanbaru are two neighboring markets on Sumatera Island, while Banjarmasin and Palangkaraya are two neighboring markets on Kalimantan Island. Interestingly, that the two pairs of the highest volatility markets are neighboring with the markets that experience low volatility. A closer look into the data reveals that the rates of volatility in the different markets in Indonesia are not much different from each other. Therefore, the difference

between the lowest rate of volatility and the highest rate of volatility is very small, although they are shown in the map in different colors since the markets are divided into quintiles.

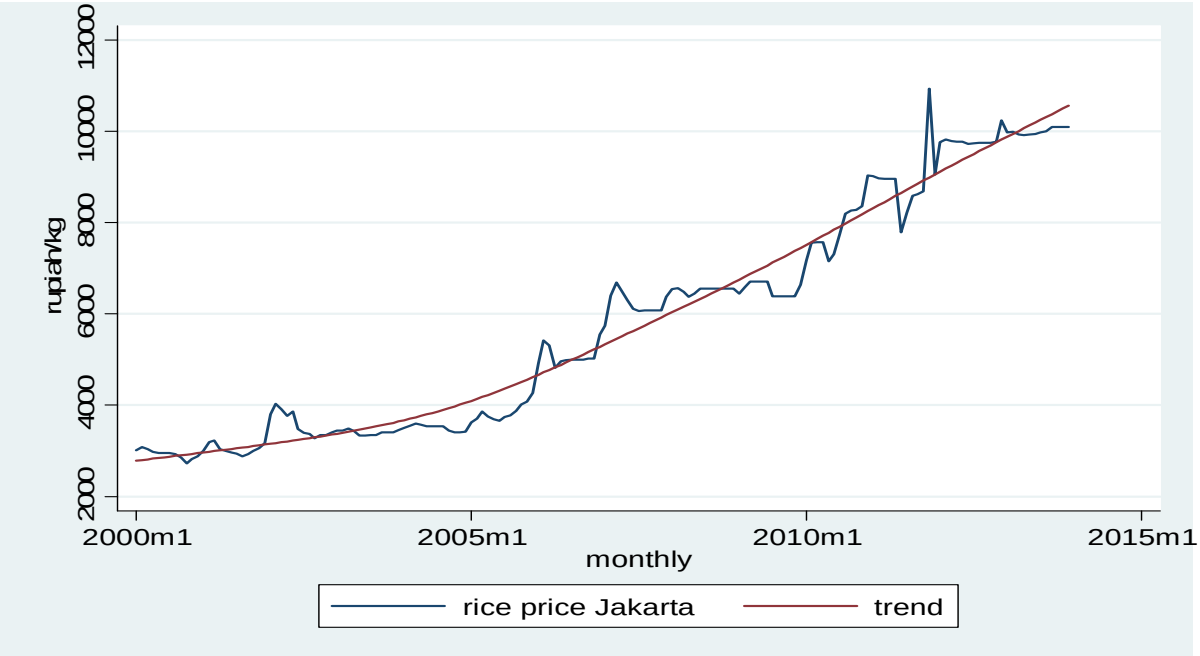
Price variations can have severe impacts when they are abrupt and unanticipated by the economic agents (HLPE, 2011). It is also important to note that price changes may have different impacts on the different economic agents. High food prices can be incentives for net food producers to produce more food. More income can be generated when food prices are on the upward trend relative to input prices. On the other hand, high food prices negatively impact consumers. Poor people will have to spend much more of their income on food when the prices are higher.

In the absence of a common definition of food price crisis, for the purpose of the analysis, this study will use a definition of crisis that focuses on the customers' point of view. According to this definition, food markets are considered to be in a crisis when the observed price is above a certain level of the price that can be considered normal. The analysis first estimates the price trend for each market over the whole period using the Hodrick-Prescott filter (HP filter). The HP filter is widely used to remove cyclical components of macroeconomic time series data to obtain a smoothed-curved representation of the series, which can be written as:

$$\min_{\tau}\left(\sum_{t=1}^{T}(y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1}[(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2\right)$$

The first term of the equation is the sum of the squared deviations $d_t = y_t - \tau_t$ which penalizes the cyclical component. The second term is a multiple smoothing parameter (λ) of the sum of squares of the trend component's second differences. This second term penalizes variation in the growth rate of the trend component. The larger the λ, the larger the penalty for the second term. As recommended for monthly data, λ is chosen to be 129600.

Figure 2.6. Rice price and trend in Jakarta

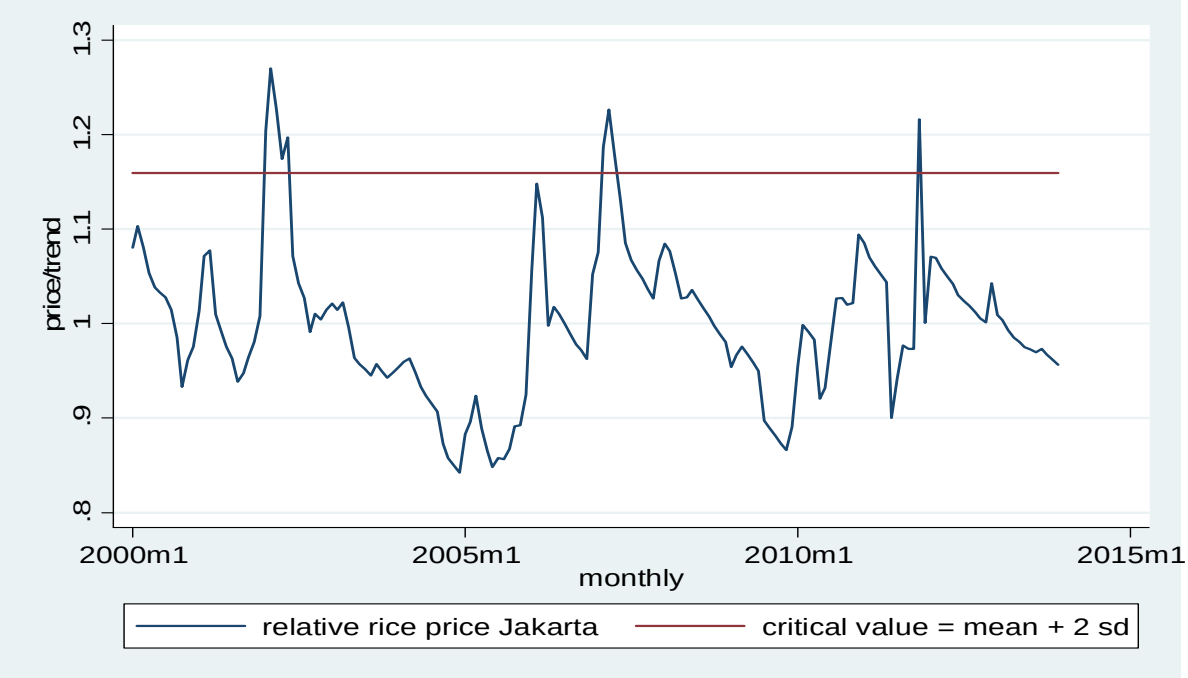


Source: own elaboration based on BPS data.

The definition of an abnormal price (i.e. a price above a certain level that can be considered as normal) is based on the relative spread and not on the absolute price level because inflation and long-term trends increase the absolute spread in both directions (positive and negative). For instance, an increase of Rp.100/kg is large if the price is Rp.200/kg but small if the price is Rp.1000/kg. To obtain a relative spread, we divide the price series by its HP-price trend, which normalizes the mean price to 1. The standard deviation is further estimated from these relative fluctuations for the analyzed period. A market is considered to be in crisis when the relative spread between the relative price and its mean value is greater than two standard deviations (Figure 2.7). For poor consumers, who usually spend more than half of their income on food, the price level of greater than two standard deviations is a severe shock to their purchasing power, since they experience such fluctuations only rarely. Assuming normally distributed prices, 95 percent of the relative price spreads should be smaller than 1.96 standard deviations and larger than -1.96 standard deviations. Thus, one would expect prices above 2 standard deviations in less than 2.5 percent of the observations.

To illustrate, in Jakarta, the price level greater than two standard deviations is 16 percent higher than the trend price (Figure 2.7). If the share of food expenditure in total expenditure of the poor people in Indonesia is 63.3 percent (von Braun and Tadesse, 2012), then a crisis reduces their purchasing power by roughly 10 percent (16 percent times 63.3 percent). This implies that the share of their food expenditure in total expenditure would increase to 73.3 percent. In other areas, the number can be even higher. In Banjarmasin, for instance, the price level greater than two standard deviations is 28 percent higher than the normal price. This implies that the share of food expenditures in the total expenditure of the poor would increase to 81 percent. This abnormal price that increases purchasing power deficiency in such ways would also increase food deficiency.

Figure 2.7. Food price crisis in Jakarta



Source: own elaboration

2.4. Key Markets Identification

The idea of monitoring food price movements only in key markets relies on the concept of spatial price transmission and market integration. The underlying theory of spatial price transmission is spatial arbitrage, which implies that the difference between prices of homogeneous goods in different markets is only subject to transaction costs. Therefore, most empirical works in spatial price transmission analysis aim at assessing whether the *Law of One Price* holds or not (Listorti and Esposti, 2012).

Our analysis aims to measure the degree of integration between each pair of markets and uses this information to analyze how markets are connected with each other. Two markets are defined as being integrated when shocks arising in one market are transmitted to the other market (Fackler and Goodwin, 2001). More specifically, market i for good x is said to be spatially integrated with market j for the same good if a shock in i that changes, for instance, demand in i but not in j, affects the prices in both i and j. This implies that the price series for a homogenous commodity in the two markets share a long-run stochastic trend.

The study identifies the key markets whose prices can help to forecast price movements in other markets by Granger-causality tests. These are conducted in the vector error correction (VEC) model framework. The Granger-causality is a statistical hypothesis test on whether one time series is useful in forecasting another (Granger, 1969). This study tests whether there is a Granger-causal relationship between prices on market *i* and prices on market *j*.

The VEC model is appropriate to analyze the short-term and long-term effects of one market on another when two conditions are met. First, every price series is non stationary and integrated in degree 1, which can be written as I(1), and second, two or more series are co-integrated. When two I(1) are co-integrated, there exists a linear combination of the two series that is stationary. The study analyzes two prices at a time, so that the co-integrating equation can be written as:

$$P_i = \alpha + \beta P_j + \varepsilon \quad \text{or} \quad \varepsilon = P_i - \alpha - \beta P_j, \quad \text{where } \varepsilon \text{ is stationary.}$$

The stationarity of each price series is tested using Augmented Dickey Fuller (ADF), and the results show that the price series for all markets are non-stationary, and each pair of the series is

also found to be co-integrated[15], which means that there is a long-run relationship between prices of two markets. The VEC model for each pair of the price series is estimated using the following formulation:

$$\Delta P_t^i = \alpha + \theta\left(P_{t-1}^i - \beta P_{t-1}^j\right) + \delta\Delta P_{t-1}^j + \rho\Delta P_{t-1}^j + \eta_t$$

Where P_t^i is the price of market i and P_t^j is the price of market j. Δ is the difference operator, so $\Delta P_t = P_t - P_{t-1}$. $\alpha, \theta, \beta, \delta, \rho$ are the estimated parameters and η_t is error term.

Having already concluded that each pair of the price series is co-integrated, meaning that the two series have a long-run causal relationship, the causality being tested in the VEC model indicates a short-run Granger-causality. It is important to note that, if *i* is said to Granger cause *j*, this does not imply that *j* is the result of *i*. Granger-causality measures precedence and information content, but does not by itself indicate causality in the more common term. Here, the Granger-causality test shows whether prices in one market lead another. The results of the tests are shown in Table 2.1.

The study attempts to find one market in which Granger-causes most other relevant markets. In other words, prices in this market play significant roles in explaining prices in other markets and can help to predict the latter. However, the results show that no single market Granger-causes all other markets. Surabaya and Palangkaraya are the two markets that Granger-cause most other markets but not all markets (each of them only Granger causes 21 markets). This means that three markets are not Granger-caused by each of them. When the population is considered, Riau is found to have the largest effect, although it Granger-causes only 19 other markets. For the effect on poor population, Palangkaraya is found to have the largest effect compared to all other markets.

[15] Co-integration test is performed by Engle Granger two steps method by testing the stationarity of residuals ε

Table 2.1. Granger-causality test results

Market	Granger-causes… other markets	Population affected (millions)	Poor population affected (millions)
Banda Aceh	13	146.6	16.2
Medan	18	198.5	23.0
Padang	16	213.1	24.3
Riau	19	220.8	24.7
Jambi	14	183.7	21.3
Palembang	19	199.3	22.6
Bengkulu	19	214.0	24.4
Bandar Lampung	17	209.1	23.8
Jakarta	17	207.4	22.8
Bandung	17	197.4	22.2
Semarang	20	207.3	24.0
Yogyakarta	18	216.1	24.4
Surabaya	21	209.4	24.5
Denpasar	19	202.6	23.3
Mataram	16	199.6	22.7
Kupang	18	205.8	23.3
Pontianak	18	199.4	22.0
Palangkaraya	21	218.8	24.8
Banjarmasin	18	206.3	24.2
Samarinda	18	207.1	22.9
Manado	17	199.3	22.6
Palu	15	190.6	22.0
Makassar	20	219.8	24.6
Kendari	12	135.9	16.7
Jayapura	13	182.2	20.9

Note: Granger causality tests are conducted in the VEC model framework and performed separately for each pair of the markets at the significance level of 5percent.

The focus of the study is to predict price movements using the information from the market. Therefore, the study aims to find the market that Granger-causes all other markets in the country. However, since a single market that Granger-causes all other market cannot be found, the study considers more than one market to be identified as the key market. The combination of Surabaya and Palangkaraya is found to Granger-cause all markets in Indonesia. Thus, the two markets are identified as the key markets, as their prices are expected to help in forecasting prices in all other markets in Indonesia.

Table 2.2. Granger-causality test for the key markets

Key Market	Not granger causes..
Surabaya	Jakarta, Banjarmasin, Makassar
Palangkaraya	Pekanbaru, Samarinda, Palu

Note: Granger causality tests are conducted in the VEC model framework at the significance level of 5percent.

An additional Granger-causality test is performed to analyze how integrated the Indonesian markets are with the international market. Using the rice price in Bangkok as international price, the result of the test shows that 20 markets in Indonesia are Granger-caused by the international price. This means that price movements in many markets in the country follow price movements in the international markets. Thus, although the international price movements cannot fully explain the price dynamics in all of the markets in Indonesia, monitoring the international price can also be used as an alternative to explain price movements in many different markets in Indonesia. However, the following analysis will focus on testing the relevance of monitoring the key markets in detecting price crisis since the combination of Surabaya and Palangkaraya (as the key markets) can explain price movements in all markets in Indonesia.

Table 2.3. Granger-causality test from international market

International Market	Granger-causes … Indonesian markets	Not granger-causes..
Bangkok	20	Riau, Palangkaraya, Samarinda, Manado, Palu

Note: Granger causality tests are conducted in the VEC model framework at the significance level of 5percent.

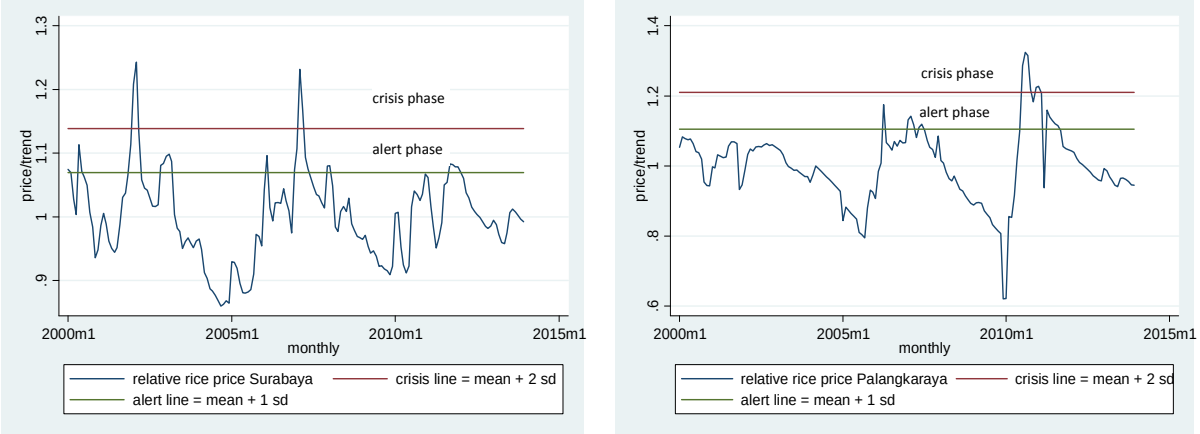
2.5. Detecting Price Crisis by Monitoring the Key Markets

This section is devoted to test the relevance of using the key markets to predict the price crisis in Indonesia. As defined previously, markets are considered in crisis when the relative spread; i.e. the spread between the relative price and its mean value is greater than two standard deviations. First, the study determines an alert indicator that is expected to predict the crisis. Furthermore, the probability that an alert on the key markets will lead to a crisis on one (or more) of the other markets is tested econometrically using Probit and Poisson regression models.

2.5.1. Alert Indicator

The analysis starts by identifying the periods of abnormal prices based on the relative spread of the prices. The crisis phase, in which the spread between the relative price and its mean value is more than two standard deviations, is usually preceded by a phase of increasing price that moves from the level that can be considered as normal. The periods of this increasing price are considered an alert phase: an alert is defined as an event during which the spread of the relative price is more than one standard deviation but below two standard deviations (Figure 2.8). The alert indicator to predict a potential crisis in any market in the country will be the alert phase of the two key markets. The following Probit and Poisson models will test whether it is relevant to observe the alert indicator in the key markets to predict crises in other markets.

Figure 2.8. Alert and crisis phases in the key markets



Source: Own elaboration

2.5.2. Probit Model

The probit model, also called probit regression, is used to model dichotomous or binary outcome variables. The inverse of the cumulative distribution function of the standard normal distribution is used as a link function to map a linear combination of the predictors to the binary outcome. The regression aims at assessing the probability that an alert in the key markets leads to a crisis in any market of the country. The dependent variable is a binary variable taking value 1 if one or more markets are in the crisis phase at time t, and 0 otherwise. The independent variable is a

binary variable of the alert phase of each key market, taking value 1 if the key market is on alert, and 0 otherwise. A regression model is created by parameterizing the probability of the occurrence of a crisis to depend on a regressor of the alert phase of the key market where:

$$p_{it}^{*} = \beta x_{kt-1} + \varepsilon_{it}$$

p_{it}^{*} is the latent dependent variable which refers to the probability of the crisis; p_{it} is the observed binary outcome variable defined as:

$$p_{it} = \begin{cases} 1 \; if \; p_{it}^{*} > 0 \\ 0 \; otherwise \end{cases}$$

x_{kt-1} is the alert phase at the lagged value of each key market and ε_{kt} is error term. Although the alert phase at time t-1 is preferable since it is used as a predictive measure, the study also attempts to use the alert phase at time t to analyze the price dynamics among the markets at the contemporaneous time. The alert phase of Surabaya and Palangkaraya that may lead to crisis in any market of the country is tested separately. The results of the tests are as follows:

Table 2.4. Probit regression result

Key Market	Alert at time t-1	Alert at time t
Surabaya	0.3956	0.8334***
	(0.3120)	(0.2987)
Palangkaraya	1.0815***	1.0597***
	(0.3686)	(0.3682)

*Note: Standard errors are in parentheses, * p<0.1, ** p<0.05, *** p<0.01*

The results show the alert in the key market that may lead to crisis in any other market in the next month (alert at time t-1) is statistically insignificant for Surabaya, while for Palangkaraya, the coefficient is positive and statistically significant (1.08). For the alert at time t, the alert at the key market that may lead to crisis in any other market in the same month is positive and statistically significant for both key markets with the coefficient 0.83 and 1.06 for Surabaya and Palangkaraya, respectively.

From these results, the study considers the predicted probability with the following categories:

(i) Alert in the key market that may lead to crisis in any other market.

(ii) Alert in the key market that may lead to no crisis in any other market.

(iii) No alert in the key market that may lead to crisis in any other market.

(iv) No alert in the key market that may lead to no crisis in any other market.

The predicted probabilities of the above categories are as follows:

Table 2.5. Predicted probability of crises

Key Market	**Time t-1**				**Time t**			
	Alert=0		**Alert=1**		**Alert=0**		**Alert=1**	
	Crisis = 0	**Crisis = 1**	**Crisis = 0**	**Crisis = 1**	**Crisis = 0**	**Crisis = 1**	**Crisis = 0**	**Crisis = 1**
Surabaya	-	-	-	-	0.86	0.14	0.59	0.41
Palangkaraya	0.84	0.16	0.46	0.54	0.83	0.17	0.46	0.54

Note: Alert=0 (no alert); Alert=1 (Alert); Crisis=0 (no crisis); Crisis=1 (Crisis)

Table 2.5 shows the predicted probabilities of (no) alert in the key markets that may lead to (no) crisis in any other market. While we cannot say much for Surabaya, since the coefficient in the probit regression is statistically insignificant, an alert in Palangkaraya may lead to 54 percent probability of crisis in any other market in the next month. This also means that, when we observe an alert in Palangkaraya, the probability of no crisis in any other markets in the next month is 46 percent. On the other hand, when we do not observe alert in Palangkaraya, the probability of no crisis in any other markets in the next month is 84 percent, and the probability of crisis that may occur in any other markets in the next month is 16 percent.

At the contemporaneous time, when we observe an alert in Surabaya, there is a probability of 41 percent crisis and 59 percent probability of no crisis in any other markets. On the other hand, when we do not observe an alert in Surabaya, there is still 14 percent probability of crisis and 86 percent probability of no crisis in any other markets. For Palangkaraya, an alert may lead to a 54 percent probability of crisis and 46 percent of no crisis in any other markets, and when we do not observe alert, the probability of crisis and no crisis in any other market is 17 percent and 83 percent, respectively.

Although the results indicate that not all alerts at the two key markets lead to a crisis, monitoring price movement in the two key markets can help to better anticipate possible price crisis events. By observing alert or no alert in the two key markets, the probability of crisis or no crisis in any other markets that may occur can be predicted. While there is still much uncertainty in predicting

crises when alerts are issues at the key markets (which is natural, as these are rare extreme events that do not occur very often), the lack of alerts gives rather high confidence that no crisis occurs at any other market. This asymmetry in the prediction power should be kept in mind. It is also important to note that the alert that has predictive power is not only at the lagged time but also at the contemporaneous time. This is possible since monthly price data are used in the analysis while price dynamics among the markets may be faster than monthly changes.

2.5.3. Poisson Model

The second analysis is based on a Poisson model that seeks to explain the extent of the crisis. The dependent variable is the number of markets within the country that will be in crisis if the key market is on alert. The Poisson regression is appropriate when the dependent variable is count data. The independent variable remains the same as in Probit regression, which is a binary variable of the alert phase of each key market, taking a value of 1 if the key market is on alert and 0 otherwise.

The basic Poisson probability specification can be written as:

$$f(y_t|x_{t-1}) = \frac{e^{\mu}\mu^{y_t}}{y_t!}$$

Where y_t is factorial, it is the number of markets that is experiencing a price crisis at time t. x_{t-1} is the alert phase at the lagged time of each key market and μ is the parameter of Poisson distribution. As in the probit regression, we attempt also to analyze price dynamics among the markets at the contemporaneous time, which means that the alert at time t is also analyzed. For $\mu > 0$, the mean and variance of this distribution can be shown to be:

$$E(y) = var(y) = \mu$$

Since the mean is equal to the variance, any factor that affects one will also affect the other; thus, the usual assumption of homoscedasticity would not be appropriate for Poisson data. The results of the Poisson tests are as follows:

Table 2.6. Poisson regression result

Key Market	t-1	t
Surabaya	1.3186***	0.6806***
	(0.2031)	(0.2278)
Palangkaraya	1.6809***	1.6771***
	(0.2067)	(0.3480)

*Note: Standard errors are in parentheses, * p<0.1, ** p<0.05, *** p<0.01*

The results show that all coefficients are positive and statistically significant, which imply that an alert in Surabaya leads to an increase of the number of other markets that will be in crisis in the next month by 1.32, and an alert in Palangkaraya leads to an increase of a number of other markets that will be in crisis in the next month by 1.68. At the contemporaneous time, an alert in Surabaya leads to an increase in the number of other markets that will be in crisis by 0.68, and an alert in Palangkaraya leads to an increase of the number of other markets that will be in crisis by 1.68.

2.6. Summary and Conclusion

Indonesia is among the countries that experience high food price volatility accompanied by high risk of food and nutrition security (Mujahid and Kalkuhl, 2014). Detecting excessive price spikes is prime for a developing country such as Indonesia, a large part of whose citizens spend more than half of their income on food. Thus, uncertainty as a result of food price volatility threatens their food and nutrition security. This study investigates price movements in the major markets in Indonesia, identifies the key markets, and analyzes whether price movements in all markets in the country can be monitored by focusing only on the key markets.

The study uses monthly retail rice prices from 25 major markets in Indonesia for the periods of 2000-2013. The key markets are identified using Granger-causality tests that are conducted within the VEC model framework. The results show that Surabaya and Palangkaraya can be considered as the key markets, whose price movements can help to explain prices in all other markets. This finding is not surprising, as Surabaya and Palangkaraya are two important cities in the trade network within Indonesia. Surabaya has an important port connecting Java Island with many other islands, and Palangkaraya is located in central Kalimantan, which may influence

many other markets, especially those in the east part of Indonesia. Thus, despite that rice production volume of the two markets relative to their population is not much bigger than the other markets, their role as market hub connecting many other markets make it possible for them to play such an indicator role as the key markets.

Granger-causality test on rice price in Bangkok as international price shows that 20 markets in Indonesia are Granger-caused by the international price. This means that price movements in many markets in the country follow price movements in the international markets. Thus, although the international price movements cannot fully explain the price dynamics in all of the markets in Indonesia, monitoring the international price can also be used as an alternative to explain price movements in many different markets in Indonesia. However, this study focuses on testing the relevance of monitoring the key markets in detecting price crisis, since the combination of Surabaya and Palangkaraya (as the key markets) can explain price movements in all markets in Indonesia. The results of the tests using Probit and Poisson models indicate that, although not all alerts at the two key markets lead to crises, monitoring price movement in the two key markets can help to better anticipate possible price crisis events. By observing alert or no alert in the two key markets, the probability of crisis or no crisis in any other markets that may occur can be predicted.

This study shows an efficient approach in monitoring price movement using the information from market prices. In a large developing country such as Indonesia, where markets are located in different islands with considerable distances, the results become important, as it is possible to monitor price movement in a country with fewer resources. By monitoring only Surabaya and Palangkaraya, price movements in the 25 markets in Indonesia (affecting more than 27 million poor) can be forecasted. While one may argue that the cost of monitoring food prices in all markets is low in the current new era of information technology, the proposed study can serve as an alternative approach, which can be useful in integrating policies between different markets.

Chapter 3. ASEAN Food Reserve and Trade: Review and Prospect

3.1. Introduction

High uncertainty and volatility of food prices in the recent years have renewed the interests of many countries in considering food reserves as an important instrument in managing food price instability. These reserves come back into the focus of policy agenda as a result of the huge doubts on the reliability of international trade to guarantee food supply. The 2008 crisis, in particular, highlighted that low levels of food stocks make countries vulnerable to excessive price volatility even only with low levels of supply or demand shocks (Wright, 2009).

Countries in Southeast Asia have been using storage-based price stabilization for decades (Rashid et. al., 2006). Grain price stabilization in the Philippines started in 1960s, carried out by Rice and Corn Administration (RCA) and Rice and Corn Board (RICOB). In Indonesia, price stabilization is managed by *Badan Urusan Logistik* (BULOG), a national food reserve agency created in 1967. At the regional level, the cooperation on food reserves has been ongoing since the late 1970s, when the original members of the Association of Southeast Asian Nations (ASEAN) established the Agreement on Food Security Reserve (AFSR). The ASEAN Emergency Rice Reserve (AERR) was created in 1979 with the initial earmarks of 50,000 tons of rice to serve as the subset of national stocks in addressing food emergencies in the region. However, due to small size of the stocks and its complex release mechanism, the AERR had never really been activated during the entire operational period of more than a quarter of a century (Dano, 2006).

The recent food price crisis affecting almost all countries in the world led to a new phase of the regional reserve cooperation in Southeast Asia. The ten member countries of ASEAN, in partnership with China, Japan and Korea, agreed on the ASEAN Plus Three Emergency Rice Reserve (APTERR), which entered into force in July 2012. The APTERR is a permanent reserve scheme which replaces the pilot project East Asia Emergency Rice Reserve (EAERR), which itself was presented as a metamorphosis of the AERR. The initial earmark of APTERR is 787,000 tons of rice, roughly twice the size of von Braun and Torero's (2009) proposal for a

modest emergency grain reserve of 300,000-500,000 metric tons for the whole world. However, the APTERR has hardly been tested in practice. Since entering into force, only 200 tons of rice have been released at the end of 2012 for poverty alleviation and the malnutrition eradication program in Indonesia, and another 800 tons of rice in early 2014 for typhoon Haiyan victims in the Philippines. Several other small releases have been made during its pilot phase from 2004-2010.[16]

This study aims to review the storage-based price-stabilization policy in Southeast Asia, both at the national and regional level, and to discuss the prospect of the policy in the current era of price instability. The remainder of the chapter is organized as follows: Section 3.2 provides a brief literature review on food reserve and trade cooperation. Section 3.3 follows by providing information on ASEAN market structure, which will discuss the food trade and development of trade cooperation in the region. Section 3.4 and 3.5 describe food reserves at the national and regional level in ASEAN, including a discussion on their cost and benefit. The discussion about food reserves at the national level will use several countries in ASEAN as examples, while at the regional level, the discussion will mainly focus on the ASEAN+3.[17] Section 3.6 analyzes the WTO rules on public stockholding, and the last section provides the concluding remarks.

3.2. Food Reserve and Trade Cooperation

Empirical literature emphasizes the interchangeability of food reserve and trade to balance unstable production (Williams and Wright, 1991; Makki et al, 1996). Trade is advantageous if supply shocks between countries are negatively or uncorrelated (Koester, 1984). On the contrary, securing stocks through storage is favorable for countries that switch between net-importer and net-exporter. Moreover, food reserve is more favorable to trade for countries that bear high transportation cost such as landlocked countries.

In response to the global food crisis 2007/2008, many governments carry out intervention policies through the implementation or enhancement of public reserve. However, these

[16] www.apterr.org accessed on 17 September 2014.

[17] Association of Southeast Asian Nations (ASEAN) members are: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam; Plus Three Countries (+3) are China, Japan, Rep. Korea.

interventions are often criticized due to their effects in distorting markets and high cost of operation (Tchirley and Jayne, 2010; Newberry and Stiglitz, 1981). On the other hand, international trade appears to be powerless in dampening price shocks when domestic insulation policies are enforced by the exporters (Martin and Anderson, 2012).

Against this, regional cooperation may serve as a solution to the problem. The idea of a regional response to food price instability based on the possibility of cost sharing and capability of timely intervention (Wright and Cafiero, 2011; FAO et al., 2011). Regional trade agreements (RTAs) encourage free trade among the members in which the governments do not restrict imports from or export to other member countries. However, RTAs in the past were mainly concerned with encouraging industrial development (Matthews, 2003). Agriculture sector is often considered as a sensitive issue, thus, many exceptions are applied to the sector. Incorporating agriculture into RTAs brings pressures in harmonizing agricultural policies and often become unresolved issue in the negotiations. The level of common external tariff, rules on domestic subsidies, financial mechanism for the farmers are among the issues that need to be addressed in the agreements. These issues become more complicated when the authority to set the policies are being transferred to supranational or regional level.

Regional food reserve is a relatively cheap means as an alternative to national reserves (FAO et al., 2011). The cooperation has a direct objective to enhance food security by ensuring food supply. The main function of the reserve is to provide additional supply in the case of emergency or abnormal market situation. Joint reserve requires an agreement on rules and mechanism with respect to country's contribution and entitlement to receive stocks. The value of trust among participant countries becomes very high as the successful joint reserve needs information sharing on production, supply and stock levels. Moreover some elements of food sovereignty at the national level are being transferred to the regional level.

The idea of multinational reserve has been already in place for decades. In 1933, major exporting countries agreed on International Wheat Agreement (IWA) to ensure supply stability. After global food crisis in the 1970s, the idea of regional and global grain reserves was largely discussed (Konandreas et al, 1978; Reutlinger et al., 1976; Johnson, 1976). In the wake of 1974 World Food Conference, countries agreed on 500,000 tons of grain to tackle emergency situation

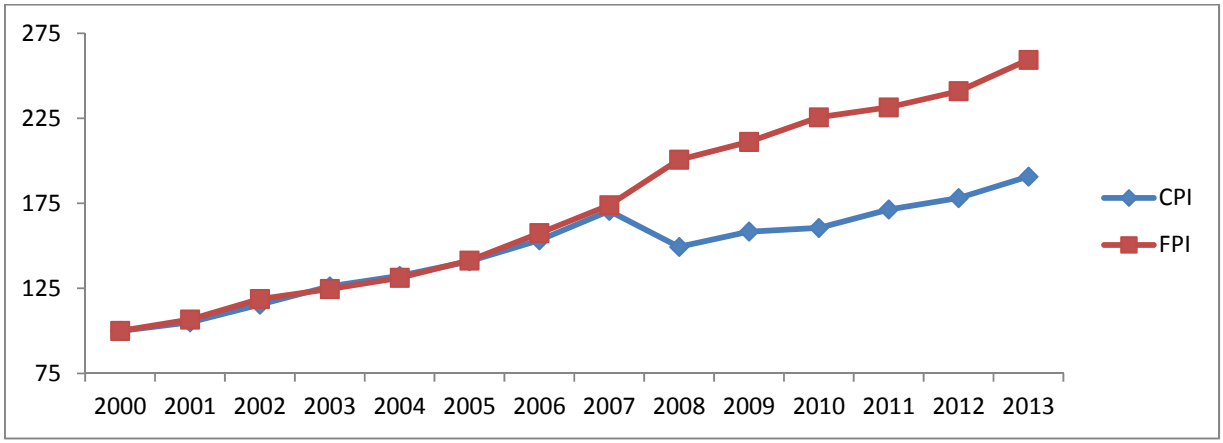
in the food crisis (Shaw, 2007). In Southeast Asia, regional reserve cooperation has started since 1979 by the establishment of ASEAN Emergency Rice Reserve (AERR).

The motivation of countries in joining regional cooperation varies. Some countries may expect to benefit from releases of stocks to secure their domestic supply while other countries probably not intend to directly benefit from releases of stocks but to maintain their relation with the neighbouring countries. Political economy is highly involved in the governments' decision to agree on regional mechanism. In the case of ASEAN plus three, for instance, China is unlikely to participate in ASEAN Plus Three Emergency Rice Reserve (APTERR) with intention to benefit from releases of regional stocks. APTERR stock level is just too small to secure China's domestic supply. Instead, China is likely to provide assistance to other smaller participant countries. One important point to note is that APTERR has proven that joint reserve at the regional level is possible although its effectiveness in enhancing food security remains to be investigated.

3.3. ASEAN Food Market Structure

The recent waves of global food price crisis have affected almost all countries in the world. ASEAN countries are among those that are hit by the price crisis. Since 2007, the food price index increases have been higher than the consumer price index increases in the region (Figure 3.1).

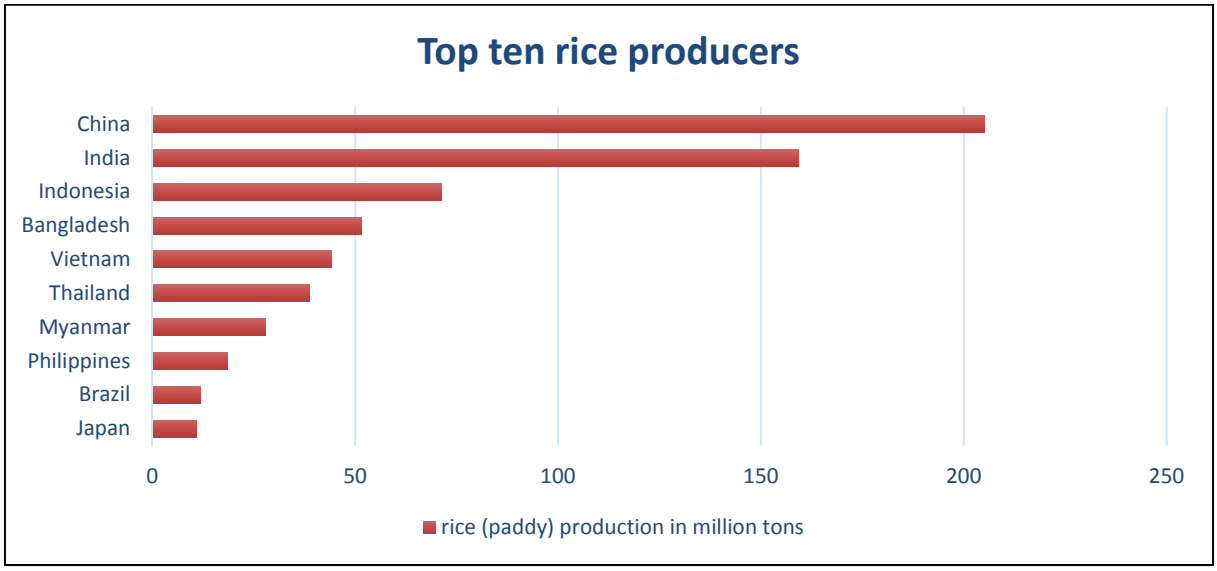
Figure 3.1. Consumer Price Index and Food price index in Southeast Asia (2000=100)



Source: FAOSTAT, http://faostat3.fao.org/home/E accessed on August 18, 2015.

ASEAN provides a mix of cases. It is home to some of the world's biggest producers, consumers, exporters and importers of rice at the same time. Thailand and Vietnam are among the biggest rice exporters, whereas Indonesia, Malaysia and the Philippines are among the biggest rice importers in the world. However, Indonesia and the Philippines, with their goals to achieve self-sufficiency, view trade as the last source of supply, making them occasional rice importers depending on their production level. Other countries such as Singapore and Brunei are considered as traditional purchasers of rice.

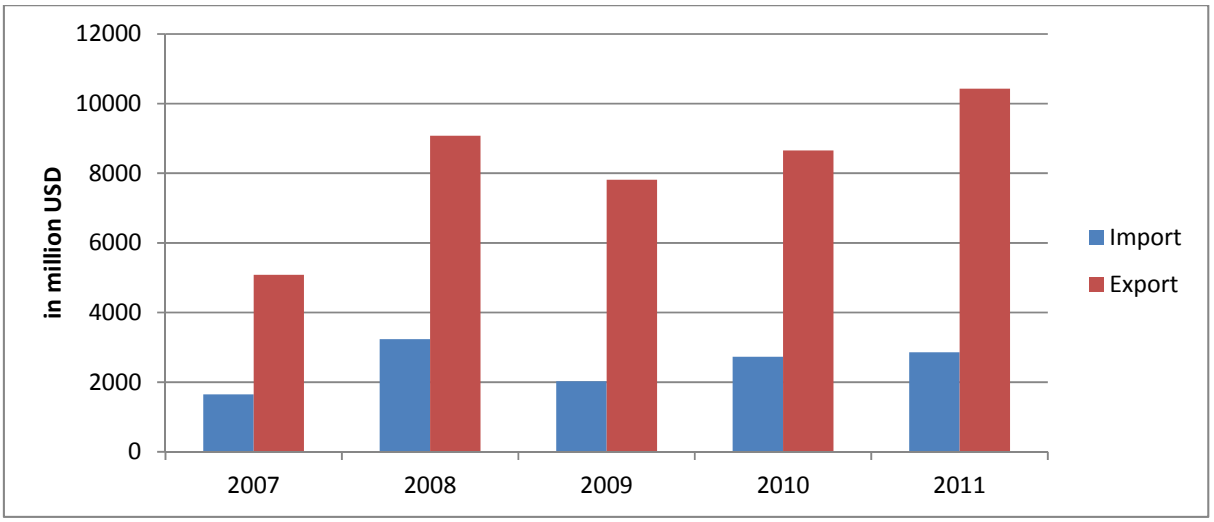
Figure 3.2. World's rice production in 2013



Source: FAOSTAT, http://faostat3.fao.org/home/E accessed on August 18, 2015.

The international rice market has been historically thin and unstable (Dawe and Timmer, 2012). The geographic concentration of rice production and the thinness of international rice trade with high transactions costs are among the factors contributing to its instability. Only about 5 percent of the total global rice production enters the international market, which is mostly concentrated in Asia. Southeast Asia as a region is a net rice exporter (Figure 3.3), but the bulk of the countries are rice importers (Table 3.1)

Figure 3.3. ASEAN rice trade 2007 – 2011



Source: FAOSTAT, http://faostat3.fao.org/home/E accessed on August 18, 2015.

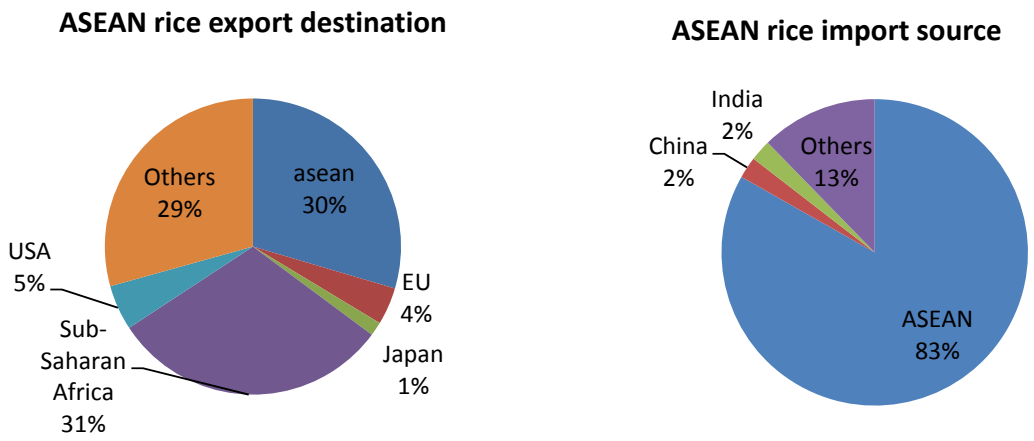
Table 3.1. ASEAN countries' rice trade balance 2011 (million USD)

Country	Import	Export	Net Import
Brunei	39.6	2.0	37.6
Myanmar	1.6	98.5	-96.9
Indonesia	1513.2	0.8	1512.3
Cambodia	4.9	107.9	-103.1
Lao PDR	9.8	NA	NA
Malaysia	606.1	0.4	605.7
Philippines	383.2	1.7	381.5
Singapore	284.3	52.6	231.6
Thailand	8.9	6507.5	-6498.6
Vietnam	1.3	3656.8	-3655.5

Source: FAOSTAT, http://faostat3.fao.org/home/E accessed on August 18, 2015.

ASEAN countries' imports are mainly sourced from within the region. The countries in this region absorb roughly one third of the total regional exports and send the excess rice supply to the rest of the world (Figure 3.4).

Figure 3.4. ASEAN rice trade flow 2011



Source: UN COMTRADE, retrieved via http://wits.worldbank.org/ , accessed in July 2015.

The average rice tariff rates of ASEAN countries are relatively high compared with other commodities. In 2012, the tariff for rice was 15.94 percent on average among ASEAN countries, which was much higher than the total average tariff rates for all commodities (Table 3.2).

Table 3.2. Average tariff rates of ASEAN countries in 2012 (%)

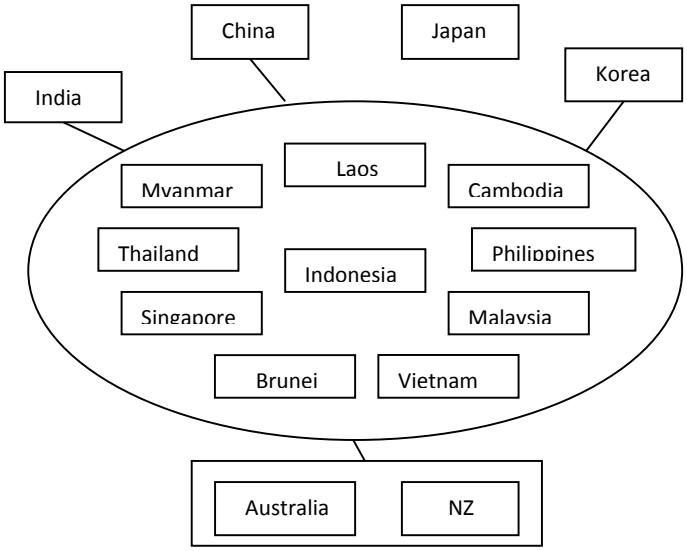
Sector	**Tariff rates**
All commodities	5.42
Food commodities	7.01
Rice	15.94

Note: Average tariff rates not weighted, classification based on standard product in SITC
Source: TRAINS database accessed via WITS, http://wits.worldbank.org/, retrieved in July 2015

Southeast Asian countries liberalize their markets through regional and multilateral trade agreements. The cooperation through ASEAN started in 1967, and all ASEAN members are currently also members of the World Trade Organization (WTO). Through the ASEAN Trade in Goods Agreement (ATIGA), which supersedes the Common Effective Preferential Tariff (CEPT) scheme implemented in 1992, international trade within the region is almost without tariffs except for certain sensitive commodities. In addition to bilateral cooperation between ASEAN members and many other countries, the members also build cooperation with

neighboring countries while maintaining ASEAN centrality (Figure 3.5). There are AK-FTA (with Rep. Korea), AC-FTA (with China), AANZFTA (with Australia and New Zealand) and AI-FTA (with India). Although the agreement of ASEAN and Japan has not yet entered into force, many ASEAN members have already established bilateral agreement with Japan. Furthermore, Regional Comprehensive Economic Partnership (RCEP), which will combine ASEAN and their six partners, is currently under negotiation.[18] ASEAN itself is entering a new phase of stronger cooperation through the ASEAN Economic Community (AEC) in 2015.

Figure 3.5. ASEAN Free Trade Agreement



Source: WTO

However, despite having significantly reduced their tariffs on many commodities through trade agreements among ASEAN members (and plus countries), considerably high cereals tariffs are still in place (Table 3.3). Cereal products, especially rice, are considered highly sensitive commodities in ASEAN, and thus ASEAN countries still make exceptions by not reducing the tariff on these commodities.

[18] RCEP participating countries are ASEAN countries (Brunei, Burma, Cambodia, Indonesia, Laos, Malaysia, Singapore, Thailand, Philippines, Vietnam) plus their six partners (Australia, China, India, Japan, New Zealand and South Korea), launched in November 2012.

Table 3.3. Tariff of selected agricultural product of different trade agreement regimes 2012 (%)

Commodity	MFN applied	ATIGA	AK FTA	AC FTA	AANZ FTA	AI FTA
Animals & product	4.6	0.0	0.1	0.0	0.8	2.2
Dairy products	5.4	0.0	0.0	0.0	0.8	2.2
Fruit, vegetables & plants	5.3	0.0	0.1	0.0	1.2	3.8
Coffee & Tea	6.4	0.0	0.0	0.0	0.4	4.3
Cereals	11.8	7.1	7.3	7.3	7.7	10.1
Oil seeds, fats & oils	4.3	0.0	0.0	0.0	0.1	2.3
Sugar	12.8	8.1	8.1	8.1	8.1	10.4
Cotton	4.0	0.0	0.0	0.0	0.0	1.6
Other agriculture products	4.1	0.0	0.0	0.0	0.1	2.4

Source: WTO

Note: MFN-Most Favoured Nations, ATIGA – ASEAN Trade in Goods Agreement, AK FTA – ASEAN Korea FTA, AC FTA – ASEAN China FTA, AANZFTA – ASEAN Australia New Zealand FTA, AI FTA – ASEAN India FTA.

3.4. National Food Reserves in Southeast Asia

The fact that the international rice market has been historically thin and unstable forced countries in this region to prevent the transmission of world price fluctuations to domestic markets (Dawe and Timmer, 2012; Rashid et. al, 2006). Storage-based public intervention policies have been part of their development agenda for many years to control food availability in the market.

Food price stabilization in the Philippines is managed by the National Food Authority (NFA), which acts as a regulator as well as a corporation engaged in grain trading. The history of the NFA started in the 1960s, when the RICOB and the RCA were still active. In 1972, the National Grains Authority (NGA) replaced these two agencies to promote the integrated growth and development of the grain industry in the country. In 1981, the NGA was transformed to the NFA, and the new organization has two primary mandates: ensuring food security and stabilizing the supply and price of rice. This highlighted the importance of rice in the society. The NFA aimed to fulfill its mandates through procurement, distribution, importation and buffer stock activities. For the buffer stock activities, the NFA is required to maintain rice stocks which are equivalent to 15 days of consumption for the entire country in its warehouses (Aquino, et al., 2013).

In Indonesia, price stabilization was managed by BULOG, a national food reserve agency created in 1967 with the special objective to protect Indonesian domestic markets from sharp price fluctuations on world markets. BULOG buys excess rice production that is not absorbed by

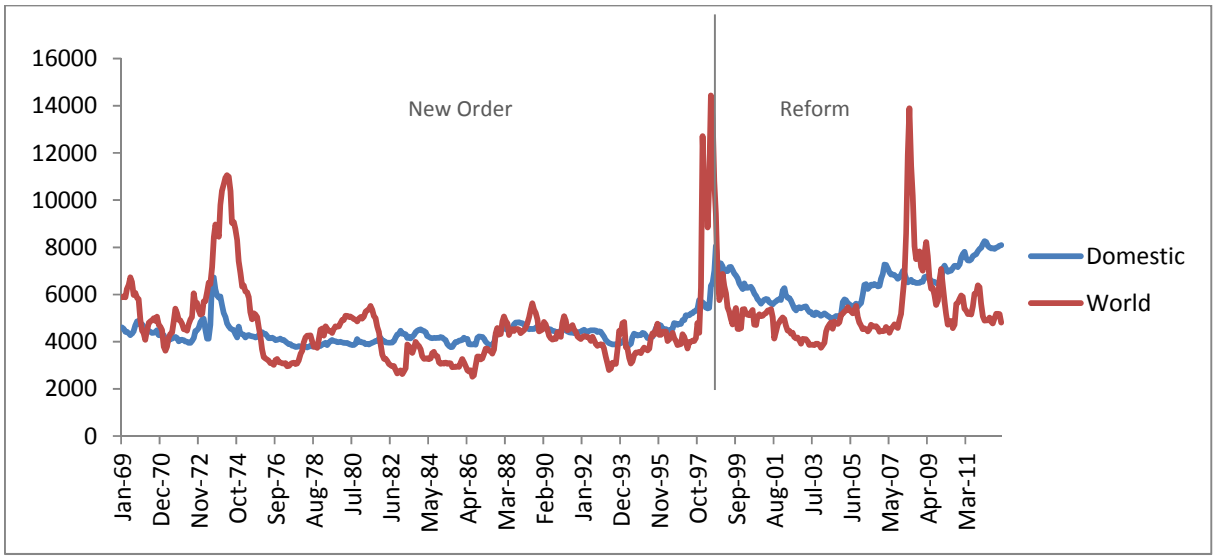
the market during harvest seasons from farmers, keeps the rice in its warehouses throughout the country, and distributes the rice at low prices during planting seasons, drought or other conditions that may cause sharp increases in market rice prices. BULOG maintains a ceiling price policy to ensure the affordability of rice for low-income consumers, especially those living in urban areas. Like the NFA in the Philippines, BULOG also monopolizes rice imports in Indonesia.

As rice importers, Indonesia and the Philippines mainly control rice imports. Other countries, such as Vietnam, which is an exporter country, also use public reserve policies to control rice exports. VINAFOOD in Vietnam is responsible for managing rice availability and rice prices in the market.

3.4.1. The Benefits and Costs of National Reserves

Although it is difficult to separate the contributions of policies, the study has provided some reviews and discussions on the costs and benefits of national food reserve using qualitative approaches. Rashid et al. (2006) argued that storage-based price stabilization policies benefit countries through price stability and better agricultural performance. Southeast Asian countries were among those that successfully managed their domestic food prices for years. Under the "New Order", Indonesia was one of the success stories of food price stabilization, especially for rice. From 1969 to 1997, domestic rice prices were substantially less volatile than in the "reform" period after 1998, when BULOG has less power to intervene in the market (see Figure 3.6). In Vietnam, agricultural policies introduced in the early phase of the unification of North and South Vietnam have transformed the country with disappointing agricultural production to one of the biggest rice exporters in the world.

Figure 3.6. Rice prices in Indonesia during “New Order” and Reform"



Source: Dawe (2008) and GIEWS

Price stability benefits consumers and producers at the same time (Timmer, 1989). Poor consumers in Southeast Asia, like many others in developing countries, spend more than half of their income on food (von Braun and Tadesse, 2012). Excessive price volatility and spikes can cause food and nutrition insecurity for those consumers who cannot maintain consumption stability. Reducing food and nutrition intake, even only temporarily, can have short- and long-term effects (Block et al., 2004). Price stabilization policy serves as a preventive program instead of a response program for emergency cases. This kind of policy can help consumers better manage their expectations on food prices and thus better manage their food and nutritional intake. Price stability also helps producers maintain consumption stability because most farmers in Southeast Asia are also categorized as poor citizen living in rural areas.

Furthermore, price stability allows farmers to better manage price expectations on food crops, which can enhance efficiency in the farming sector through better management of planting systems. Moreover, price stability contributes to social and political stability. Arezki and Brückner (2014) showed that price movements can induce political instability, which is manifested in political riots and civil conflicts. Sociopolitical instability can in turn make it difficult for governments to promote growth and development.

Food price stability is in fact associated with the rapid economic growth during the early development phase in Southeast Asia (Dawe and Timmer, 2012, Cummings et al., 2006). However, the downside of stabilization policies are that the fiscal costs of public reserves are often high, while the benefits may not be as high as expected. In the Philippines for instance, the government spending on the NFA surpassed its spending on agrarian reform, research and development, and extension services during the period of 2003-2008 (Aquino et al., 2013). In Indonesia, a financial audit report by Arthur Anderson covering the period from April 1993 to March 1998 suggested that total inefficiency of BULOG was about 400 million USD per year (Arifin, 2008). Likewise, the economic costs of distorting market and crowding out private storage and trade can also be very high.

Over decades, there have been several shifts in the price stabilization policies in Southeast Asia. In the 1980s and 1990s, public reserves fell out of favor particularly because of the changing interest of many countries, which wanted to improve market efficiency. Fiscal difficulties caused by the Asian crisis in the late 1990s triggered countries in the region to intervene less in the market. Indonesia loosened its monopolistic structure and created competition within the domestic market. BULOG lost its domestic power to monopolize the sugar and rice trade because Indonesia was required to comply with the International Monetary Foundation (IMF) Letter of Intent by liberalizing its market.

3.5. Regional Food Reserve Cooperation

Following the global food price crisis in 2008, ASEAN countries agreed on the ASEAN Integrated Food Security (AIFS) framework, which aimed to address four major components of the food security challenges: food security arrangements and emergency short-term relief, sustainable food trade development, integrated food security information system, and agricultural innovation. The AIFS framework provides the foundation for the establishment of the APTERR, an ASEAN regional reserve cooperation together with its three partners. The APTERR was finally agreed upon in October 2011 and entered into force in July 2012.

The history of the APTERR dates back to 1979, when the original members of ASEAN agreed on the ASEAN Emergency Rice Reserve (AERR). The objective was to build up physical rice reserves that would serve the needs of member countries when the demand in any member country cannot be fulfilled from own production or through purchases in international market. The main reason for the cooperation was that the ASEAN countries identified food instability as a common threat and as the consequence of the high vulnerability of the region's food production. The AERR was created with the initial earmarks of 50,000 tons of rice as a subset of national stocks. Releases from the AERR were to be arranged through bilateral negotiation between a country in a state of emergency and a country offering its earmarked reserve. The system, however, was never used, and the amount of rice in the reserve was too undersized to cope with an actual emergency.

The efforts of building up stocks in the region continued. In 2001, ASEAN countries, in partnership with China, Japan and Korea, initiated a consultation and cooperation process in establishing an emergency rice reserve at the regional level. A pilot project of the East Asia Emergency Rice Reserve (EAERR) was created at the end of 2003 with the political support of the ASEAN Plus Three countries. The purpose of the EAERR is twofold: maintaining food security in case of emergency and contributing toward price stability in the region (APTERR, 2014). The food price crisis in 2008 led the ASEAN Plus Three governments to strengthen the financial and stockpiling abilities of the EAERR and move beyond the project beyond its pilot phase. The APTERR was finally agreed upon as a permanent scheme in October 2011 and entered into force in July 2012.

The initial earmarked stock of the APTERR is 787,000 tons of rice, which were voluntarily contributed by the member countries (Table 3.4). The stocks remain owned and controlled by the respective governments for meeting the needs of any other member countries in case of emergency. The governments are also responsible for the management cost of their earmarked stocks to ensure the stocks remain in good quality. Another type of APTERR stock is a stockpiled emergency rice reserve, which could be in form of cash or rice, but is owned collectively by APTERR member countries and managed by the APTERR secretariat under the supervision of the APTERR council.

Table 3.4. Earmarked Stock of APTERR

Country	Earmarked stocks (tons)
ASEAN Countries	
Brunei Darussalam	3,000
Cambodia	3,000
Indonesia	12,000
Lao PDR	3,000
Malaysia	6,000
Myanmar	14,000
Philippines	12,000
Singapore	5,000
Thailand	15,000
Vietnam	14,000
Plus Three Countries	
China	300,000
Japan	250,000
Korea	150,000
TOTAL	**787,000**

Source: APTERR

The APTERR is designed to mainly address emergency situations anywhere in the region. Emergency is defined as "the state or condition having suffered extreme and unexpected natural or man-induced calamity, which is unable to cope with such state or condition through its national reserve and is unable to procure the need through normal trade".[19] In principle, given the definition of emergency, extreme price volatility is not a reason for releasing rice from the APTERR.

The APTERR presents itself as a subset of national reserves. Rice release from the APTERR is only possible when a national reserve is unable to cope with extreme shocks. The release of APTERR stock is based on the request of the member country which encounters an emergency rice shortage. The requesting country is also responsible for the transportation and operational costs incurred during the stock release.

[19] ASEAN Integrated Food Security Framework.

The APTERR heavily relies on the commitment and political will of every member country, without any sanction mechanism in place. Nevertheless, APTERR member countries appoint a Management Team to ensure rice releases take place in case of emergency.

3.5.1. The Benefits and Costs of Regional Reserves

There have been extensive debates on storage-based price stabilization policies (Galtier, 2013). On the one hand, countries with public reserve policies can benefit from price stability and better agriculture performances, which are associated with economic success. On the other hand, the policies are often criticized for their high fiscal and economic costs.

National public food reserves in Southeast Asia are largely managed as buffer stocks to address price instability. The size of national public food reserves is usually large, and their stocks are frequently rotated to maintain the quality of the stocks. Consequently, the fiscal costs of storing food/grains are high, and the potential of creating market distortion is high as a result of the high degree of intervention. On the other hand, an emergency public reserve usually holds a low amount of stocks and is only intended for addressing humanitarian needs rather than for price stabilization.

In the competitive storage model, the central idea behind storing food today for tomorrow's consumption is based on the assumption that an equilibrium price can be reached when today's price (p_t) equals the expected price tomorrow (p_{t+1}) plus the costs of storage. Stocks are held in anticipation of profit, which implies that the marginal gain of holding stocks should exceed the marginal cost. However, under this condition, the optimal stock level is not necessarily optimal from the social welfare perspective.

Using this assumption, public involvement in stockholding is needed to address the economy-wide consequences of demand or supply shocks. Difficulties arise when determining the optimal stock level (Gardner, 1979) as it depends on the criterion of desirability. For instance, public rice stocks maintained by the NFA in the Philippines are equivalent to 15-day consumption needs of the entire country (Aquino, et al., 2013). This stock level is determined based on the assumption

that the national stock level (public and private) should be equivalent to the 90-day consumption needs, which covers the lean season, when usually no harvests from domestic production prevail.

Notwithstanding the difficulties in determining the optimal stock level, we provided an illustration on how regional cooperation can significantly reduce the required stocks.[20] Following Kornher and Kalkuhl (2014), the study estimated the required stocks as the difference between the largest historic supply shortfall and the percentage of threshold:

$$S = \max\left[\left(1 - \frac{x}{100}\right) E(Q_t) - Q_t\right] \quad (1)$$

where x is the level of allowed supply shortfall. For instance, if we want to maintain 97 percent consumption stability, then the allowed supply shortfall is 3 percent. $E(Q_t)$ is the expected supply level at time t. Since supply for consumption increases with population growth, the study measured shortfall around a trend.

Supply shortfalls of countries individually were compared with the total supply shortfalls of the entire region using the coefficient of variation of supply, which can be written as:

$$CV^2(\sum_1^n Q_i) = \sum_1^n s_i^2\ CV\ (Q_i) + 2\sum_1^n \sum_{i+1}^n s_i s_i + 1\ r_{i,i+1}\ CV(Q_i)CV(Q_{i+1}) \quad (2)$$

where $CV^2(\sum_1^n Q_i)$ is the coefficient of variation of the regional supply, and Q_i is the supply of each country. s_i and $r_{i,i+1}$ are a country's share and coefficient of correlation respectively. This condition assumes that there is free flow of food between the countries within the region. Production shortfall can be compensated by imports, which means that the supply shortfall in one country can be compensated by supply surpluses in other countries.

Considering that not all of ASEAN countries are rice producers, supply data (production + imports) was used instead of production data only. Rice supply in Singapore, for instance, relies heavily on imports. Using the actual rice supply data of ASEAN+3 countries from the USDA PSD for the period of 1980-2014, we estimated the required stocks for the two-month consumption stability at 97 percent (allowed supply shortfall of 3%). Countries' stocks were

[20] Further discussion on optimal stock level can be found in Kornher and Kalkuhl (2014)

determined from the regional stocks using their consumption shares. The results of the estimations are presented in Table 3.5.[21]

Table 3.5. Stocks required for allowed supply shortfall of 3% (tons)

	w/o cooperation		with cooperation		Actual APTERR stock	
	required stock	**stock-to-use ratio**	**required stock**	**Stock-to-use ratio**	**earmarked stock**	**stock-to-use ratio**
ASEAN						
Brunei	1227	23.22	688	13.02	3000	56.76
Cambodia	47768	12.95	26799	7.27	3000	0.81
Indonesia	57413	1.05	32210	0.59	12000	0.22
Lao PDR	18912	10.73	10610	6.02	3000	1.7
Malaysia	17947	5.59	10069	3.14	6000	1.87
Myanmar	34552	2.37	19385	1.33	14000	0.96
Philippines	78355	5.41	43960	3.04	12000	0.83
Singapore	10420	23.28	5846	13.06	5000	11.17
Thailand	130132	8.60	73008	4.82	15000	0.99
Vietnam	136657	5.42	76669	3.04	14000	0.55
Plus Three						
China	678268	3.2	380533	1.8	300000	1.42
Japan	132280	8.7	74214	4.88	250000	16.45
Korea	59788	6.93	33543	3.90	150000	17.40
Total	**1403717**	**3.81**	**787535**	**2.14**	**787000**	**2.14**

Source: Own elaboration based on USDA PSD

Note: required stocks w/o cooperation and with cooperation are calculated for two months consumption

The simulations showed that regional cooperation can significantly reduce the required rice stock by roughly 44 percent, from 1,403,717 tons to 787,535 tons. This implies that the fiscal costs associated with holding stocks can be reduced through cooperation and risks sharing. The simulations also showed that all countries can reduce the required contributions of stocks through regional risk sharing.

[21] Correlation matrix of supply shortfall, maximum shortfall, average annual supply and consumption shares that were used for the estimations are available in appendix.

In the APTERR system, stocks remain owned and controlled by the respective governments for the purpose of meeting the needs of any other APTERR member countries when they experience an emergency. However, transportation costs arise when transferring rice from a donor country to a country in need. This transportation costs should also be taken into consideration when calculating the cost reduction resulting from cooperation. Since transportation costs arise only when a country within the region experiences a shortfall, we calculated the transportation costs from the expected trade volume in times of shortfall, which was estimated to be equal to the required stocks for two months consumption. The results are available in Table 3.6.

Table 3.6. Storage and transportation costs (million USD)

	storage cost		**transportation cost**		**total cost**	
	low	**high**	**low**	**high**	**low**	**high**
w/o cooperation	35	49	-	-	35	49
with cooperation	20	28	0.7	1.1	20.7	29.1
cost savings					14.3	19.9

Note: Storage cost is estimated in the range of USD 25 (low) to USD 35 (high) per ton. Transportation cost within ASEAN+3 countries is estimated in the range of USD 10 (low) to 15 (high) per ton.
Source: own elaboration

The total cost saving through food reserve cooperation was estimated to be about 14.3 to 19.9 million USD when storing enough food to satisfy consumption for two months. The saving is roughly 40 percent of the estimated cost without cooperation.

The current APTERR stock is roughly equal to the total stocks needed by the region to maintain consumption stability at 97 percent for two months. However, the voluntary contribution of each member country of the APTERR is not the same as the required stock for each country with cooperation through risks sharing. For instance, Japan and Korea contribute more than what they need, but Cambodia and Lao PDR contribute less than their required stocks. Richer countries of the APTERR are more likely to provide food assistance to their poorer neighboring countries. This can be seen also from the voluntary contributions of APTERR member countries: each of the “Plus Three” countries contribute more than the total contribution from all ASEAN countries. There is a strong indication that the large contribution from the “Plus Three” countries has brought APTERR into practice. Its predecessor, the AERR, which consisted only of ASEAN

members with small size of stock, had never released its stock during its entire operational period.

The study also conducted a simulation to determine the required stock for ensuring consumption stability of 97 percent in different cooperation regimes in order to analyze whether countries benefit from larger cooperation (Table 3.7). Through simulation of three scenarios–ASEAN, ASEAN+3 and ASEAN+3 plus India–the study found that the benefits of cooperation decreased when more countries joined the cooperation. This is possible because the correlation of shortfall risks increases with the increasing number of member countries. However, although the benefits of cooperation was decreasing, the required stock was still significantly reduced. For instance, if India also joined the ASEAN+3 cooperation, the required stock would be reduced by 31 percent. Moreover, larger cooperation means larger coordination between countries, which can potentially prevent collective action failures.

Table 3.7. Stocks required for allowed supply shortfall of 3% in different cooperation regimes (tons)

Regional cooperation (simulation)	**Required stocks without cooperation**	**Required stocks with cooperation**	**Reduced by**
ASEAN	533382	178885	66%
ASEAN+3	1403717	787535	44%
ASEAN+3+India	2362418	1637777	31%

Source: Own elaboration based on USDA PSD

3.6. WTO Rules on Public Reserve

The central issue in a WTO-compatible framework for developing countries, including those in Southeast Asia, is whether these countries are able to stockpile their staple food (i.e., rice) to ensure stable incomes for their farmers while ensuring that their low-income citizens are able to access the basic food at an affordable price. This issue, however, affects or has the potential to affect other countries. The potential spillovers of public reserves are high in different member countries due to different conditions of countries in ensuring food security for the citizens. The

increasing demand for food for stockholding purposes increases prices and potentially reduces supply for immediate consumption in other countries. When food stocks are finally released for consumption, international trade can be distorted, affecting market competition.

The present WTO rules allow member countries to maintain or introduce domestic support measures without any limitations or reduction commitments. To qualify for this, domestic support to food reserves must meet "the fundamental requirement that they have no, or at most minimal, trade distorting effect or effects on production". Countries, however, may argue the definition of minimal trade distorting effects.

A public reserve is not only economically complex but also politically encumbered. The Bali Package, which has been mentioned as the first-ever agreement reached in the history of the WTO, still makes an exception for public stockholding. In the 9th ministerial meeting held in Bali, Indonesia, at the end of 2013, the WTO member countries adopted an interim solution and agreed to negotiate a permanent solution that would specifically address public reserve by the 11th ministerial meeting in 2017. Furthermore, in the Post-Bali work, countries also agreed to continue with the interim solution if the permanent solution cannot be agreed upon by 2017. This means that no agreement has been reached for a public reserve. Nevertheless, the interim solution, which should prevent countries from challenging other countries through dispute settlement mechanism until a permanent solution is found, can be a starting point for a new institutional arrangement to prevent collective action failures of uncoordinated national public reserves, which can further destabilize prices at the international level.

3.7. Conclusion and Policy Implication

Public food reserve policies have been used by many countries for decades. Although in the 1980s and 1990s public reserves fell into disfavor particularly with changing interest of many countries to improve market efficiency, the policy has always been part of the development agenda in many countries. Storage-based stabilization policy through public food reserve receives much more attention today in the era of increasing food price volatility. Food security

concerns in the recent years have led many countries to reconsider public food reserve as the main policy to deal with such uncertainty and price instability.

ASEAN countries provide an interesting case with their long experience in storage-based price stabilization policies. Albeit difficulties to measuring the impact of different policies, price stabilization in fact has been an integral part of their development agenda for decades and contributes to price stability which is associated with economic successes in this region. ASEAN also shows that cooperation at the regional level is possible. APTERR presents as regional effort to face common challenges in ensuring food security.

One of the main concerns of public reserve is that the fiscal cost needed to store the food is relatively high. The cost, however, can be reduced with cooperation. Simulations show that regional cooperation significantly reduces the required stocks which will definitely reduce the costs of holding them. When transportation cost is also added in due to the decentralized storage in the different countries, the total cost for food reserve with cooperation is still lower than food reserve without cooperation. This definitely will be beneficial for all participating countries.

ASEAN and their partner countries can also consider expanding the cooperation that may include other neighboring countries. Simulation with India as the "fourth" country shows that the cooperation still significantly reduces the required stocks that will be beneficial for all member countries involved. India is emphasized in the simulation for its important role in the region. The fact that the country is home to around 200 million undernourished people[22], has brought serious concerns to the policy makers in the country. With the world's largest food programs covering public procurement, storage and distribution of wheat and rice, India has been successfully stabilized its food prices for many years. However, the policies run at the very high fiscal cost. In 2013, the cost is estimated around 1.2 percent of GDP (Kozicka, et. al., 2015).

Yet, India is not part of ASEAN plus three countries food reserve cooperation. However, ASEAN and India has already an FTA which entered into force since January 2010. The countries involved can also consider bringing food reserve as part of their cooperation which will likely bring benefits to all participant countries. In addition to reduce the fiscal costs, larger cooperation and coordination also means that collective actions failures are diminished.

[22] Estimated from 17 percent of population as stated in the Global Hunger Index, IFPRI et. al., 2014.

Learn from ASEAN case, public food reserve is an ancient idea that meets its relevance today. The way forward is to build institutional arrangements that accommodate coordination and cooperation among countries, including through the multilateral trading system of the WTO. Each of ASEAN trade agreements with six countries[23] which might go further under Regional Comprehensive Economic Partnership (RCEP) framework that combines all ASEAN "plus" agreements can be a starting point for a stronger and larger cooperation including in public reserves.

[23] The six countries are Australia, China, India, Japan, Korea and New Zealand.

Chapter 4. Do the WTO and RTAs Promote Food Trade?

4.1. Introduction

After more than a decade of deadlock in the negotiations of Doha Development Agenda, the World Trade Organization (WTO) has gained a noteworthy momentum by the success of the Ninth Ministerial Meeting at the end of 2013. The first-ever multilateral trade agreements since the formation of the WTO and approved by all member countries have been reached in Bali Indonesia. However, countries are still struggling to find permanent solution on public stockholding for food security issues, confirming that food remains a very sensitive sector in the agreement.[24]

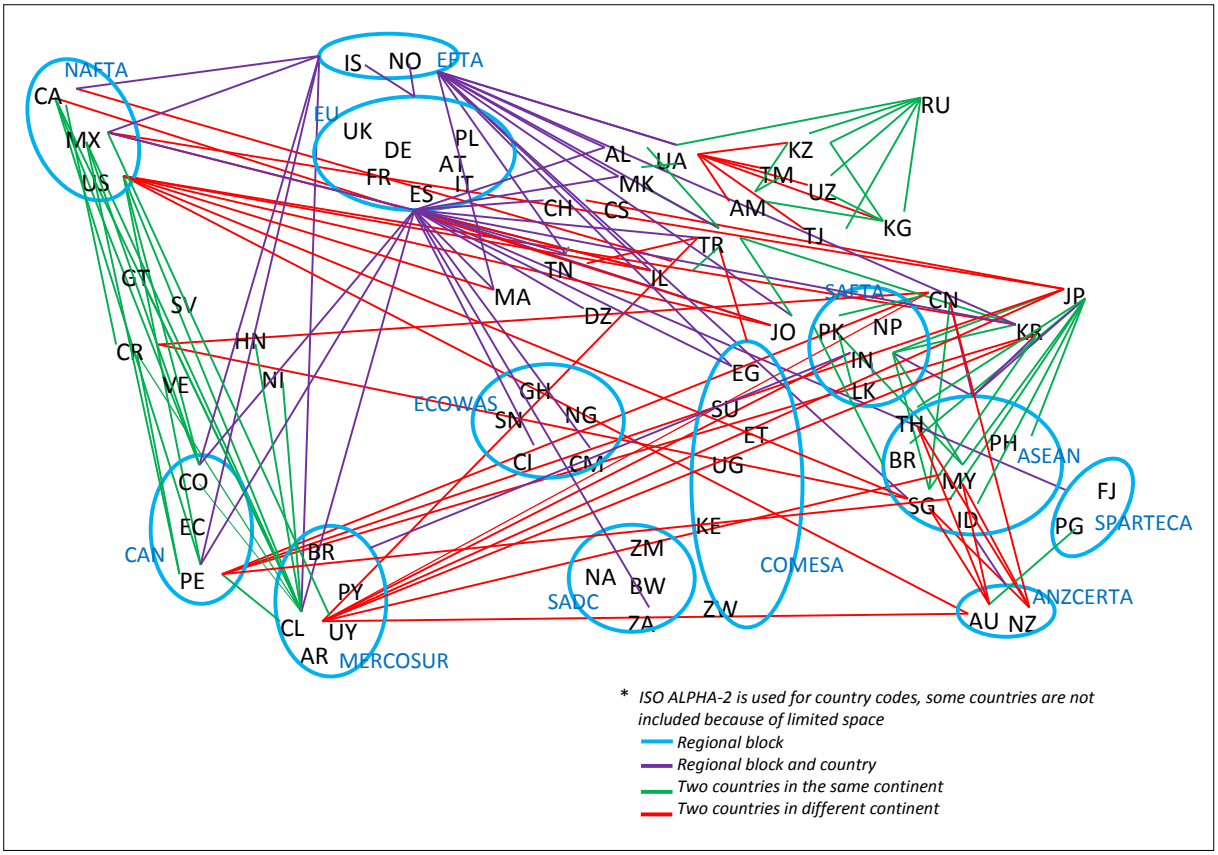
On the other hand, the world has seen a remarkable proliferation of regional trade agreements (RTAs) in the last two decades, growing from only less than 40 in 1990 to nearly 400 that were in force in 2013. The data suggest that almost all WTO members are participating in one or more regional trade agreements. These figures result in very complicated overlapping trade relations among countries (Figure 4.1). The term "Spaghetti Bowl" has been widely used by trade researcher and practitioner to describe global trade relations.

One issue often raised is whether these agreements can play a positive role in strengthening food security at the worldwide level. "*Food security exists when all people, at all times, have access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life*"[25]. An important key factor relates to this definition of food security is physical availability of food at all times in all places. Economic means to access food will be meaningless when food is not available. Certain geographies in the global world are endowed by natural resources needed to produce surplus food, while some others deficit because they have more demand than food that they can produce. Global imbalances occur since high population is

[24] At the 9th WTO ministerial meeting in Bali, December 2013, member countries agreed on an interim solution of public stockholding for food security purposes until permanent solution is found by 2017. In the post-Bali work, India blocked Trade Facilitation Agreement (TFA) requesting to delete the time limit of 2017. In November 2014, member countries agreed that if the permanent solution cannot be found by 2017, the interim solution remains.
[25] 1996 World Food Summit

not associated with high food production (Figure 4.2). Food security at the global level is only possible when food can move freely from areas of surplus to areas of deficit.

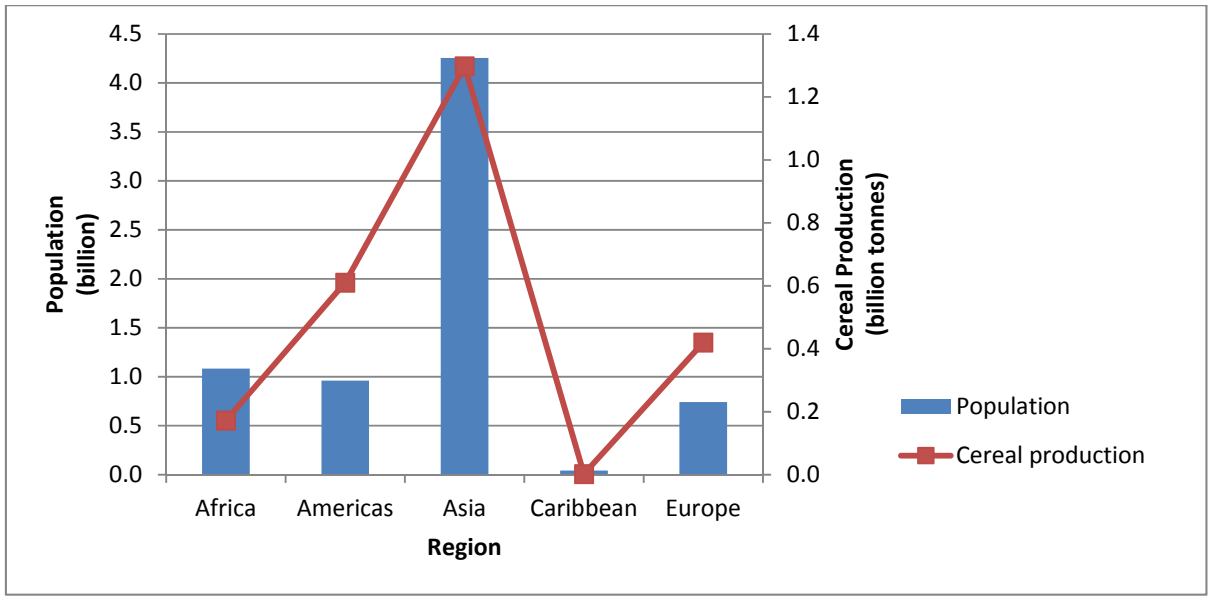
Figure 4.1. Global map of trade agreements as of 2013



Note: Countries' geographical positions are placed as in normal map but without scaling, ISO alpha 2 codes can be accessed via http://www.iso.org/iso/country_codes
Source: Own illustration based on WTO database

In the light of the recent excessive food price volatility since 2007-08, in which international trade distortions have been found to be among the main key drivers of the food price crises (Martin and Anderson, 2012; von Braun and Tadesse, 2012; World Bank, 2010), it is highly important to analyze whether trade agreements may contribute to reduce trade distortions and could bring the world to a freer flow of food by increasing food trade among countries.

Figure 4.2. Population and cereal production in 2012



Source: FAOSTAT

Trade agreements are usually based on the commitments to reduce market barriers for all trade sectors among participant countries. Food is an integral part of these agreements as usually no important sector is omitted. However, as these agreements are subject to negotiation, they are substantially varied in scope and depth. The agreements to reduce the so-called bound tariff rates may or may not affect market access, depending on the gap between the bound rates and the tariffs that a country actually applies to imports. In addition, non-tariff measures (NTMs) are often used to protect countries' interests in some sectors including food. Therefore, the impact of trade agreements on food trade is an empirical question. Despite the fact that this appears to be a very relevant issue, to date there is rather poor empirical evidence on the impact of trade agreements on food trade. Most studies on trade agreements both at the multilateral and at the regional level are usually based on aggregate trade, without exclusively looking at the food sector.

This chapter contributes to the literature in two-folds. First, although a number of studies have addressed the impacts of WTO and RTA membership on agricultural trade, only very few to none of the studies found in the literature exclusively analysed the impact of trade agreement on food trade, which will be the main focus of this chapter. Second, unlike most studies which usually focus on one of the multilateral or regional institutions, this chapter brings the WTO and

RTAs together in one analysis to compare their impacts on food trade. Using gravity model of international trade, the discussions framework built in this chapter is simply to answer whether the establishments of the WTO and RTAs have facilitated food trade among the participant countries.

The remainder of this chapter is organized as follows. The next section provides a review of previous studies on the impacts of the WTO and RTA membership on trade flow. Section 4.3 follows by providing background information on trade agreements, market access and food trade. Section 4.4 discusses the theoretical framework followed by section 4.5 which describes model specification, data description and results discussion. Section 4.6 concludes.

4.2. Previous Studies on the Impacts of Trade Agreements on Trade

Many studies on the impacts of trade agreements on trade flow have come naturally to the use of gravity model, one of the most successful trade analysis device offered in the literature (Anderson, 1979). Among others, Rose (2004), Subramanian and Wei (2007), Grant and Boys (2012), Baier and Bergstrand (2007) and Sun and Reed (2010) are among the few careful empirical studies using gravity model to analyse the impact of multilateral and regional trade agreements on trade of the participant countries. While the first three studies mentioned above focused on the WTO, the interests of the latter two are on regional trade agreements.

Prior to Rose (2004), the WTO is often considered as one of the most successful multilateral institution in the modern economy (Bagwell and Staiger, 2002). Contrary to much of conventional believes, Rose (2004) claims that the members of the WTO do not trade more than the non-members. The study was based on a standard gravity model of international trade covering the periods over 50 years and 175 countries. Rose's influential article embarks a growing body of literature that empirically analyze the impact of the WTO membership on members' trade. The findings of the studies are varied and sometimes come with conflicting results. While Rose (2004) claims no evidence that the WTO enhance trade among the members, Tomz, Goldstein and Rivers (2007) found the opposite. They reversed Rose's findings by shifting the focus on formal membership to informal participation. Their argument is based on the right and obligation of the trade institutions that are not only for contracting parties but also

for colonies, newly independent states and provisional members. However, the study cannot explain why informal participation does have larger effect than the formal members (Rose, 2007).

Subramanian and Wei (2007) found that the WTO promotes trade "strongly", but only for industrialized countries. Their analysis is based on the asymmetric structure of the WTO by focusing only on the countries and products that are covered by the WTO liberalization. They argue that the developing countries experience very little trade increase because they have special and differential treatment. Subramanian and Wei (2007) also report that the WTO has negative implication on agricultural trade. Another study that analyze the impacts of the WTO membership on agricultural and non-agricultural trade flows is Grant and Boys (2012). Their study employs the recent advances in the gravity model specification and found that the WTO has delivered significant positive impacts on members' trade, both for agricultural and non-agricultural trade.

Studies on analyzing the impacts of RTAs on members' trade can be differentiated by two categories: using benchmark scenario and investigating specific RTAs. Among others, Baier and Bergstrand (2007) is an example of the study using benchmark scenario while Sun and Reed (2010) investigates agricultural trade impacts of several specific RTAs. With a careful econometric analysis, Baier and Bergstrand (2007) show that on average RTAs have strong positive and significant impacts on trade flows among the members. Sun and Reed (2010) who analyse several RTAs found that The ASEAN-China trade agreement, European Union (EU)-15, EU-25, and Southern African Development Community agreements (SADC) generate large increases in agricultural trade among the members while no agricultural trade increases for the North American Free Trade Agreement (NAFTA).

As shown by the results of the studies on trade impacts of the WTO, many of previous studies analyzing the impacts of RTA membership on trade have also produced different and sometimes conflicting results. For instance, the results of the investigation on trade effect of the Association of Southeast Asian Nations (ASEAN) membership. Hassan (2001) found negative effect, Krueger (2000) found positive effect, Sharma and Chua (2000) found no trade effect associated with the ASEAN membership.

The variety and sometimes conflicting results of the studies, both for the WTO and RTAs, are suspected due to the different specification and sample selection used by the researchers. For example, Subramanian and Wei's (2007) results on agricultural trade was based only on six product at the four level of Harmonized System (HS4): cabbages, frozen vegetables, margarine, malt extracts, tomatoes and tobacco. The results might be problematic not only because these products face high tariff in the world trade, but also the six products are too few to define more than 200 HS4 products of the agriculture sector. Moreover, recent advances in the gravity model specification is prime important to be applied as shown by Grant and Boys (2012). Failures to apply the correct model and specification may produce inconsistent results.

4.3. Trade Agreements, Market Access and Food Trade

Before discussing the theoretical framework of the gravity model used in the analysis and presenting the results, this section provides background information for the study. It provides some information on the development of trade agreements both multilateral and at the regional level, followed by the market access of food and global food trade.

4.3.1. Trade Agreements

Trade Agreements in the global world trade system can be distinguished by multilateral and regional trade agreements. The WTO is the one and only recognized body in the multilateral trading system that intends to supervise international trade. The organization officially exists since 1995, replacing its predecessor the General Agreement on Tariffs and Trade (GATT) which embarked in 1948. The WTO has been struggled for more than a decade to complete the Doha Development Agenda which was launched in 2001[26]. The negotiations have been deadlocked because of the many differences between developed and developing countries mainly in view of some major issues including agricultural trade restriction and facilitation. Only at the end of 2013 was significant progress made by the negotiation. Trade facilitation agreement

[26] Doha Development Agenda is the current WTO trade negotiation round launched at the fourth ministerial meeting in Doha, Qatar November 2001

known as “Bali Package” was adopted in the Ninth Ministerial Meeting hosted by Indonesia, and thus, the first multilateral agreements approved by all member countries have been finally reached in the history of the WTO.

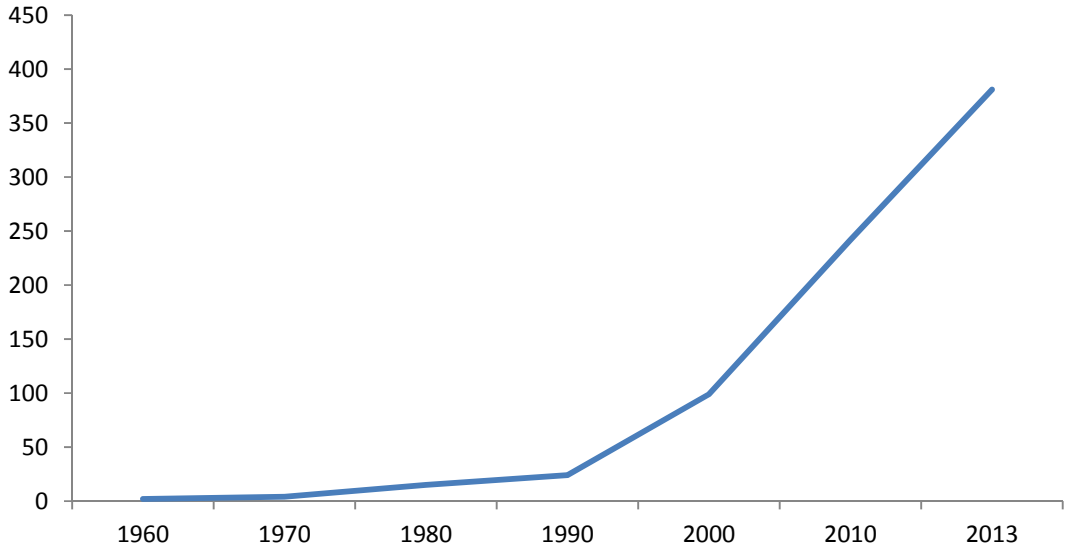
While the principle of non-discrimination in trade is central to multilateral trade system under the GATT/WTO system, member countries are permitted to enter RTAs to promote free trade among members as long as these agreements do not raise barriers to non-members[27]. However, RTAs have had controversial role, some argue that the enormous number of RTAs has been hampering multilateral trade negotiation (Levy, 1997), while some others believe that RTAs have positive effects toward freer multilateral trade (Freund, 2000; Ornelas, 2005).

Regional trade agreements s come in variety of types and forms based on the scope and depth. The most common type of the agreement is free trade agreement, which is a commitment among participant countries to remove tariffs across members while continuing to maintain their own tariff regimes to other countries that are not members of the agreement. Another type of the agreement is customs union which goes one step further by uniting tariff regimes. Beyond customs union is a common market which allows not only free flow of goods but also other factors of production i.e. labor and capital. A common market with monetary union is generally referred as an economic union. However, even though there are some distinctions between these agreements, the borderlines between those definitions are somehow blurred in practice and depend on the settings agreed by all participant countries.

As of January 2014, there have been 583 regional trade agreements notified to the WTO, 377 of them were in force[28]. Figure 4.3 shows that the numbers of regional trade agreements have been growing sharply since early 1990s, and even more accelerated since early 2000s. The agreement formation among countries has gone beyond only with neighboring countries and their only natural trading partners, often cross continents. European Union – Papua New Guinea, US – Australia, Japan – Switzerland are among a few mentioned trade agreements that have been formed among countries or entities from different continents.

[27] GATT, Article XXIV
[28] http://www.wto.org/english/tratop_e/region_e/region_e.htm, accessed on March 17th 2014

Figure 4.3. Numbers of regional trade agreements 1960 – 2013



Source: Author illustration based on WTO database

4.3.2. Market Access

Most of trade agreements are based on the commitments of member countries to reduce market barriers. For example, the 1995 Agreement on Agriculture (AoA) of the WTO required 36 percent average tariff reduction by developed countries with a minimum per tariff line reduction of 15 percent over six years. Developing countries are required to reduce their tariffs by 24 percent on average with a minimum per tariff line reduction of 10 percent over 10 years. Least developed countries were exempted from tariff reductions, but had to either convert their NTMs to tariffs or bind their tariffs and creates a ceiling which cannot be increased in the future.[29]

Tariff reduction schedules of RTAs are varied depend on their settings. However, most of these agreements have contributed to tariff reductions across products and countries. Fulponi et al., (2011) discover that in addition to WTO-AoA, RTAs have a significant impact on tariffs elimination in agricultural products. Their investigation found that on average over products and concessions, 90 percent of tariff lines are duty-free at the end of RTA implementation period.

[29] http://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm3_e.htm, accessed March 17th, 2014.

Table 4.1. Average tariff rates of different sectors

Sector	Tariff Rates	
	1992	2012
All Sectors	13.06	6.74
Manufactures	13.21	6.49
Agriculture	13.28	10.24
Textiles	17.21	10.06
Food	14.55	11.55

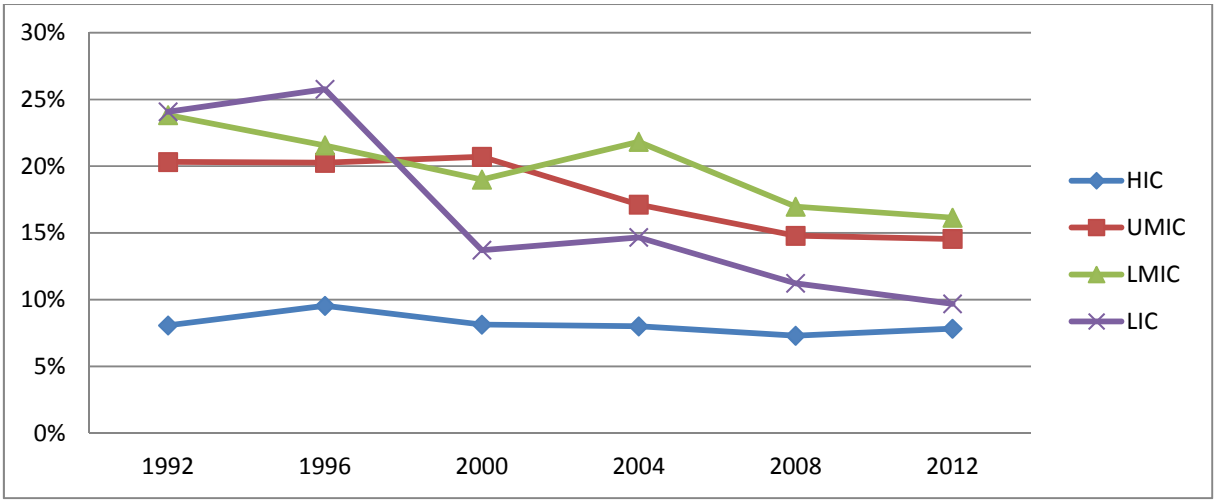
Note: Average tariff rates not weighted, classification based on standard product in SITC
Source: TRAINS database accessed via WITS

All countries have been found to reduce their tariffs on average for all sectors including food (Table 4.1). However, food is always among the highly restrictive sectors in international trade. In 2012, the simple average applied tariff rate of food for all countries is 11.55 percent, which has been reduced from 14.55 percent in 1992. This tariff reduction is relatively lower compared to other sectors. For textiles, for example, the tariffs on average have been reduced from 17.21 percent in 1992 to 10.06 percent in 2012.

Surprisingly, Low Income Countries (LIC) have contributed the most to the food tariff reduction (Figure 4.4). This country group has significantly reduced their tariffs on food from 24 percent in 1992 to 10 percent in 2012 on average. The fact is interesting since least developed countries are exempted from tariff reduction in the WTO-AoA.

Average applied tariff rates of food are found to have decreased over years for all country groups, except for high-income countries (HIC) which remain 8 percent in 1992 and 2012. Their applied food tariff rates have been already low compared to other country groups. Upper middle-income countries (UMIC) have reduced their applied food tariff rates from 20 percent in 1992 to 15 percent in 2012 on average, while lower middle-income countries (LMIC) are found to have reduced applied food tariff rates from 24 percent in 1992 to 16 percent in 2012 on average.

Figure 4.4. Food tariff rates evolution 1992 - 2012



Note: Average tariff rates not weighted of country groups based on level of income facing all countries. HIC (High Income Countries); UMIC (Upper Middle Income Countries); LMIC (Lower Middle Income Countries); LIC (Lower Income Countries)
Source: TRAINS database accessed via WITS

There are also a number of policy measures other than tariffs that may affect trade flow between countries. These policy measures are usually categorized as non-tariff measures (NTMs) and are described as the following:

Table 4.2. International classification of non-tariff measures

A	Sanitary and phytosanitary measures
B	Technical barriers to trade
C	Pre-shipment inspection and other formalities
D	Price control measures
E	Licenses, quotas, prohibitions ad other quantity control measures
F	Charges, taxes and other para-tariff measures
G	Finance measures
H	Anti-competitive measures
I	Trade-related investment measures
J	Distribution restrictions
K	Restrictions on post-sales services
L	Subsidies (excluding export subsidies)
M	Government procurement restrictions
N	Intellectual property
O	Rules of origin
P	Export-related measures

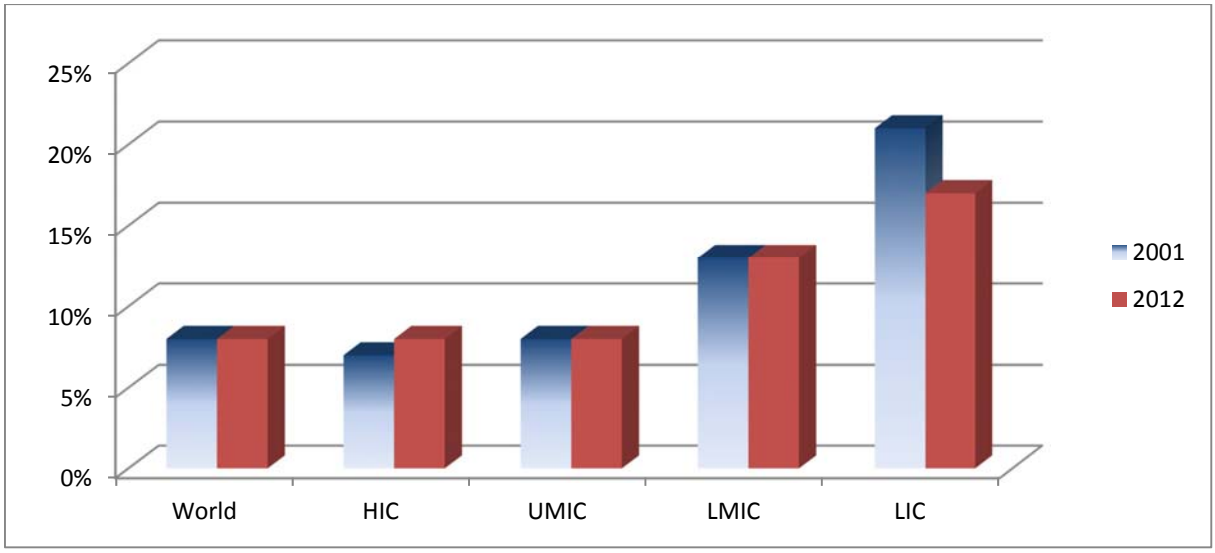
Source: UNCTAD

Although quantitative studies continue to evaluate trade based on tariffs as trade barriers, much attention has now shifted to NTMs. However, data on NTMs are less transparent compared to tariffs; thus, it is more difficult to evaluate. The most important is to analyze what have been the impacts of NTMs on the trade flow. Thus, the analysis can be directly addressed at the trade flows among countries.

4.3.3. Food Trade

Trade plays an important role in the food equation of most countries. It can be alternative when supply of food from own production does not meet demand because the inelastic nature of food production can only respond slowly to increasing demand (Haile et al., 2013). Food trade is also the source of income for many countries, especially for the main food producer countries.

Figure 4.5. Shares of food in total trade



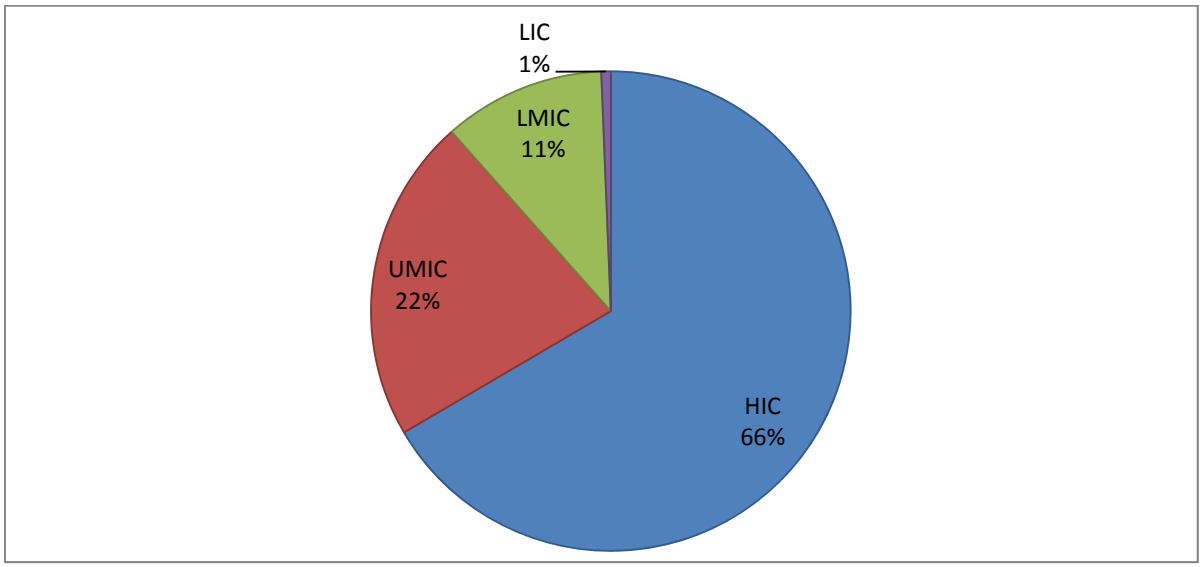
Note: HIC (High Income Countries); UMIC (Upper Middle Income Countries); LMIC (Lower Middle Income Countries); LIC (Lower Income Countries)
Source: Author calculation based on UN COMTRADE

The shares of food in the total world trade are relatively small and remain stable over years at about 8 percent in 2001 and in 2012 (Figure 4.5). The highest shares of food in the total trade are found for LIC which account for 21 percent in 2001 and have decreased to 17 percent in 2012. The shares' decrease is not because LIC trade less food, but their trade in other sectors has

increased more than in food sector. This is an indication that LIC are more connected to the world trade system. Change in shares of food in the total trade is also the case for HIC have higher food shares in 2012 compared to 2001. Other country groups' shares remain stable across years at 8 and 13 percent for UMIC and LMIC, respectively.

The total value of the world food trade in 2012 is USD 2.6 billion[30]. HIC have the highest shares that account for 66 percent of the total world food trade, followed by UMIC, LMIC and LIC (Figure 4.6). The data show that shares of country groups in world food trade are consistent with their income levels. The higher the income, their shares in the world food trade are also higher. Although the shares of food in the total trade of LIC are relatively higher compared to those of other country groups, their total value accounts for only 1 percent of the world food trade.

Figure 4.6. Shares of countries in world food trade



Note: HIC (High Income Countries); UMIC (Upper Middle Income Countries); LMIC (Lower Middle Income Countries); LIC (Lower Income Countries), Source: Author calculation based on UN COMTRADE

[30] UN COMTRADE via WITS, Standard International Trade Classification (SITC) is use to categorize food

4.4. Theoretical Framework

The gravity framework that is employed in this study suggests that the patterns of trade are explained by the forces behind trade flows between two trading partners. The theoretical underpinning of the model was inspired by the Newtonian theory of gravitation, where countries are mutually attracted to trade just like planets that are mutually attracted in proportion to their sizes and proximity. After being conceptualized for the first time by Jan Tinbergen[31] in 1962, gravity model is considered as the workhorse of international trade with fortunate empirical validity.

Initially, there was no theoretical foundation behind the econometric model used as the ex-post analysis of trade pattern between the two countries. One of the very first theoretical explanations for the gravity model was the work of Anderson (1979), which is based on a demand function using Armington elasticity[32] where each country produces and sells goods on the international market that are differentiated from other goods produced in other countries. Later works have built gravity model in the monopolistic competition frameworks (Helpman and Krugman, 1985), Heckscher-Ohlin framework (Deardorff, 1998) and the Ricardian framework (Eaton and Kortum, 2002). The gravity models work well in these multiple existing approaches, each with different assumptions.

The gravity model in the Ricardian framework builds on the assumption that trade is beneficial due to comparative advantage. A country that is less productive in absolute terms can nevertheless have a comparative advantage in the production of a good by differing costs in production or production technologies. In the Heckscher-Ohlin, international trade occurs as a result of relative differences in factor endowments between countries. Countries tend to export goods which are produced by relatively much of their abundant factor endowments and import goods which are relatively manufacture-intensive. Consequently, the exported goods are relatively cheap to produce, whereas the imported goods are relatively expensive in production due to factor scarceness. The Helpman and Krugman approach assumes increasing returns to scale and a state of monopolistic competition between firms. The approach usually is used to

[31] Jan Tinbergen was an economist with physics degree. He was the first Nobel Prize winner in economic science which he received in 1969 together with Ragnar Frisch

[32] Armington elasticity refers to the work by Paul Armington (1969) that products traded internationally are differentiated by country of origin

explain intra-industry trade, which is the trade of products belonging to the same categories. Economies of scale incentivize the countries to produce selected products and trade with other countries producing some other products.

International trade is basically not so much different from domestic trade as the motivation and behavior of traders involved do not change fundamentally regardless of whether trade is across national border or within a nation. The main difference is that international trade is typically more costly as crossing national borders usually imposes additional costs such as tariffs or other costs associated with country differences such as language and culture. These additional costs are usually well captured in the gravity equation. The gravity model essentially explains how countries attracted to goods produced in other countries and this attraction is reduced by costs related with geographical distance and other costs associated with countries' differences.

Bilateral trade flows are also heavily influenced by trade agreements. In a non-discriminatory trade, countries are able to export their products if they are the most efficient producers and to import from the lowest-cost suppliers. Trade agreements change this pattern by lowering barriers to trade among member countries. Member countries of an agreement which could be not the most efficient producers might be able to export their products to other member countries simply because they enjoy tariff preferences in the agreements.

Economic motivation is in particular important consideration in the choice of partner countries in establishing or joining an agreement. Welfare gains from trade are expected from expanding the market. Nevertheless, economic motivation is not always behind the deal of countries to form an agreement. Empirical studies suggest that the welfare effects of trade agreements can be positive or negative; thus, the expected benefit could be non-economic factors. Wonnacott and Lutz (1989) argue that political factors are also important for countries in determining with which countries they are likely to form trade agreements.

Standard method to evaluate the impacts of trade agreement on bilateral trade flows is usually to include trade agreement as dummy variable in the right-hand side of the gravity equation. The direction is clear, to what extent trade agreement influences trade flows between countries. However, trade agreement might not be purely exogenous when one considers these economic

and political factors in driving countries' choices of partners in forming or joining trade agreement.

4.5. Model Specification

The basic formulation of the gravity equation that will be used in the study is the following:

$$(1) \qquad X_{ijt}^{k} = \alpha_1 Y_{it} + \alpha_2 Y_{jt} + \sum_{m=1}^{M} \beta_m Z_{ij(t)}^{m} + \gamma_a WTO_{ijt} + \delta_n RTA_{ijt} + \varepsilon_{ijt}$$

where X_{ijt}^{k} is unidirectional trade[33] nominal value at time t with the superscript k to note that the estimation will distinguish the value of total trade and food trade to allow for comparison between the two. Y_{it} and Y_{jt} are economic size represented by gross domestic product (GDP) of country i and country j at time t respectively. $Z_{ij(t)}^{m}$ is a vector of observable trade cost or trade promotion which include bilateral distance, tariffs[34] and five dummies denoting whether any of the country pair is landlocked country, shared border, shared common language, have colonial link and were colonized by the same country. WTO_{ijt} and RTA_{ijt} are dummy variables take the value of 1 if the two countries are members of the WTO and if the two countries are ever in the same RTAs at time t, respectively, and take the value of 0 otherwise. ε_{ijt} is error term. The standard independent variables in the gravity model and the expected signs are described in Table 4.3. The main interest in this study is the coefficient γ and δ which show the estimation of the impact of WTO and RTA on members' food trade, respectively.

The use of unidirectional trade nominal value is to avoid typical mistakes in the gravity model because of averaging reciprocal trade flows and inappropriate deflation of trade flows (Baldwin and Taglioni, 2006). Many gravity models work with the average of two way exports, i.e. average of country i imports from country j and country i export to country j. Baldwin and Taglioni show that unidirectional bilateral trade value is more theoretically well founded since

[33] Unidirectional trade could be import of country i from country j or export of country i to country j, here import value is used.

[34] For total trade, total tariff is used. For food trade, an additional variable of food tariff/total trade is added in the specification.

the gravity model is a modified expenditure function which explains the value of spending by one country on the goods produced by another country.

Table 4.3. Standard gravity independent variables and expected signs

Independent Variables Descriptions	**Expected Signs**
Gross domestic product of the importer country i	+
Gross domestic product of the exporter country j	+
Geographical distance	-
Tariffs	-
Landlocked	-
Shared border	+
Common language	+
Colonial link	+
Common colony	+

There are several issues that need to be addressed related to the potential problems in estimating the standard gravity equation. First, sample selection bias which can be addressed by including importer and exporter specific fixed effects as suggested by Baier and Bergstrand (2007), and the equation can be written as:

$$(2) \qquad X_{ijt}^{k} = \emptyset_i + \emptyset_j + \emptyset_t + \alpha_1 Y_{it} + \alpha_2 Y_{jt} + \sum_{m=1}^{M} \beta_m Z_{ij(t)}^{m} + \gamma_a WTO_{ijt} + \delta_n RTA_{ijt} + \varepsilon_{ijt}$$

where $\emptyset_i$, $\emptyset_j$ and $\emptyset_t$ denote importer, exporter and time dummies respectively. All other variables are as described in the equation (1).

Including importer and exporter specific fixed effects as in equation (2) can also address another potential problem related to relative trade cost or "multilateral trade resistance" as called by Anderson and van Wincoop (2003). They emphasized that the propensity of trade between two countries is not simply determined by absolute trade cost between the two, but also on each country's trade cost toward its partners relative to their partners in the rest of the world. For instance, relative trade cost between two countries surrounded by oceans is different from country pair surrounded by other exporting or importing countries. Ignoring multilateral trade resistance (MTRs) could lead to biased estimation results (Anderson and van Wincoop, 2003;

Feenstra, 2004). However, multilateral trade resistances are difficult to measure as they are not directly observable. Importer and exporter fixed effects are included to control all unobserved characteristic for both importer and exporter countries.

In a panel setting, it is also possible to include time varying fixed effects to control all characteristic of importer and exporter countries that may vary over time. Including these importer and exporter time varying fixed effect yields the equation as the following:

$$X_{ijt}^{k} = \emptyset_{it} + \emptyset_{jt} + \emptyset_{t} + \sum_{m=1}^{M} \beta_m Z_{ij(t)}^{m} + \gamma_a WTO_{ijt} + \delta_n RTA_{ijt} + \varepsilon_{ijt} \quad (3)$$

where $\emptyset_{it}$ is country i fixed effect at time t and $\emptyset_{jt}$ is country j fixed effect at time t. Variables that are country and time specific, including importer and exporter GDP (Y_{it} and Y_{jt}) are absorbed by $\emptyset_{it}$ and $\emptyset_{jt}$. All other variables are as defined previously.

Moreover, it may be the case that countries are likely to form trade agreements with their partners which already trade a lot which can lead to bias estimation results. To address this issue, we will use country-pair fixed effect which can rule out all unobserved bilateral characteristics between the pair countries. The equation including the country-pair fixed effect can be written as:

$$X_{ijt}^{k} = \emptyset_{ij} + \emptyset_{t} + \alpha_1 Y_{it} + \alpha_2 Y_{jt} + \sum_{m=1}^{M} \beta_m Z_{ij(t)}^{m} + \gamma_a WTO_{ijt} + \delta_n RTA_{ijt} + \varepsilon_{ijt} \quad (4)$$

where $\emptyset_{ij}$ is country-pair fixed effect and $\emptyset_{t}$ is time effect. All other variables are as defined previously.

Applying gravity model into a sector level of trade such as food is not entirely straightforward. The reason is that there are more differences between countries when one aims to analyze a specific sector. For instance, not all countries are categorized as food producers. These differences, however, can be well captured by including country specific fixed effects in the estimation. Another consideration that needs to be specially addressed in analyzing sectoral trade is zero trade values. It is likely that zero trade values are more frequent when estimating

specific sector of trade. The use of logarithmic transformation in the standard gravity model creates immediate problem when trade value is zero, since log of zero is undefined. Omitting zero variables may result in bias estimation (Santos Silva and Tenreyro, 2006). As an alternative, Santos Silva and Tenreyro suggest to use Poisson Pseudo maximum Likelihood (PPML) estimator. They show that PPML provides robust estimation in the presence of heteroscedasticity. PPML estimation can be estimated by solving the following first order condition:

$$\sum_p (X^p - \exp(Z^p \hat{\beta})) = 0 \quad (5)$$

where p denotes country pairs, X^p is unidirectional trade (i.e. imports) between the country pairs expressed in levels not in logarithms and Z^p is the full vector of the gravity equation as defined in equation (1).

4.6. Data Description

Bilateral food and total trade data are derived from the United Nations Commodity Trade Statistics Database (UN COMTRADE) via World Integrated Trade Solution (WITS). The definition of food uses standard product in the Standard International Trade Classification (SITC, revision 1) 0+1+22+4. Specifically it includes food and live animal, beverages and tobacco, oil seeds, oil nuts, oil kernels, animal and vegetable oils/fats.

The database developed in this study consists of 162 countries around the globe over the period 1991 – 2012 with three years intervals (1991, 1994, …, 2012). There are maximum 208656 (162x161x8) observations with the number of zero trade observations are 90867 (43.5%) and 144240 (69%) for total trade and food trade respectively.

Gross domestic product (GDP) in nominal US dollars comes from World Development Indicators[35] of the World Bank. Data on total tariffs and food tariffs come from Trade Analysis and Information system (TRAINS) database and derived via WITS[36]. Data on distance, landlocked, contiguous border, common language, colonial link and common colony are taken from *Centre d'Etudes Prospectives et d'Informations Internationales* (CEPII). WTO database is the main source for data on WTO membership and regional trade agreements. There are 188 RTAs included in the sample covering all regional trade agreements involving sample countries in the analysis that enter into force from 1960 to 2012. Countries' level of development is represented by income level; high income countries is categorized as developed countries, middle and low income countries are categorized as developing countries. The levels of income are according to GNI per capita, taken from the World Bank database.

4.7. Results Discussions

The basic estimation results are presented in Table 4.4. The first estimation employs ordinary least squares (OLS) with time, importer and exporter fixed effects. On the total trade as dependent variable, all coefficients are statistically significant and show the correct signs as expected. Economic size (GDP) both importer and exporter positively impact total trade. Tariff, Distance and landlocked negatively impacts trade, while sharing border, language and colonial ties stimulate trade. For food trade, statistically significant coefficients are found for GDP importer, tariff, distance and shared border. Other variables are not statistically significant. Tariff is found positively impacts food trade while food tariff relative to total tariff is found statistically insignificant.

The main interests of the estimation are the coefficients of WTO and RTAs that show to what extent both agreements, at the multilateral and regional levels, impact trade flow among participant countries. For total trade as dependent variable, the membership of the WTO results in a coefficient 0.216 that is positive and statistically significant; suggesting that trade among

[35] In some cases, data are taken from national statistics to supplement World Bank data when it is missing or incomplete.
[36] When data on tariffs is missing in some years of a particular country, the tariffs of the nearest year is used and the earlier year comes at the first place.

WTO members is about 22 percent higher relative to non-members. The result for RTA membership is also positive and statistically significant with the coefficient 0.250, suggesting that joining RTA increase members' trade about 25 percent on average compared to other countries trade without RTAs. The key question is whether WTO and RTAs have facilitated food trade among the participant countries. However, no statistically significant results are found from the estimations. the coefficient of WTO is negative (-0.0540) and the coefficient of RTAs is positive (0.0303), both are statistically insignificant.

The results of the estimation when controlling for all characteristics of the importer and exporter that may vary over time by including time varying fixed effects do not change a lot from the previous estimation. Nearly all coefficients of the standard gravity model explanatory variables consistently show the same signs and significance level as in the previous estimation. Only tariff is much different but with the same sign with the previous specification with the coefficient of (-0.102) and statistically significant at 1 percent. In this estimation, GDP importer and GDP exporter are absorbed by the time varying fixed effects. However, this does not really matter since our main interest is on the coefficient of WTO and RTA. We found the coefficient of the WTO is 0.231 which is positive and statistically significant, suggesting that the WTO have increased trade among its member countries by 23 percent on average compared to non members. The coefficient of RTA is 0.169, positive and statistically significant, suggesting that trade among RTA members is relatively 17 percent higher compared to countries without RTAs. For food trade, we found that the coefficient of tariff is statistically insignificant. All other variables are consistent with the previous specification in terms of signs and significance levels. The magnitudes of the coefficient are also not much different. For the variable of interests, like in the previous specification, the coefficient of WTO membership is negative (-0.0115) and statistically insignificant. However, RTAs is positive and statistically significant with coefficient 0.115 which suggests that food trade among RTA members are relatively about 12 percent higher than non-members on average.

Table 4.4. Basic results of the gravity estimations

	OLS (1)		OLS (2)		OLS (3)		PPML	
	Total Trade	Food Trade	Total trade	Food Trade	Total Trade	Food Trade	Total Trade	Food Trade
GDP Importer	0.967***	0.775***			1.002***	0.830***	0.734***	0.792***
	(0.0263)	(0.0396)			(0.0265)	(0.0403)	(0.0321)	(0.0707)
GDP Exporter	0.503***	-0.00963			0.526***	-0.0002	0.696***	0.0527
	(0.0287)	(0.0358)			(0.0292)	(0.0366)	(0.0315)	(0.0409)
Total Tariff	-0.0108*	0.0530***	-0.102***	0.0174	-0.00650	0.0356***	0.00222	0.0090
	(0.0058)	(0.0097)	(0.0121)	(0.0132)	(0.00573)	(0.0099)	(0.00959)	(0.0100)
Food/Total Tariff		0.0067		-0.0032		0.0025		0.0002
		(0.0127)		(0.0133)		(0.0131)		(0.0228)
Distance	-1.600***	-0.329***	-1.613***	-0.317***				
	(0.0207)	(0.0335)	(0.0208)	(0.0340)				
Landlocked	-0.916***	0.285	-2.068***	-0.301				
	(0.197)	(0.348)	(0.330)	(0.407)				
Shared Border	0.337***	0.469***	0.333***	0.463***				
	(0.113)	(0.170)	(0.114)	(0.173)				
Common Language	0.737***	0.0663	0.747***	0.0610				
	(0.0432)	(0.0718)	(0.0434)	(0.0727)				
Colonial Link	1.111***	-0.164	1.100***	-0.155				
	(0.102)	(0.177)	(0.103)	(0.183)				
Common Colony	0.948***	-0.0023	0.936***	-0.0126				
	(0.0557)	(0.0882)	(0.0560)	(0.0894)				
WTO	0.216***	-0.0540	0.231***	-0.0115	0.193***	-0.0489	0.108***	0.108
	(0.0264)	(0.0366)	(0.0677)	(0.111)	(0.0270)	(0.0375)	(0.0299)	(0.119)
RTA	0.250***	0.0303	0.169***	0.115**	0.176***	-0.0380	0.0698**	0.223***
	(0.0231)	(0.0466)	(0.0258)	(0.0475)	(0.0266)	(0.0567)	(0.0355)	(0.0765)
t dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
i and j dummies	Yes	Yes	No	No	No	No	No	No
it and jt dummies	No	No	Yes	Yes	No	No	No	No
ij dummies	No	No	No	No	Yes	Yes	Yes	Yes
Observations	117,789	64,416	117,789	64,416	117,789	64,416	178,128	116,856
Number of pair id	22,266	14,607	22,266	14,607	22,266	14,607	22,266	14,607

*Note: All variables are in logarithm, except the dummies and the dependent variables in ppml estimations. Food/total tariff is the change of food tariff relative to total tariff. Robust standard errors clustered by country pairs are in parentheses, * p<0.1, ** p<0.05, *** p<0.01.*

In the estimations of OLS with bilateral country pair fixed effect to control for all unobserved country-pair characteristics, we found that both GDP importer and exporter positively impacts trade with the coefficient of 1.002 and 0.526 that are statistically significant. The coefficient of tariff is negative (-0.0065) but statistically insignificant and all other country-pair specific variables are absorbed by the country-pair fixed effects. For the variable of interests, the coefficient of WTO is 0.193, positive and statistically significant, suggesting that the WTO have increased trade among its member countries by 19 percent on average compared to non-members. RTAs is also positive and statistically significant with coefficient 0.176 which suggests that food trade among RTA members are about 18 percent higher than non-members on average. For food trade, the two coefficients of WTO and RTAs are statistically insignificant.

Further estimation of the gravity model employs Poisson Pseudo-Maximum Likelihood (PPML) estimator. In this specification, bilateral country-pair fixed effect is used to control all unobserved bilateral country-pair characteristics. For total trade, GDP importer and GDP exporter are found positive and statistically significant as expected with the coefficient of 0.734 and 0.696 respectively. For tariff, the coefficient is statistically insignificant, while all other country-pair specific variables are absorbed by the bilateral fixed effect. For food trade, as in the previous estimations using OLS, only GDP importer of the standard gravity variables that is found positive and statistically significant. For the variables of interest, the WTO and RTAs are positive and statistically significant for total trade with the coefficients of 0.108 and 0.0698 respectively, suggesting that the trade of WTO members and RTAs members are higher about 11 percent and 7 percent respectively compared to non-members. For food trade, the coefficient of WTO is found statistically insignificant, while RTA is positive and statistically significant with the coefficient of 0.223.

The results show that nearly all signs and significance levels of the variables estimated are consistent with slightly different magnitudes in all different specifications. However, interesting result comes from tariff, especially for food trade, which shows positive sign suggesting that the increase of tariff increases food trade. The study further checks this result by estimating the effect of WTO and RTA membership on tariff. This is important since the purpose of trade agreements is basically to reduce trade barriers including through tariff reduction. Moreover, the test is conducted to find out whether higher tariff reduction in one sector such as food discourage

trade in other sector or vice versa. The effects of the WTO and RTAs on tariff are tested using three categories; total tariff, food tariff and food tariff relative to total tariff. On the third category, we divide the food tariff by total tariff to analyze the increase/reduction of food tariff relative to total tariff.

Table 4.5. Impacts of WTO and RTAs on Tariff

	Total Tariff	**Food Tariff**	**Food Tariff/Total Tariff**
WTO	0.107***	0.136***	-0.0289***
	(0.00743)	(0.00685)	(0.00584)
RTA	-0.240***	-0.0727***	-0.168***
	(0.0136)	(0.0126)	(0.0107)

*Total tariff is used for total trade and food tariff is used for food trade, both using 1+tariff specification. Time and bilateral country-pair effects are included but not reported. Robust standard errors are in parentheses, * p<0.1, ** p<0.05, *** p<0.01.*

Only RTAs is found to have significantly reduced tariff and food tariff, while the WTO is found to have positive impacts on tariff. The results are not as expected and that are questioning the tariff reduction effects of the memberships of the WTO. On the food tariff relative to total tariff, we found negative signs for both WTO and RTAs. This indicates that the WTO and RTAs memberships result in higher food tariff reduction relative to total tariff.

Further investigation is conducted to analyze possible asymmetries in trade agreements especially between developed and developing countries and countries in different regions. Since all specifications in the previous estimations show consistent results, the following estimations only employ PPML with considerations that addressing zero trade values in analyzing sector trade such as food is highly important. Bilateral country pair fixed effect is included in the estimation to control all unobserved variables that are country-pair specific.

Table 4.6. Results of developed and developing countries

	Total Trade	Food Trade
WTO both developed	-0.189***	0.0298
	(0.0408)	(0.0884)
WTO both developing	0.587***	0.401***
	(0.0711)	(0.125)
WTO developed and developing	0.161***	0.0393
	(0.0374)	(0.125)
RTA both developed	-0.0582	-0.0139
	(0.0656)	(0.143)
RTA both developing	0.141**	0.322
	(0.0714)	(0.213)
RTA developed and developing	0.0819*	0.235**
	(0.0468)	(0.0932)
Country-pair and Year dummies	Yes	Yes
Observations	178,128	116,856
Number of pair id	22,266	14,607

*Note: variables included but not reported: gdp importer, gdp exporter and tariffs. Distance, landlocked, shared border, common language, common colony, colonial link are absorbed by the country-pair fixed effects. Robust standard errors are in parentheses, * p<0.1, ** p<0.05, *** p<0.01.*

Table 4.7. Impacts of WTO in different regions

	Total Trade	Food Trade
WTO both Asia	0.0762	-0.327***
	(0.0862)	(0.108)
WTO one Asia	0.170***	0.102
	(0.0369)	(0.0636)
WTO both Africa	0.608***	0.762***
	(0.164)	(0.202)
WTO one Africa	0.160***	0.0691
	(0.0577)	(0.0828)
WTO both America	0.0443	0.113
	(0.0891)	(0.0978)
WTO one America	0.202***	-0.0057
	(0.0643)	(0.0831)
WTO both Europe	0.122*	0.895***
	(0.0675)	(0.250)
WTO one Europe	(0.0354)	0.0028
	(0.0368)	(0.0674)
Country-pair and Year dummies	Yes	Yes
Observations	178,128	116,856
Number of pair id	22,266	14,607

*Note: variables included but not reported: gdp importer, gdp exporter and tariffs. Distance, landlocked, shared border, common language, common colony, colonial link are absorbed by the country-pair fixed effects. Robust standard errors are in parentheses, * p<0.1, ** p<0.05, *** p<0.01.*

The results suggest that WTO negatively impacts trade when both countries are developed but positively impacts trade when trade involves developing countries. While for food trade, positive impacts are found when both counties are categorized as developing countries. RTAs are also found to have positive impacts when trade is between developed and developing countries or both parties are developing countries. The study found statistically insignificant effect of the RTAs on trade when both countries are developed countries. While for food trade, positive and statistically significant effect is found when food trade is between developed and developing country.

From the estimation of the WTO based on regions, the WTO is found to have different impacts in different regions (Table 4.7). The highest positive impact of the WTO on trade is found for trade between African countries with the coefficient of 0.608. For food trade, the highest positive impact is found for food trade between European countries with the coefficient of 0.895. The results also indicate that food is traded more within a region rather that traded across regions.

The study further analyses several specific RTAs around the globe (Table 4.8). RTAs analysed are selected from different continents to see their impacts on food trade. For Asia, this include ASEAN Free Trade Area (AFTA) and Pan Arab Free Trade Area (PAFTA). In Africa, RTAs analyzed are Common Market for Eastern and Southern Africa (COMESA), Economic Community of West African States (ECOWAS) and Southern African Development Community (SADC). North American Free Trade Agreement (NAFTA) and Southern Common Market (MERCOSUR) are taken for American countries, and European Union (EU) for Europe.

COMESA, ECOWAS, EU, MERCOSUR and SADC are found to have positive impacts on trade among the members with ECOWAS being the highest with the coefficient of 1.608. Among these RTAs, only EU is found to also positively impacts food trade among its members with the coefficient of 0.940 which suggests that food trade among its members is about 94 percent higher compare to non-members. Another RTA that found to have positive impacts on food trade is NAFTA. However, no statistically significant result is found that NAFTA has also positive impacts on total trade among its members.

Table 4.8. Results of selected RTAs around the globe

	Total Trade	**Food Trade**
AFTA	-0.117	0.456
	(0.224)	(0.309)
COMESA	1.183***	0.455
	(0.377)	(0.689)
ECOWAS	1.608***	1.168
	(0.485)	(0.721)
EU	0.170***	0.940***
	(0.0391)	(0.0782)
MERCOSUR	0.466***	-0.266*
	(0.141)	(0.157)
NAFTA	0.0628	3.177**
	(0.112)	(1.324)
PAFTA	-0.197	-0.375
	(0.165)	(0.246)
SADC	1.045***	-0.148
	(0.404)	(0.190)
Country-pair and Year dummies	Yes	Yes
Observations	178,128	116,856
Number of pair id	22,266	14,607

*Note: variables included but not reported: gdp importer, gdp exporter and tariffs. Distance, landlocked, shared border, common language, common colony, colonial link are absorbed by the country-pair fixed effects. Robust standard errors are in parentheses, * p<0.1, ** p<0.05, *** p<0.01.*

4.8. Conclusions

The fast increase and excessive volatility of food prices in recent years are a significant indication of change in the global food market and a strong signal of resource scarcity (von Braun et al., 2014). Therefore, global food security is only possible when food can move freely from countries of surplus to countries of deficit and should not be prevented by international trade distortions.

This chapter is questioning the contributions of the enormous number of trade agreements in the world trade system in strengthening food security at the worldwide level. The focus of the study is investigating whether trade agreements, both multilateral i.e. the WTO and at the regional level enhance food trade among the participant countries and bring the world into a freer flow of food.

Empirical results suggest that the multilateral and regional trade institutions indeed have delivered significant positive impacts on trade but not necessarily in the food sector. The findings suggest that only RTAs enhance food trade among their member countries whereas no evidences can be found that the WTO membership increase food trade among the members. Surprisingly, however, contrary to general believes where the WTO is often criticized by benefiting the developed countries more than the developing ones, we found that the WTO has facilitated trade as well as food trade of the developing countries more than of the developed ones. We found positive impacts of the WTO on trade when trade involves developing countries. The negative sign of trade between developed countries also indicates that the developed countries trade more with the developing countries than with the other developed ones. The results indicate that developing countries are more connected to the global trade than before.

The findings also suggest that trade among countries is likely to have gone beyond only with traditional partners and beyond only with partner country in the same region. Food trade however, is still concentrated based on regions. The WTO is found to have stronger effects on food trade when the country-pair belongs to the same region than food trade between countries in different regions. The analysis on selected RTAs around the globe also supports the evidences.

Trade agreements, both at multilateral and regional level, are intended to reduce trade barriers including through tariff elimination. However, the results suggest that no evidences can be found that the WTO has reduced tariffs among the member countries. Only RTAs are found to have reduced tariffs among the members. Nevertheless, the positive effects of the WTO on trade show that the cooperation in the multilateral trade institution is more than only reducing tariffs. The member countries seems to prefer trade more with other members compared to trade with non-members even without tariff facilitation. On the other hand, no tariff reduction effect of the WTO on food trade confirms the findings that the food sector in the cooperation is still left behind.

Stronger cooperation and coordination among countries is still needed to ensure the delivery of food to the people at all times in all places. The success of the Ninth Ministerial Meeting of the WTO which has delivered the Bali Package can be an important momentum in strengthening international trade cooperation at the multilateral level including in the food sector and bring the

world to a freer flow of food. Way forward is to ensure that the agreements can be implemented and bring benefits to global food security.

Chapter 5. General Conclusions

In the current global economy that has been increasingly integrated, strengthening national policies alone is not sufficient to achieve more stable food prices. The two recent food price crises of 2008 and 2011 have shown evidences how markets between countries link with each other. Shocks in one part of the world spread easily to the other parts and disrupted the entire global food system.

This dissertation discussed the cooperation among countries in ensuring food security and preventing food prices from excessive volatility with special focus on Indonesia. It included three levels of analytical inquiry: national, regional and global levels. The dissertation started by providing an analysis of food price dynamics in Indonesia and further continued with a review of the cooperation at the regional level to mitigate excessive food price volatility and an investigation on the potential of international and regional collaboration to enhance food trade.

Indonesia provided an interesting case on the studies of cooperation and its relation to food price dynamics. The country is among the countries that experience high food price volatility as well as high risk of food and nutrition security. While the impact of food price volatility on food security is beyond the analysis of this study, ensuring affordable food prices to everyone in the country is highly important for Indonesia since the large part of its population are still living in poverty and are vulnerable to poverty.

The results of the analysis showed that food price movements in terms of volatilities, spikes and trends in many different markets in Indonesia can be forecasted by focusing only on the key markets. Using the concept of price transmission and market integration, the study found that food price movements in the 25 major markets in Indonesia for the period of 2000-2013 can be monitored by monitoring food price movements in Surabaya and Palangkaraya. The study also found that it is relevant to predict potential crisis using the information from the market price. Although the results indicated that not all alert phases of the two key markets lead to crises, monitoring price movements can help to better anticipate possible price crisis events in the country. In a large developing country such Indonesia, where markets are spread in many different islands, the results become important as it is possible to monitor price movements in the

country with few resources. Moreover, the approach can be useful in integrating policies in many different markets in Indonesia. In addition, Granger-causality test using Bangkok price as international market showed that price movements in 20 major markets in Indonesia follow price movements in the international markets. Thus, although international price movements cannot fully explain the price dynamics in all markets in Indonesia, monitoring international price movements can also be an alternative to forecast price movements in a lot of major markets in Indonesia.

The study also found that cooperation at the regional level to pursue more stable food prices is possible. APTERR as a joint public reserve presents as a regional effort to face common challenges in ensuring food security. One of the main concerns of public reserve is that the cost is relatively high. This study showed that the cost of holding stocks can be reduced by cooperation. Simulations showed that regional cooperation significantly reduces the required stocks which will definitely reduce the costs of holding them. Adding transportation costs due to the decentralized storage in different countries still benefits member countries through fiscal cost reduction.

At the global level, empirical results suggest that the multilateral and regional trade institutions have delivered significant positive impacts on trade but not on food sector. The findings suggest that only RTAs enhance food trade among their member countries whereas no evidence can be found that the WTO increases food trade among the members. Surprisingly, however, contrary to the general believes where the WTO is often criticized by benefiting the developed countries more than the developing ones, the study found that the WTO has facilitated trade as well as food trade of the developing countries more than of the developed countries. Yet, there are still asymmetries in the regional and multilateral trade agreements, between developed and developing countries and between countries in the different regions, especially in the food sector. These confirm that food sector is still a sensitive issue for many countries.

The findings of this study reaffirm the importance of collaboration among countries in ensuring a sustainable level of food prices. Despite that there are winners and losers in the agreements between countries, a compromise for mutual benefits still can be reached. Southeast Asian countries and their partners have shown that the cooperation at the regional level is possible. Moreover, the Bali Package, as the first agreement in the history of the WTO that was approved

by all member countries, is another example of cooperation at the global level, showing that mutual understandings can be found. The cooperation may go further to the extent that brings benefits to all participants and can be effective in addressing the problems. Another most important point is to ensure that the agreements can be implemented in accordance to what have been agreed and can help to strengthen global food security.

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Appendix

Table A.2.1. Summary statistics

Market	Obs	Mean	Std. Dev.	Min	Max
Banda Aceh	168	5476.87	2256.13	2552.45	9745.2
Medan	168	5516.15	2130.11	2895	9387.17
Padang	168	5918.94	2759.36	2751.46	12273.25
Riau	168	5775.55	2576.28	2772.5	11310.25
Jambi	168	5138.05	2349.91	2326.56	9712.17
Palembang	168	5043.33	2257.42	2186.25	9210.83
Bengkulu	168	5018.60	2095.20	2137.81	8699
Bandar Lampung	168	5063.32	2367.07	2243.75	10037.33
Jakarta	168	5802.56	2487.06	2724.29	10935
Bandung	168	5118.59	2134.40	2311	8676
Semarang	168	4994.76	2195.93	2272	8966.67
Yogyakarta	168	4868.41	2221.75	2141.33	9026.4
Surabaya	168	5068.46	2312.94	2255.31	9623
Denpasar	168	5180.17	2202.66	2422.5	9370.75
Mataram	168	4577.74	2072.31	1954.69	9091
Kupang	168	5208.28	2180.96	2540.38	9754
Pontianak	168	5515.88	2727.67	2437.5	10480.8
Palangkaraya	168	6097.42	2892.92	2915	11465.91
Banjarmasin	168	5412.18	3040.06	2279.36	11723.75
Samarinda	168	5426.26	2379.46	2485.34	9999.25
Manado	168	5243.97	2110.03	2741.67	8985.5
Palu	168	4661.19	2053.29	2016.67	8183.8
Makassar	168	4491.90	1840.41	2193.75	7739.5
Kendari	168	4832.60	2174.21	1817.81	8538.17
Jayapura	168	6183.77	2410.93	3100	10633.67

Source: own calculation based on BPS database

Table A.2.2. Population and Poor Population per Province in Indonesia 2014 (000)

Province	Population	Poor Population	%
Aceh	4930.659	837.42	16.98
Sumatera Utara	13808.442	1360.60	9.85
Sumatera Barat	5149.075	354.74	6.89
Riau	6235.294	498.28	7.99
Jambi	3359.111	281.75	8.39
Sumatera Selatan	7969.898	1085.80	13.62
Bengkulu	1852.024	316.50	17.09
Lampung	8048.412	1143.93	14.21
Kepulauan Bangka Belitung	1353.652	67.23	4.97
Kepulauan Riau	1940.242	124.17	6.40
DKI Jakarta	10103.494	412.79	4.09
Jawa Barat	46196.846	4238.96	9.18
Jawa Tengah	33582.041	4561.83	13.58
DI Yogyakarta	3661.028	532.59	14.55
Jawa Timur	38665.763	4748.42	12.28
Banten	11775.682	649.19	5.51
Bali	4120.698	195.95	4.76
Nusa Tenggara Barat	4789.434	816.62	17.05
Nusa Tenggara Timur	5059.695	991.88	19.60
Kalimantan Barat	4734.718	381.92	8.07
Kalimantan Tengah	2453.75	148.83	6.07
Kalimantan Selatan	3938.794	189.50	4.81
Kalimantan Timur	4005.566	252.68	6.31
Sulawesi Utara	2392.301	197.56	8.26
Sulawesi Tengah	2844.448	387.06	13.61
Sulawesi Selatan	8452.463	806.35	9.54
Sulawesi Tenggara	2460.512	314.09	12.77
Gorontalo	1120.513	195.10	17.41
Sulawesi Barat	1284.199	154.69	12.05
Maluku	1665.304	307.02	18.44
Maluku Utara	1144.254	84.79	7.41
Papua Barat	858.495	225.46	26.26
Papua	3107.987	864.11	27.80
Indonesia	**253064.794**	**27727.78**	**10.96**

Source: Statistics Indonesia, 2014.

Table A.3.1. Correlation of supply shortfalls from target consumption of 97%

	BRN	KHM	IDN	LAO	MYS	MMR	PHL	SGP	THA	VNM	CHN	JPN	KOR
BRN	1												
KHM	-0.0124	1											
IDN	-0.1529	0.0534	1										
LAO	-0.0805	-0.0614	0.3666*	1									
MYS	0.1322	0.1505	0.0084	0.15	1								
MMR	-0.2106	0.0689	0.1542	0.1115	0.6032*	1							
PHL	0.0871	-0.0514	-0.0697	0.0825	0.0027	-0.1111	1						
SGP	-0.1477	0.3081	-0.1211	-0.1792	-0.1117	-0.1291	0.0638	1					
THA	-0.1184	-0.1699	0.0066	0.0013	-0.0322	-0.0356	0.4060*	0.3721*	1				
VNM	-0.1455	-0.1263	-0.0643	-0.1139	-0.0923	-0.1028	-0.0728	0.0142	0.0815	1			
CHN	0.4617*	-0.0895	-0.0635	-0.1097	0.2073	-0.0577	-0.072	0.0488	0.1212	-0.0664	1		
JPN	0.0248	-0.0494	0.224	0.5026*	-0.0518	-0.1373	-0.0028	-0.1397	-0.0782	-0.0897	0.2056	1	
KOR	0.2939	0.0595	-0.0642	-0.0528	0.5680*	0.109	-0.0374	-0.194	-0.1071	-0.1088	0.5560*	0.0391	1

*Note: BRN (Brunei Darussalam), KHM (Cambodia), IDN (Indonesia), LAO (Lao PDR), MYS (Malaysia, MMR (Myanmar), PHL (Philippines), SGP (Singapore), THA (Thailand), VNM (Vietnam), CHN (China), JPN (Japan), KOR (Rep. Korea). * represents significance level at 5 percent.*

Source: Own calculation based on USDA PSD

Table A.3.2. Rice supply, consumption and shortfall 1980-2014

	Supply		Consumption		Shortfall		
	annual average (000 tons)	**regional share (%)**	**annual average (000 tons)**	**regional share (%)**	**number of shortfall**	**maximum shortfall (000 tons)**	**mean of shortfall (000 tons)**
ASEAN							
Brunei	31.7	0.01	31.71	0.01	14	7.36	1.27
Cambodia	2494.63	0.80	2213.09	1.00	9	286.61	36.52
Indonesia	37250.69	11.94	32765.20	14.84	3	344.48	15.57
Lao PDR	1089.40	0.35	1057.20	0.48	9	113.47	11.35
Malaysia	2327.60	0.75	1926.37	0.87	7	107.68	6.92
Myanmar	10019.80	3.21	8751.66	3.96	7	207.31	19.50
Philippines	10958.83	3.51	8685.11	3.93	6	470.13	23.72
Singapore	271.86	0.09	268.60	0.12	11	62.52	7.09
Thailand	18737.71	6.01	9079.97	4.11	6	780.79	66.28
Vietnam	19028.09	6.10	15135.54	6.85	3	819	39.41
Plus Three							
China	191979.50	61.56	126655.20	57.35	4	4069.61	180.69
Japan	11315.51	3.63	9118.14	4.13	7	793.68	50.65
Rep. Korea	6352.40	2.04	5171.37	2.34	6	358.73	41.60
Total	**311857.73**	**100**	**220859.17**	**100**	**92**	**8422.30**	**500.57**
Regional	**311857.73**	**100**	**220859.17**	**100**	**31**	**4725.21**	**506.43**

Note: Regional refers to ASEAN plus three countries as a region

Source: Own calculation based on USDA PSD

Table A.4.1. List of sample countries

Albania (WTO, 2000)	Greece (WTO, 1995)	Papua New Guinea (WTO, 1996)
Algeria (Non WTO)	Grenada (WTO, 1996)	Paraguay (WTO, 1995)
Antigua and Barbuda (WTO, 1995)	Guatemala (WTO, 1995)	Peru (WTO, 1995)
Argentina (WTO, 1995)	Guinea (WTO, 1995)	Philippines (WTO, 1995)
Armenia (WTO, 2003)	Guinea-Bissau (WTO, 1995)	Poland (WTO, 1995)
Australia (WTO, 1995)	Guyana (WTO, 1995)	Portugal (WTO, 1995)
Austria (WTO, 1995)	Honduras (WTO, 1995)	Qatar (WTO, 1996)
Azerbaijan (Non WTO)	Hungary (WTO, 1995)	Romania (WTO, 1995)
Bahamas, The (Non WTO)	Iceland (WTO, 1995)	Russian Federation (WTO, 2012)
Bahrain (WTO, 1995)	India (WTO, 1995)	Rwanda (WTO, 1996)
Bangladesh (WTO, 1995)	Indonesia (WTO, 1995)	Samoa (WTO, 2012)
Barbados (WTO, 1995)	Iran, Islamic Rep. (Non WTO)	Saudi Arabia (WTO, 2005)
Belarus (Non WTO)	Ireland (WTO, 199)	Senegal (WTO, 1995)
Belgium (WTO, 1995)	Israel (WTO, 1995)	Seychelles (Non WTO)
Belize (WTO, 1995)	Italy (WTO, 1995)	Sierra Leone (WTO, 1995)
Benin (WTO, 1996)	Jamaica (WTO, 1995)	Singapore (WTO, 1995)
Bhutan (Non WTO)	Japan (WTO, 1995)	Slovakia (WTO, 1995)
Bolivia (WTO, 1995)	Jordan (WTO, 2000)	Slovenia (WTO, 1995)
Botswana (WTO, 1995)	Kazakhstan (Non WTO)	Solomon Islands (WTO, 1996)
Brazil (WTO, 1995)	Kenya (WTO, 1995)	South Africa (WTO, 1995)
Brunei Darussalam (WTO, 1995)	Kiribati (Non WTO)	Spain (WTO, 1995)
Bulgaria (WTO, 1996)	Korea, Rep. (WTO, 1995)	Sri Lanka (WTO, 1995)
Burkina Faso (WTO, 1995)	Kuwait (WTO, 1995)	St. Lucia (WTO, 1995)
Burundi (WTO, 1995)	Kyrgyz, Rep. (WTO, 1998)	St. Vincent and the Grenadines (WTO, 1995)
Cambodia (WTO, 2004)	Latvia (WTO, 1998)	
Cameroon (WTO, 1995)	Lebanon (Non WTO)	Sudan (Non WTO)
Canada (WTO, 1995)	Lesotho (WTO, 1995)	Suriname (WTO, 1995)
Cape Verde (WTO, 2008)	Lithuania (WTO, 2001)	Swaziland (WTO, 1995)
Central African Rep. (WTO, 1995)	Luxembourg (WTO, 1995)	Sweden (WTO, 1995)
Chad (WTO, 1996)	Macedonia (Non WTO)	Switzerland (WTO, 1995)
Chile (WTO, 1995)	Madagascar (WTO, 1995)	Syrian Arab Rep. (Non WTO)
China (WTO, 2001)	Malawi (WTO, 1995)	Tajikistan (WTO, 2013)
Colombia (WTO, 1995)	Malaysia (WTO, 1995)	Tanzania (WTO, 1995)
Comoros (Non WTO)	Maldives (WTO, 1995)	Thailand (WTO, 1995)
Congo, Rep. (WTO, 1997)	Mali (WTO, 1995)	Togo (WTO, 1995)
Costa Rica (WTO, 1995)	Malta (WTO, 1995)	Tonga (WTO, 2007)
Cote d'Ivoire (WTO, 1995)	Mauritania (WTO, 1995)	Trinidad & Tobago (WTO, 1995)
Croatia (WTO, 2000)	Mauritius (WTO, 1995)	Tunisia (WTO, 1995)
Cyprus (WTO, 1995)	Mexico (WTO, 1995)	Turkey (WTO, 1995)
Czech Republic (WTO, 1995)	Moldova (WTO, 2001)	Turkmenistan (Non WTO)
Denmark (WTO, 1995)	Mongolia (WTO, 1997)	Tuvalu (Non WTO)
Dominica (WTO, 1995)	Morocco (WTO, 1995)	Uganda (WTO, 1995)
Dominican Rep. (WTO, 1995)	Mozambique (WTO, 1995)	Ukraine (WTO, 2008)
Ecuador (WTO, 1996)	Namibia (WTO, 1995)	United Arab Emirates (WTO, 1996)
Egypt, Arab Rep. (WTO, 1995)	Nepal (WTO, 2004)	
El Salvador (WTO, 1995)	Netherlands (WTO, 1995)	United Kingdom (WTO, 1995)
Ethiopia (Non WTO)	New Zealand (WTO, 1995)	United States (WTO, 1995)
Fiji (WTO, 1996)	Nicaragua (WTO, 1995)	Uruguay (WTO, 1995)
Finland (WTO, 1995)	Niger (WTO, 1996)	Vanuatu (WTO, 2012)
France (WTO, 1995)	Nigeria (WTO, 1995)	Venezuela, RB (WTO, 1995)
Gabon (WTO, 1995)	Norway (WTO, 1995)	Vietnam (WTO, 2007)
Gambia, The (WTO, 1996)	Oman (WTO, 2000)	Yemen, Rep. (Non WTO)
Georgia (WTO, 2000)	Pakistan (WTO, 1995)	Zambia (WTO, 1995)
Germany (WTO, 1995)	Palau (Non WTO)	Zimbabwe (WTO, 1995)
Ghana (WTO, 1995)	Panama (WTO, 1997)	

Note: WTO memberships including year of joining and level of income are in parentheses
Source: WTO database

Table A.4.2. List of sample regional trade agreements

EFTA (1960)	Georgia-Kazakhstan (1999)	Japan-Mexico (2005)	Peru-Chile (2009)
CACM (1961)	Chile-Mexico (1999)	Ukraine-Moldova (2005)	Australia-Chile (2009)
PACTRA (1977)	EFTA-Morocco (1999)	EFTA-Tunisia (2005)	Chile-Colombia (2009)
SPARTECA (1981)	Georgia-Turkmenistan (2000)	Pakistan-Sri Lanka (2005)	MERCOSUR-India (2009)
LAIA (1981)	WAEMU (2000)	Turkey-Tunisia (2005)	Panama-Guatemala (2009)
ANZCERTA (1983)	EU-South Africa (2000)	Thailand-New Zealand (2005)	EFTA-Canada (2009)
US-Israel (1985)	EU-Morocco (2000)	India-Singapore (2005)	Canada-Peru (2009)
CAN (1988)	EU-Israel (2000)	Jordan-Singapore (2005)	Peru-Singapore (2009)
GSTP (1989)	EU-Mexico (2000)	EU-Algeria (2005)	Japan-Switzerland (2009)
MERCOSUR (1991)	Israel-Mexico (2000)	SAFTA (2006)	Japan-Vietnam (2009)
ASEAN/AFTA (1992)	EAC (2000)	US-Morocco (2006)	EU-Cameroon (2009)
ECO (1992)	SADC 2000)	Turkey-Morocco (2006)	India-Nepal (2009)
EFTA-Turkey (1992)	Turkey-Macedonia (2000)	CAFTA_DR (2006)	Colombia-Northern Triangle (2009)
European Union (1993)	New Zealand-Singapore (2001)	Korea-Singapore (2006)	Panama-Nicaragua (2009)
EFTA-Israel (1993)	EU-Macedonia (2001)	TPSEP (2006)	EU-PNG (2009)
Russia-Azerbaijan (1993)	EFTA-Mexico (2001)	Japan-Malaysia (2006)	ASEAN-Korea (2010)
Russia-Turkmenistan (1993)	Ukraine-Macedonia (2001)	Panama-Singapore (2006)	ASEAN-India (2010)
Russia-Tajikistan (1993)	Dominican Rep.-Central America (2001)	India-Bhutan (2006)	AANZFTA (2010)
Russia-Belarus (1993)	India-Sri Lanka (2001)	US-Bahrain (2006)	Korea-India (2010)
Kyrgyz, Rep-Russia (1993)	US-Jordan (2001)	EFTA-Korea (2006)	Peru-China (2010)
Russia-Kazakhstan (1993)	APTA-China (2002)	Chile-China (2006)	Chile-Guatemala (2010)
ECOWAS (1993)	Chile-Costa Rica (2002)	Ukraine-Belarus (2006)	New Zealand-Malaysia (2010)
MSG (1994)	EFTA-Macedonia (2002)	EU-Albania (2006)	EFTA-Albania (2010)
NAFTA (1994)	EU-Jordan (2002)	EFTA-Lebanon (2007)	Turkey-Jordan (2011)
Ukraine-Russia (1994)	Chile-El Salvador (2002)	Turkey-Syria (2007)	Turkey-Chile (2011)
Georgia-Russia (1994)	Ukraine-Tajikistan (2002)	Egypt-Turkey (2007)	EU-Korea (2011)
COMESA (1994)	EFTA-Jordan (2002)	Pakistan-China (2007)	India-Japan (2011)
CIS (1994)	Canada-Costa Rica (2002)	EFTA-Egypt (2007)	India-Malaysia (2011)
Colombia-Mexico (1995)	Japan-Singapore (2002)	Chile-India (2007)	EFTA-Peru (2011)
Ukraine-Turkmenistan (1995)	EFTA-Singapore (2003)	Chile-Japan (2007)	EFTA-Colombia (2011)
Kyrgyz, Rep.-Kazakhstan (1995)	GCC (2003)	Japan-Thailand (2007)	China-Costa Rica (2011)
SAPTA (1995)	EU-Chile (2003)	Pakistan-Malaysia (2008)	Peru-Korea (2011)
EU-Turkey (1996)	EU-Lebanon (2003)	Panama-Chile (2008)	Canada-Colombia (2011)
Georgia-Ukraine (1996)	Panama-El Salvador (2003)	Turkey-Albania (2008)	Peru-Mexico (2012)
Georgia-Azerbaijan (1996)	PICTA (2003)	EFTA-SACU (2008)	Chile-Malaysia (2012)
Ukraine-Azerbaijan (1996)	Singapore-Australia (2003)	Japan-Indonesia (2008)	Japan-Peru (2012)
Canada-Israel (1997)	US-Chile (2004)	Chile-Honduras (2008)	Korea-US (2012)
Turkey-Israel (1997)	US-Singapore (2004)	Brunei-Japan (2008)	Panama-Peru (2012)
Canada-Chile (1997)	Korea-Chile (2004)	China-New Zealand (2008)	EU-EPA (2012)
EAEC (1997)	CEZ (2004)	EU-CARIFORUM (2008)	US-Colombia (2012)
Russia-Belarus-Kazakhstan (1997)	EU-Egypt (2004)	Turkey-Georgia (2008)	EFTA-Ukraine (2012)
PAFTA (1998)	Mexico-Uruguay (2004)	Panama-Costa Rica (2008)	Mexico-Central America (2012)
Kyrgyz-Ukraine (1998)	SACU (2004)	ASEAN-Japan (2008)	Canada-Jordan (2012)
EU-Tunisia (1998)	EFTA-Chile (2004)	Japan-Philippines (2008)	Chile-Nicaragua (2012)
Ukraine-Kazakhstan (1998)	ASEAN-China (2005)	EU-Cote d'Ivoire (2009)	US-Panama (2012)
CEMAC (1999)	US-Australia (2005)	China-Singapore (2009)	
	Thailand-Australia (2005)	US-Oman (2009)	
		Panama-Honduras (2009)	
		US-Peru (2009)	

Note: Years of entry into force are in parentheses, the analysis takes into account different years of joining of some member countries into the agreement but their years of joining are not shown in the table to save space, further information can be found at http://rtais.wto.org/UI/PublicAllRTAList.aspx
Source: WTO database