TRADE COST AND ITS IMPACT ON AGRI-FOOD TRADE GROWTH AMONG CHINA, EU AND ASEAN

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ABSTRACT

Trade cost is broadly defined to include all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself. According to Anderson and van Wincoop (2003), a rough estimate of the tax equivalent trade costs for industrialized countries is 170 percent. While compared to industrial products, agricultural goods suffer more from trade cost due to its low value to volume ratio and perishable characteristic as well as high protection in both developed and developing economies.

By using the trade cost index developed by Dennis Novy (2013), this study examines the trade costs and its relationship with trade growth among China, EU, and ASEAN in agricultural sector. The results indicate that first, although the bilateral agricultural trade among these three economies have been growing steadily over last fifteen years, their trade costs are still high. In particular, the average trade cost between China and EU is about 633 percent tax equivalent. Secondly, economic growth is still the key driver of trade expansion. The contribution of trade cost reduction varies among trading pairs. In the case of China & ASEAN and EU & ASEAN, its impact is limited. But, in the case of China and EU, it contributes over half of the overall trade growth. Combined with the fact that China now has converted from a net exporter to a net importer of EU’s agricultural products, a further trade liberalization between these two could possibly increase bilateral trade significantly. Thirdly, the reduction of multilateral trade barriers diverts large amount of bilateral trade. The trade diversion effect of regional trade agreement is one possible reason. Finally, compared to distance, which is a static number, the trade cost index has a better explanatory power. It is time sensitive, more comprehensive, and not hard to compute.

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Chapter 1: Introduction

As the reduction of trade costs contribute to trade growth and more participation in Global Value Chains (GVCs), understanding trade costs is essential for policy makers to develop proper interventions to reduce it and further enhance competitiveness and economic outcome of one country. However, getting a straight answer of it is never easy due to the complex nature of trade cost itself. There are various trade cost factors along the trade chain. Some of them are crossing border measures like tariff and custom compliance requirements, while others are behind border measures like market access restrictions and finance availability. And then there are others involved at all stages of the international trade train, like transport infrastructure and logistics. The sources of these factors are sparse and hard to quantify, yet in total they are large and important as Anderson and van Wincoop (2004) reminds us. For years, researchers have tried to analyse trade cost and its impact via different approaches. In traditional gravity model, distance is usually used as trade cost proxy and it has a significant negative relationship with bilateral trade flow. However, this application is far from sufficient. It is not only because that distance, as trade cost proxy, is more considered as transportation cost which is only a part of total trade cost. But it is also for the distance that is static while transportation cost is changing over time. In order to avoid these drawbacks, Novy (2013) proposes a trade cost index derived from Anderson and van Wincoop's (2004) revised gravity model. The intuition of this new method is simple. If all else is held constant and a country trades more with a trading partner than with itself (intra-national trade), it suggests that the ratio of domestic to international trade costs has changed. This average trade cost between one country and its particular trading partner could simply be computed by observable data, namely trade and production. Compared to other approaches, this measure is believed to be more comprehensive and it varies with time.

Agricultural goods are traded much less than industrial goods. There are two possible explanations to the low trade density of it- high trade barriers and low degree of comparative advantage. A high trade cost is considered as the major reason (Xu 2015). Overall, bulky agricultural products are penalized by transport cost when agricultural protection in OECD countries remains high (Anderson and Van Wincoop 2004). Besides, the Phyto-Sanitary and Technical Barriers to Trade (TBT) agreements impede agricultural export from developing countries to developed economies (Moïsé and Le Bris 2013).

As important global agricultural producers and traders, China, EU, and ASEAN have high degree of bilateral trade among themselves. After China officially joined WTO in 2001, its trade performance has been stunning. In terms of agricultural products, even though China applies a self-sufficient policy, its demand for imports has been growing significantly in the past fifteen years. In 2012, China became a net importer of EU and ASEAN's agricultural products. ASEAN, as a long established common market, has a large population and high rate of economic growth, as does China. Yet, ASEAN is still a net exporter of agricultural products like most of other developing economies. In regard to EU, it is an importer with ASEAN but a net exporter with China after 2012. EU's export is featured with high value products like meat, dairy produce and sprits. Along with the establishment of ASEAN-China Free Trade Agreement (ACFTA) and the Belt and Road Initiative proposed by China, trade cooperation among these three economies is expected get closer. A reduction of their bilateral trade cost could be the very first step to these initiatives.

1.1 Objectives

This study is aimed at examining the agricultural trade and trade cost between trading pairs as follow: China & EU, China & ASEAN and EU & ASEAN via newly developed trade cost index. The specific objectives are four.

First, to calculate the agricultural trade balances among China, EU and ASEAN during the period 2001 to 2015. Second, to identify the changing pattern of trade cost between these trading pairs in the same period. Third, to measure the relationship between agricultural trade growth and trade cost reduction. Fourth, to compare the traditional trade cost proxy distance to the newly developed trade cost index.

1.2 Motivations

The trade cost index proposed by Novy (2013) has been used by several researchers because of its great explanatory power. Yet, many of these studies are focused on developed economies and not so much involving developing countries and/or between developed and developing countries (e.g. Arvis, Duval et al. 2016; David S. Jacks, Christopher M. Meissner et al. 2008; David S. Jacks, Christopher M. Meissner et al. 2010; David S. Jacks, Christopher M. Meissner et al. 2011). Also, in terms of industry, agricultural sector receives less attention due to its low trade density and small contribution to overall GDP. However, in many developing countries, agriculture is still the sector with the largest employment and a high proportion of exports. Agriculture is also much more protected than manufacturing in both developing and developed countries. Till today, the liberalization of agricultural trade is in a deadlock in the Doha Round.

Against this backdrop, it is important to have more understanding of the trade cost and its impact on trade growth and overall benefit to the economy.

Along with economic development and rising living standards, China now has become a net importer of agricultural goods. Both EU and ASEAN are its important trading partners, although United States has been the top agricultural supplier of China for years and countries like Canada, Argentina and Australia all have a close relationship with China as well. Compared to these latter countries, the reason why the EU and ASEAN could be better off in their future trade with China is the relatively lower trade cost in addition to their comparative advantage. From a geographic point of view, ASEAN is China's neighbour sharing long borders. EU, although is farther away, is still comparably closer to China than Americas or Oceanic countries. Culturally, EU and ASEAN all have long historical trade connections with China. Goods had been transferred massively via the ancient Silk Road, both the terrestrial and the maritime routes that connect Asia and Europe. The impact of the Silk Road was profound in history and the newly proposed Belt and Road Initiative in 2012 is considered to revive this legacy. Soon after its announcement, several projects aiming to improve trade facilities have been put in action; for example, the formation of Asia Infrastructure Investment Bank (AIIB) and the expansion of China-Europe Railway Express. A close examination of agricultural trade cost among China, EU and ASEAN could help policymakers achieve a greater understanding of the present and offer some useful insight for the future if further trade liberalization is to be achieved.

1.3 Structure

The study is organized into six chapters. In first chapter, the overall objectives and motivations of this study have been stated. Chapter 2 present and analysis the trade balances between these trading pairs: China and EU, China and ASEAN, and EU and ASEAN. It provides a big picture of agricultural trade globally and regionally. Chapter 3 reviews the exist literature and covers the questions of what are the trade costs, why it is important, and how we measure it. Chapter 4 explains the methodologies used in this research. In particular, the trade cost measure and trade growth decomposition method suggested by Dennis Novy are examined in detail. Based on the conclusions of literature and methodology, Chapter 5 presents the trade cost estimation and its impact on trade growth. The final chapter summarizes the contributions as well as shortages of the study and gives the recommendations for future studies.

Chapter 2: China, EU and ASEAN and their agricultural trade balances

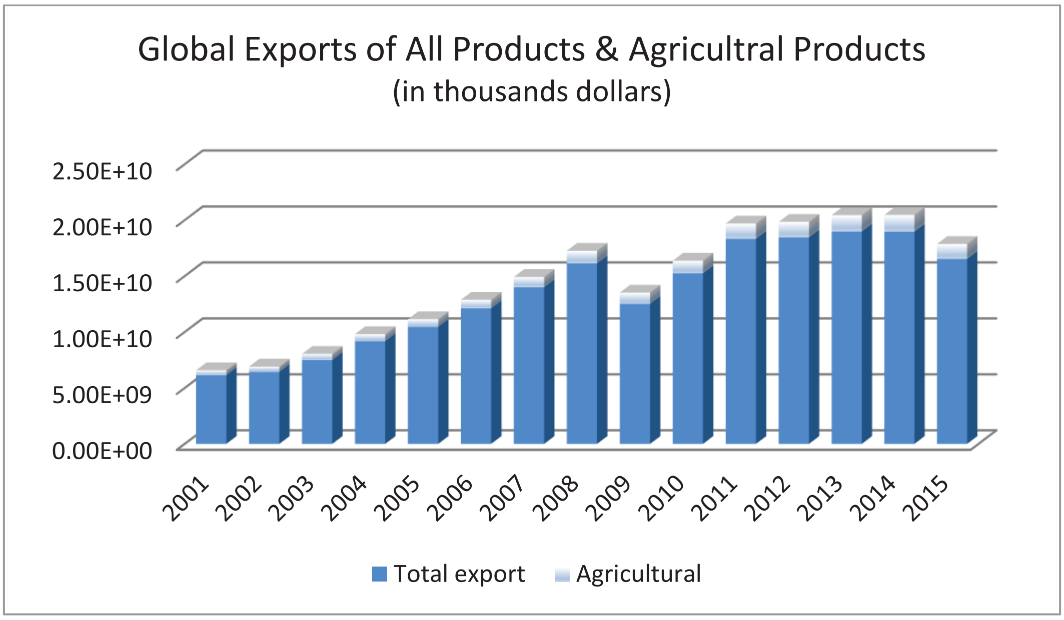
China, EU and ASEAN are considered major regional economies. In 2015, these three regions accounted for 34.21 percent of the global population and 40.26 percent of world GDP. Meanwhile, they have all had positive and high GDP growth. In particular, the annual GDP growths of China and ASEAN have been 6.9 percent and 4.6 percent respectively, much higher than the world average of 2.73 percent. In regard to international trade, a large population and economic size guarantees a large market, while the high annual GDP growth suggests a great potential for future demand. In this chapter, the agricultural trade balances of China, EU and ASEAN are examined in detail. The remaining sections are organized as follows: 2.1 Global Agricultural Trade Performance; 2.2 China's Agricultural Trade Performance; 2.3 EU's Agricultural Trade Performance; 2.4 ASEAN's Agricultural Trade Performance; 2.5 The bilateral agricultural product trade among China, EU and ASEAN.

All the calculations in this section are based on the setting that ASEAN is represented by ASEAN-5, namely Indonesia, Malaysia, Philippines, Singapore and Thailand. Second, the definition of agricultural goods follows the Harmonized System Codes (HS code). Two digit groups are from 01 to 24 (see Appendix 1). This setting is consistent with the rest of the chapters.

2.1 Global Agricultural Trade Performance

The global agricultural trade has been expanding gradually over the past fifteen years. According to the United Nations Conference on Trade and Development (UNCTAD), the total export value of agricultural products in 2015 was over thirteen trillion US dollars, being three times larger than that of 2001. At the same time, agriculture's share in world export had slightly increased from 7.2 percent (2001) to 8.09 percent (2015) (see Figure 1). Among the agricultural goods traded internationally, food products make up almost 80 per cent of the total. The second main category of agricultural products is raw materials. Since mid-1980s, trade in processed and other high value agricultural products has been expanding much faster than trade in the basic primary products such as cereals (Regmi and Gehlhar 2005).

Figure 1: The share of agricultural products exports in global total exports



Source: UNCTAD, calculated by Arthur.

The growth of agricultural trade has helped provide greater quantity, wider variety and better quality food to an increasing population at lower prices. Agricultural trade is also a generator of income and welfare for the people who are directly or indirectly involved in it. Especially for countries with a large agricultural population, increasing agricultural exports can generate growth, more than expanding domestic market demand can. Meanwhile, export growth contributes to the modernization of agriculture which, in return, create jobs in agricultural processing and marketing, as well as the expansion of other non-farm jobs (Aksoy and Beghin 2004).

The development of an agricultural trading system also plays a fundamentally important role in global food security. Since the expansion of food production and the growth of population both happen at different rates in different geographic regions, global trade is necessary to balance supply and demand across regions. Expanded trade can help to avoid food deficits arising from regional conflicts, epidemics, droughts, floods and other shocks that are likely to increase in frequency as climate change occurs (Godfray, Beddington et al. 2010).

Along with the expansion of global agricultural trade, there are changes of trade patterns and trade structures. Higher income, urbanization, technology development and consumer perceptions regarding quality and safety all contribute to these changes (Regmi 2001). Income growth, in particular, is the key factor of consumption shifts taking place in a country that changes the structure of its imports. As income increases, people tend to care more about the quality and convenience of the food products. Specifically, diet diversification and growing demand for better quality products have increased imports of processed and high value-added food products in developed countries. In developing countries, higher income leads to increased demand for meat products, often resulting in the expansion of livestock production. This, in turn, may increase imports of intermediate products such as animal feed (Regmi 2001). Furthermore, as income rises, preferences for foreign brands or varieties may increase, as per capita consumption of that item remains the same. The demand for foreign varieties results in simultaneous exporting and importing of similar products with same trading partners, so-called intra-industry trade (IIT). IIT accounts for a large share of bilateral trade in developed economies (Regmi 2001).

Other factors can affect trade structure besides those of supply and demand. These are barriers to trade that exist in the form of border protections like tariff and non-tariff barriers and transportation costs. Compared to manufacturing protection which has been declining worldwide, most industrial and many developing countries still protect their agricultural sector at a high level. For OECD countries, tariff protection for manufacturing has now fallen over the past 60 years from above 30 percent nominal rate of protection to only about 3 percent. Yet tariff protection of the agricultural sector is still close to the level of 30 percent. Even after taking preferences into account, developing country exporters still face an average tariff of 15.6 percent for agriculture and food (Anderson and Martin 2005). Besides, three major instruments have been widely used in OECD countries to protect their agriculture, namely market price support (compensate the prices difference between domestic and international), direct support (direct production-related subsidies given to farmers), and general support to agriculture through infrastructure, marketing support, training and research (Aksoy and Beghin 2004).

Previous studies have identified that both domestic subsidies and border protections distort markets. They artificially make commodity markets thin, with small trade volumes and a small number of agents, resulting in a high variability in prices and trade flows. Large trade distortions also impede trade flow, lower world prices and discourage market entry (Aksoy and Beghin 2004). Thus, reducing the distortion of agricultural support mechanisms in developed countries and lowering the global agricultural trade barriers, in general, should stimulate overall food production in developing countries and further liberate trade (Godfray, Beddington et al. 2010).

2.2 China’s Agricultural Trade Performance

Agriculture is important to the Chinese economy. In 2015, China’s agricultural production accounted for 8.8 percent of the gross domestic product (GDP) with the sector employing 28.3 percent of the population (The World Bank Group 2017). Since the late 1970s, China has experienced huge changes due to economic reforms. The reform in the agriculture sector was the starting point. It includes the transfer of land ownership, the change of policies and the opening-up of cross-border trade. Altogether, these efforts contributed to a high growth rate of China’s agricultural production. Today, China ranks as the leading global producer as well as trader of many agricultural commodities. In addition to overall production growth, the composition of Chinese agricultural production has changed over time. Share of horticulture, meat and dairy has been rising, while traditional products, like grains and tubers experienced a decline (Lohmar, Gale et al. 2009). These changes are consistent with the notion of comparative advantage. At the national level, China has a comparative advantage in labour-intensive crops (fruits and vegetables, cotton, and tobacco) and a disadvantage in many land-intensive crops (wheat and oilseeds) (Fang and Beghin 2003).

In 2001, China accessed to the World Trade Organization (WTO). Under its commitment to market-based agriculture, China had to lower tariffs on agricultural goods to an average of 15 percent and agreed to limit domestic agricultural subsidies to 8.5 percent and eliminate all agricultural export subsidies upon WTO entry (Blancher and Rumbaugh 2004). Although China has opened up to agricultural food trade in general, the central government still tightly controls imports of certain products like wheat, rice and corn due to food security reasons.

As imports have grown faster than exports during post-WTO accession years, China has gradually become a net agricultural importer instead of exporter (see Table 1). Total exports have been tripled over the past 15 years, while the import value has increased six times more than that of 2001. Much of China’s increased imports came from soybeans. Globally, China is the leading soybean importer and accounts for over 60 percent of the total share in 2015.

Table 1: Export and Import of Agricultural Products of China (in thousands of dollars $)			
Time	Export	Import	Export VS. Import
2001	1.54E+07	9.93E+06	Net Exporter
2015	6.83E+07	1.06E+08	Net Importer
Data retrieved from World Integrated Trade Solution (WITS), calculated by author.			

Implementation of several trade agreements contributed to an increased agricultural products trade between China and its partners. The combined imports from these partners exceed imports from all other countries except the United States. During 2005 and 2010, the average annual growth of agricultural imports from the trade partners with trade agreements was 28 percent, compared with 24 percent for imports from all countries (Commission 2011).

2.3 EU's Agricultural Trade Performance

The European Union (EU) is a unique, economic and political union among 28 European countries that, together, cover much of the continent. The predecessor of EU was the European Economic Community (EEC), created in 1958. Originally, it comprised only six countries: Belgium, Germany, France, Italy, Luxembourg and the Netherlands. Since then, the EU's membership has grown to twenty-eight, with the latest member state being Croatia, which joined in July 2013. As the largest single market in the world, EU benefits from the abolition of border controls and single currency between EU countries. Most goods, services, money and people can move freely throughout most of the continent.

Along with the establishment of EEC, a general agricultural policy was applied to support agricultural and rural development under its Common Agricultural Policy (CAP). Since its introduction in 1962, it has undergone several changes. The CAP protects EU farmers and agricultural processors from global competition in different ways, such as import tariffs, export subsidies and direct subsidies to input and output (Borrell and Hubbard 2000). These measures have the effect of keeping domestic prices high and stable within the union. The higher consumer prices reduce both consumption and import demand. Consumers and tax payers pay extra for agri-food products which should be lower if there are cheaper imports. Meanwhile, since the CAP imposes tariffs on imports and encourages export with support, its agricultural production surpluses have been granted to trade competitively on the world market. The dumping of EU agricultural exports, combined with its reduction of demand, has lowered world prices substantially, and it further reduces the production of non-EU agricultural exporters. Among distortions in international agricultural trade, those imposed by the EU are the most disruptive. Under its implementation, the EU has switched from being a large net importer of agricultural products to a large net exporter. This has greatly impacted world agricultural markets, imposing substantial costs on the EU itself and efficient agricultural exporters throughout the rest of the world (Borrell and Hubbard 2000).

As one of the most outward-oriented economies in the world, EU accounts for around 1 percent of the world's trade in goods. As a net exporter of agricultural products, agricultural products represent more than 7 percent of all goods exported from the EU. Its exports feature, in particular, cereals, meat, olive oil, wine and dairy products. One third of the total export value is created by high value added agricultural products, like beverages, pasta, infant food and other processed products (EuroStat 2017). In 2015, the output of the European Union's agricultural sector was valued at 410 billion euro. The exports of EU for agricultural products have increased about 5.7% and make EU the top agri-food exporter of the world with a net trade surplus of 16 billion euro. In contrast, the EU's imports are dominated by commodities and other primary products, such as tropical fruit, nuts and spices, unroasted coffee and tea in bulk, palm and palm kernel oils, and soybeans.

2.4 ASEAN's Agricultural Trade Performance

The Association of Southeast Asian Nations, or ASEAN, was established on 8 August 1967 in Bangkok, Thailand. It was founded by five initiative countries, namely Indonesia, Malaysia, Philippines, Singapore and Thailand. Later the membership was expanded to include Brunei, Cambodia, Laos, Myanmar, and Vietnam. Unlike EU though, ASEAN is not a single market that shares common agricultural policy and currency, it lowers its intra-regional tariffs through the Common Effective Preferential Tariff (CEPT) Scheme. Based on this policy, more than 99 percent of the products have been brought down to the 0-5 percent tariff range.

Agriculture is one of the key engines of most ASEAN countries. In Cambodia, Lao PDR, Myanmar, and Vietnam, over 50 percent of their population are engaged in the agricultural sector. The share of agriculture in total GDP is also large in these countries, accounting for 27.5 percent in Cambodia, 28.7 percent in Lao and 32.9 percent in Myanmar in 2012 (ASEAN, 2015). Consequently, some ASEAN countries choose export-oriented agriculture as their trade policy. For instance, Indonesia and Malaysia focus on palm oil and rubber, Viet Nam focuses on high value beverages like coffee and cacao, while others, like Thailand, recognize the importance of both export and food security needs (McConville, & Teng, 2016)

ASEAN agricultural trade to the rest of the world has been substantial compared with Intra-ASEAN. EU, China and the United States are the top three extra-regional trading partners of ASEAN, especially China and EU, as both of them account for over 10 percent of ASEAN's agricultural export and import (ASEAN, 2015). The extra-ASEAN exports feature in fats and oils, fish, preparations of fish, cereals and preparation of vegetables/fruit/nuts. On the other hand, the major extra-ASEAN imports are cereals, dairy, waste from food industry, fish and tobacco (Mangabat 2007).

ASEAN as a whole has signed FTAs with several economies, including China, India, and Australia and New Zealand. Meanwhile, due to the diverse economic status within the region, many members of ASEAN also have FTA with other countries individually. For instance, Singapore has a Free Trade Agreement with US in 2003.

2.5 The bilateral agricultural product trade among China, EU and ASEAN

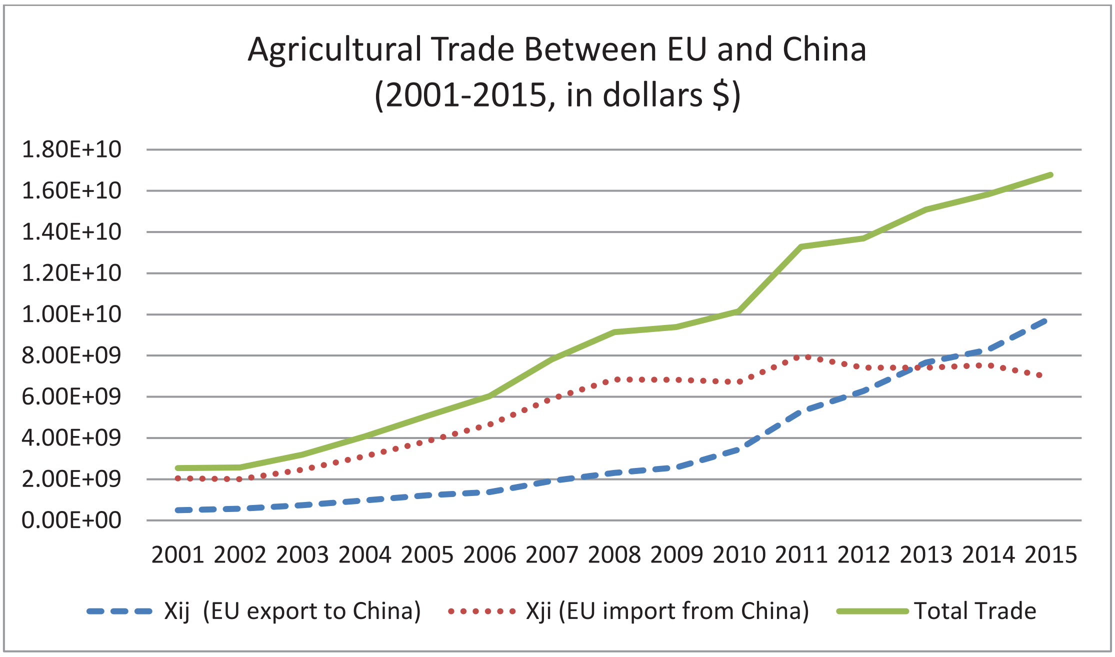
In general, bilateral agricultural trade among these three partners has been growing over the years. Specifically, ASEAN is a net exporter to both China and EU, apposition that has not changed in the last fifteen years. On the other hand, China switched its position from a net exporter to a net importer with EU. Thus, China has been a net importer among these three partners since 2012 which suggests a strong domestic demand, but raising food security concerns.

In terms of trade structure, EU's agri-exports are more focused on value-added and processed goods, like meat, dairy products, beverage and sprits. Both China and ASEAN are good at, for instance, labour-intensive products, vegetables and fruits. Yet, they are specialized in different sub-areas.

2.5.1 China and EU

Trade balance between China and EU changed after EU switched to a net exporter of agri-food products to China since 2012. In 2015, China was the second most important destination of EU and accounted for 8 percent of all EU agri-exports. The total agri-food exports from EU to China are 9.82 billion US dollars while imports are 6.96 billion US dollars (See Figure 2).

Figure 2: The bilateral agricultural trade between EU and China during 2001 and 2015



Source: data is retrieved from UNCom Trade, calculated by author.

Many of the most traded agricultural products that EU exports to China are processed or high-value goods. The top five product categories accounted for over half of the total export value in 2015, namely beverage and spirits, meat and edible meat offal, preparations of cereals/flour/starch, dairy production, and cereal. The largest growth has been in intermediate products such as preparations of cereals/flour/starch, preparations of vegetables/fruit/nuts and animal or vegetable fats and oils, over the last fifteen years. The demand for coffee, tea, mate and spice has also been growing significantly. On the other hand, China's agricultural exports to the EU mainly focus on labour intensive products. Fish and crustaceans, vegetables, oil seeds and oleaginous fruits, lac and gums, and preparations of vegetables, fruit, and nuts are the top five categories (See Appendix 2).

Agricultural sector in the EU and China are highly protected. Apart from the fact that tariffs in agriculture are higher than most industries in general, both sides are using non-tariff barriers, which additionally complicate food trade. China has been long pushing the self-sufficiency policy, while the EU spends nearly 50 billion euro per year for its Common Agricultural Policy (Kostadinov 2017), even though, along with the economic development and urbanization of China, the demand for quality food and foreign brands are expected. Meanwhile, as one of the most important destinations of China's major agricultural export, the EU is still an attractive market to China.

2.5.2 China and ASEAN-5

Bilateral agricultural trade between China and the Association of South-East Asian Nations (ASEAN) has grown very quickly since 2001. The growth of exports from ASEAN to China is significantly strong. China became ASEAN's third largest export market in 2005, after the United States and Japan(Chen and Yang 2008). The foundation of ASEAN-China Free Trade Agreement (ACFTA) further strengthened the trade relationship between these two economies. The full effect of ACFTA has not been seen as zero tariffs for agricultural products have just implemented for two years so far.

Figure 3: The bilateral agricultural trade between China and ASEAN during 2001 and 2015

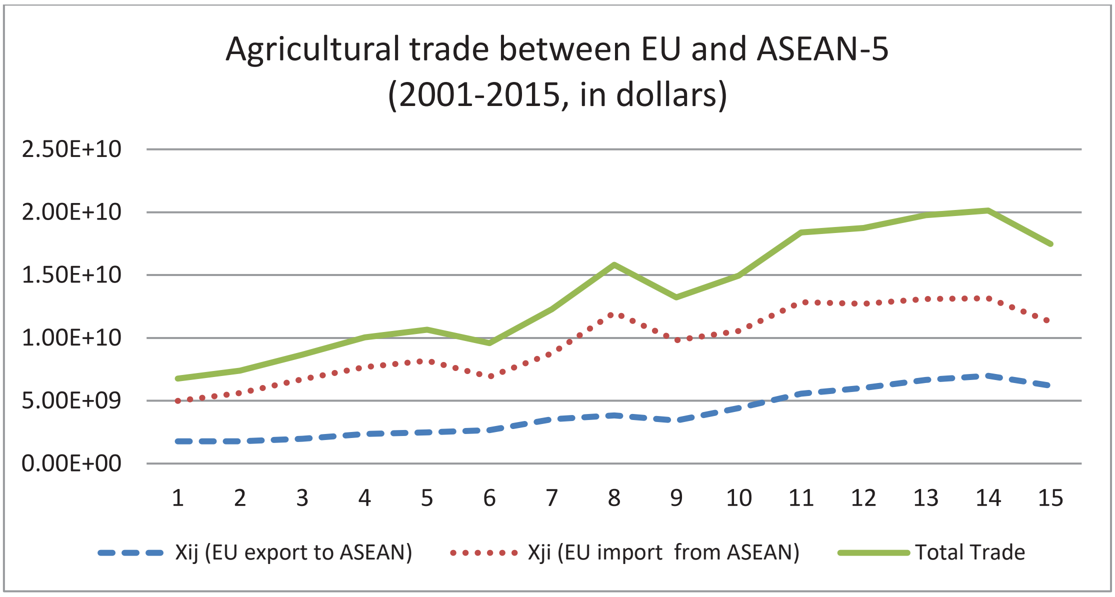
Source: data is retrieved from UNCom Trade, calculated by author.

In 2015, trade deficit of China was 4.34 billion dollars (see Figure 3). China is a net importer of ASEAN's agricultural products, with its imports from ASEAN concentrated in a few commodities. The most important imported agricultural product is animal or vegetable fats and oils, contributing over 40 percent of the total value. The second place was taken by vegetables, accounting for 14.5 percent and followed by fruit, which is 6.4 percent. The exports from China to ASEAN are diverse. Vegetables, fruit and nuts, fish and crustaceans, tobacco, and sugars are the top five groups (see Appendix.3). The trade structure between China and ASEAN here is consistent with the studies done by Chen and Yang (2008), in which the period is from 1995 to 2005. It shows that there is an overlap of China and ASEAN's agricultural bilateral trade. Both sides export and import a large amount of vegetables and fruits, even though they all good at labour intensive products. This is because China has a relative comparative advantage (RCA) in temperate fruits, like apples and pears which ASEAN countries lack. And, in contrast, China's shortage of tropical fruits, for instance, bananas and mangoes, are the RCA of ASEAN.

2.5.3 EU and ASEAN-5

The bilateral trade flows between EU and ASEAN have been doubled in the past fifteen years (See Figure 4). In 2015, the trade surplus of ASEAN to EU reached 5.09 billion US dollars. Most agricultural commodities imported from ASEAN are tropical products, which do not compete directly with EU products.

Figure 4: The bilateral agricultural trade between EU and ASEAN-5 during 2001 and 2015



Source: data is retrieved from UNCom Trade, calculated by author.

Similar to China, the most popular groups that EU exports to ASEAN are high value processed products. The top two products account for over 40 percent of the total exports. Specifically speaking, beverages, spirits and vinegar contribute 29.3 percent as the top product. Dairy produce has the share of 14.05 percent and ranks the second. Products such as meat and cereals experienced rocket growth and their shares of total export have expanded significantly. One is from 1.87 percent to 7.86 percent; the other is from 0.97 percent to 4.75 percent. It suggests the increase of income and the following changes of taste (see Appendix.4).

In terms of import of EU from ASEAN, animal or vegetable fats and oils again take the first place with a share of 46.82 percent. Fish, crustaceans, and coffee and tea together account for about 23 percent. The shares of the remaining groups are small and sparse (see Appendix 4).

2.6 Summary

This Chapter examines the global and regional agricultural trade performances in detail. In general, the global exports of agricultural products has been growing steadily in the past fifteen years. On one hand, the growth of agricultural trade benefit people who are directly or indirectly involved in it. Consequently, it boost the economic growth of countries that agricultural export oriented. On the other hand, with the development of economy and increase of income, people care more about food quality and diet diversification. It further stimulate the imports of intermediate and high value added products. China, EU and ASEAN, as large economies in the world, all play important roles in the agricultural food trade market. The bilateral agri-product trade among them are very active as well. EU is the representative of high value added agricultural products and its export features beverages, spirits, pasta, and infant food. ASEAN is a net exporter of agricultural food and its export is mainly tropical products, like palm oil, fish, crustaceans, coffee and tea. China, along with its rapid development, has switched its position from net exporter to net importer of agricultural food and shows a growing demand of intermediate as well as high value added products.

Chapter 3: Literature Review

Trade costs are important factors that not only affect bilateral trade directly, but also economic development of a country consequently. Broadly defined, trade costs include transportation costs, policy barriers, and information costs. They are hard to capture due to their diversity and complexity. In the traditional gravity model, distance is widely used as proxy to trade cost. However, there is an obvious shortcoming in this proxy. First, it is static and does not change over time as do other variables. Second, it could hardly represent all trade cost factors, especially policy-related ones. Researchers have explored different ways to measure trade costs, yet, these measures either have the problem of omitting importing trade cost factors, or the lack of proper multilateral trade resistance to calculate. Recently, a bottom-down micro-founded approach developed by Novy has shed some light on this issue. It captures a wide range of trade cost components and does not rely on extra assumptions. It could be computed by observable trade costs without extra assumptions. Many researchers have used this useful tool in practice and achieved some firm results.

The remainder of this section is organized as follows. Section 3.1 Empirical studies of trade costs; Section 3.2 Gravity Models in Agricultural Trade; Section 3.3 The Measurement of Trade Costs; Section 3.4 Summary.

3.1 Empirical Studies of Trade Cost

International trade does not exist in a frictionless world. The cost of exporting/importing goods from one country to another impedes the bilateral trade flow to a great degree. Correspondingly, the reduction of trade costs could lead to trade booms and even be an important driving force of trade growth. During the period of globalization (1950-2000), 31 percent of the global trade boom was contributed to by the reduction of trade costs. For the pre-World War I period, the decline of the trade costs could even explain 60 percent of the growth in global trade (Jacks, Meissner et al. 2011). Inspired by Krugman, Feenstra (1998) suggests that there are four possible reasons to explain the growth of world trade. Two of them are trade cost-related, namely trade liberalization and falling transportation costs. Especially in the world of increasing trade in components and geographic fragmentation of industrial production processes, the trade cost plays an even more important role.

3.1.1 Trade Cost Matters

Trade costs not only exert a great impact on international trade volume and value, but they also provide rich link to policy, country's welfare and international macro-economic stability (2004). According to Anderson and Van Wincoop (2001), policy-related trade costs are often worth more than 10 percent of national income. In the case of Mexico, removing tariffs could raise its welfare by 14.8percent. This welfare effect could be bigger if other non-tariff border barriers could be lower at the same time. Aspects of trade costs have been studied by many researchers over the years. Samuelson (Samuelson 1952) points out that trade costs and duties create differentials in relative prices of the goods and give rise to familiar "substitution effects". Donald Davis (Davis and Weinstein 1996) states that the details of trade costs are important to economic geography. The interaction of increasing returns with transport costs across countries builds a world fundamentally different from the model of comparative advantage. Further, based on the home market effect hypothesis (big countries produce more goods with scale economies), differentiated goods with scale economies having greater trade costs than homogenous goods. Trefler (1995) and Davis &Weinstein (2001) propose trade costs as a primary explanation for the celebrated absence of factor content in trade. Maurice Obstfeld and Kenneth Rogoff (2000) also argue that most of the real macroeconomic puzzles could be explained by trade costs, like international price differences and productivity differences across countries with a home bias in consumption.

Trade costs matter and it is particularly true in the least developed countries. Owing to its strong influence on trade flow and tight bonds with countries economic fundamentals like technology, factor endowments and government policies, trade costs have a great potential to influence a country's economic development(OECD;WTO; 2015). Based on neoclassical theory, trade is important to economic growth since it allows a country to consume a combination of goods and services that exceeds its production possibilities curve or frontier. It enlarges a country's consumption, increases world output, and provides access to scarce resources and worldwide markets for domestic firms. Srinivasan and Bhagwat's (2001) research on major OECD countries, during the 1960s and 1970s have shown and argued that trade does create and even sustain higher growth. Dollar & Kaay (2004) did a case study on post-1980s' countries which are highly benefit from globalization and further proved the trade-growth linkage in developing countries. One-third of developing countries, in terms of increases in trade to GDP over the past 20 years, had a particularly large proportionate increase, doubling from 16% of GDP to

33% of GDP. In particular, economies in East Asia, South Korea, China and Taiwan, are seen the fast-economic growth and trade liberalization moving ahead, hand in hand.

3.1.2 The Trade Cost Factors

Trade costs are large and variable. With the development of transportation and information technology, even though economies today have been integrated with each other more than before, trade costs are still large and could not be underestimated. Based on Anderson and van Wincoop (2004), for developed economy, the trade costs still amount to an ad-valorem equivalent of about 170% of the goods value. In their calculation, these trade costs include the domestic distribution cost and international trade cost which accounts for 55 percent and 74 percent of the overall cost respectively. The 170 percent ad-valorem equivalent trade cost could also have been broken down into a group of trade cost factors as well, namely transportation costs (shipping cost, time cost and distribution cost), policy barriers (tariffs and non-tariffs), information costs, contract enforcement costs, transaction costs, legal and regulatory costs. Owing to the complex compositions of trade costs, there is no simple relationship between the size of the trading partner and trade costs. There is no straight answer to the relationship between trade cost and per capita income levels, although trade costs are higher on trade with African countries (Pomfret and Sourdin 2010).

Over the years, researchers have conducted many empirical studies and tried to define the impact of different trade cost factors on trade. Though perspectives are different, they hall stress the importance of trade costs.

Transportation Costs

Transportation costs depend on more than distance, bulk or scale, and the determinants vary by mode of transport. In general, sea freight is cheaper than air per kilogram, yet sometimes the goods transferred by air have lower ad valorem trade costs because air freight is mostly used for higher value products. However, it is not to say that the choice of transport mode only relies on the value of the goods. Time is also a factor which needs to be considered. Air transport will be chosen when timeliness is important, for instance, the perishable agri-product like fresh sea food.

1) Shipping costs

With respect to international trade, maritime transport is still the main option for traders. Ninety percent of world trade by volume is carried by maritime shipping according to Korinek (2008) Maritime traffic doubled in the year 2007 compared to its 2003 level, and the annual income of operating merchant ships was nearly US$ 380 billion in 2007, equivalent to about five percent of total world trade. Shipping costs are not exogenous. They are influenced by both government policies and the quality of ports, roads, as well as rail infrastructure. In some cases, the shipping related costs like port fees, ease of customs clearance, and the degree of bureaucratic red tape are probably equal to the costs of sea shipment itself (Radelet and Sachs 1998). Radelet and Saches (1998) argue that shipping costs are significantly correlated with economic growth, under the condition that ten other variables stay the same. Their results imply that the annual growth of a country could be slowed down by 0.5% if the shipping costs are doubled. In the case of a landlocked country, where the shipping costs are 50% higher than a similar coastal economy, a slower growth of about 0.3 percent per year could be expected. They also point out that value-added products, which are related to vertically fragmented activities, are more sensitive to shipping costs.

2) Hard and soft infrastructure

Trade facilitation is an important component of trade costs. It can be measured from two dimensions, namely hard infrastructure (highways, railroads, ports, and so forth) and soft infrastructure (such as transparency, customs efficiency, institutional reforms)

For landlocked countries, hard infrastructure is crucial to trade costs and trade flow. A deterioration of infrastructure from the median to the 75th percentile raises transport costs by 12 % and reduces trade volume by 28% (Limao and Venables 2001). In many least developed countries, trade delays caused by poor infrastructure reduce exports greater than tariffs (Djankov, Freund, & Pham, 2010). Amjadi and Yeats (1995) provided evidence to show that Africa had a serious competitive disadvantage on export due to its high transportation costs. Over 40 percent of the export earnings of some of Africa's landlocked countries were absorbed by freight and insurance payments, much higher than the average 5.8 percent of developing countries in general. By estimating a structural Gravity model of economic geography using cross-country data on income, infrastructure, transaction costs and trade of selected Asian economies, De (2004) shows that port efficiency and hard infrastructure quality are two important determinants of trade costs. Besides, transaction costs are statistically significant and important in explaining variations in trade in Asia.

Portugal-Perez and Wilson (2012) analyse the trade costs by further breaking hard infrastructure into Information and Communications technology (ICT) and physical infrastructure, soft infrastructure into business environment and border and transport efficiency. Their study shows that among these four specifications, physical infrastructure has the greatest impact on exports. It also points out the importance of transport efficiency and business environment is decreasing with the income level. The opposite occurs with ICT and physical infrastructure. Besides, there are the complementarity effects between hard and soft infrastructure with regard to export performance of developing countries.

3) Time barrier

Owing to the fact that many products are time-sensitive, extra trade costs could be created via inventory holding, perishability, rapid technological obsolescence, and uncertain demand (Hummels and Schaur 2012). Thus, time is also a trade barrier that should not be neglected. Hummels and Lugovskyy (2006) found out that each day in transit is equivalent to an ad-valorem tariff of 0.6 to 2.3 percent and the most time-sensitive trade flows are those involving parts and components trade. Their results also suggest a link between sharp declines in the price of air shipping and rapid growth in trade as well as growth in world-wide fragmentation of production. Djankov (2010) checked the time delay effects by different gravity equations and concluded that each additional day that a product is delayed prior to being shipped decreases trade by more than 1percent. That is to say, the cost of one day's delay is equivalent to a country distancing itself from its trade partners by about 70km on average.

Policy Barriers

Policy barriers can be categorized into tariff barriers and non-tariff barriers. By using the tariff trade restrictiveness index (TTRI) and the overall trade restrictiveness index (OTRI) which is also includes non-tariff measures (NTMs), Bernard Hoekman and Nicita (2008) analyses the impact of trade policy across countries as well as industries and gain useful insights. In general, trade policies are more restrictive in lower-income countries. NTMs are more prevalent in high and middle-income countries which tend to have lower ad valorem average tariffs. Agricultural trade is much more restricted than manufacturing, both in terms of TTRI and OTRI, especially in high income countries. Different geographic regions also share different OTRI and TTRI, less restrictive areas are East Asian, Central Asian and East European countries, while South Asia, Middle East and North Africa are more restrictive.

Tariff barriers are relatively low in most of the countries for the majority of the goods. It is less than 5 percent on average in rich countries and 10 to 20 percent on average in developing countries(Anderson and Van Wincoop 2004). In contrast, non-tariff barriers are various and abundant. Crossing Border costs are transaction costs that occur during customs and other administrative procedures. They can be equivalent to around 24 percent of the value of traded goods. In some countries, revenue losses from inefficient border procedures may exceed 5 percent of GDP. Border costs vary to a certain degree, depending on the country's per capita income level, as well as on the trading firm's size. Generally speaking, richer countries and larger companies are less affected. In terms of products, agricultural products suffer higher transaction costs than manufacturing products (Moïsé and Le Bris 2013) Trade costs occurring behind borders includes market access restrictions, trade finance availability and other impediments to doing business. These costs are not obvious as tariffs and transportation costs, yet their potential impacts on trade flows are still countable. In Anderson and Van Wincoop's calculation, the policy barrier accounts for 8 percent of the overall trade costs in industrialized countries.

Language and Cultural Barriers

International trade means trade among different countries and regions. As people from different places speak various languages and have their unique histories, when they trade with each other, they need more time and money to overcome their language barriers to communicate efficiently. It is not hard to imagine that cultural differences could be impediments to trade just as other barriers do.

Even two countries that do not speak the same language, linguistic similarities could facilitate trade between them, since language is not only related with communication efficiency but also self-identity. People may naturally trade more with others who share things in common, such as culture or historical ties (Lohmann 2011). It happens in many countries with a colonial or immigration history. For instance, English is widely spoken in the world today, since UK had many colonies in the last couple of centuries. Even today, based on this long common history, the Commonwealth countries still have an extensive mutual economic and political network that greatly facilitates trade among its member countries. In the case of immigration, Helliwell (1997) found that Canadian immigrants in US states and American ones in Canadian provinces enhance trade with their country of origin. One possible explanation is that the immigrants possess knowledge of the language and culture of their native country, thus lowering the language and cultural barriers between the two nations.

3.2 Gravity Model in Agriculture Trade

The gravity model has been widely used to analyse international trade patterns. Starting with Tinbergen (1962) and Linnemann (1966), it has received much praise as well as criticism. However, as a tool which could be seen as a partial equilibrium model of export supply and import demand (Bergstrand 1985), it was still powerful and useful. In studies of agricultural product trade, the application of the gravity model is diverse. Some literature focuses on the individual determinant's effects on the growth of agricultural trade, like regional trade agreements (Jayasinghe, & Sarker, 2008), exchange rate uncertainty (Cho et al., 2002), and single agricultural commodity trade policy (Koo, W. W., et al., 1994). Others use it to analyse the overall trade pattern and the main factors influencing agriculture export. For instance, Hatab, Romstad, and Huo (2010) employed the gravity model approach to examine Egypt's agricultural exports with its major trading partners and found that GDP had a positive influence on trade whereas transportation costs which are proxied by distance negatively correlates with export. Gu, Jiangying (2008) explore China's exports to 30 OECD countries between 1999 and 2005. The study demonstrates that population and income affect China's exports significantly, while physical distance and remoteness impedes trade.

Generally speaking, the gravity model is used in agriculture trade literature is structured as below in their log-linear form:

$$x_{ij} = \alpha + \alpha_1 M_i + \alpha_2 M_j + \sum_{m=1}^{m} \beta (Z_m) + Dij + \varepsilon_{ij} \quad (1)$$

Wherex_{ij} is the trade value between country i and country j; α is a constant; M_i and M_j are demand and supply of country i and j, usually expressed by GDP and population; Z_m represents a group of variables that could influence bilateral trade like free trade agreement (FTA) and they sometimes appear as dummy variables; Dij is the geographic distance between country i and j; ε_{ij} is a log-normally distributed error term.

Demand for food is driven both by population growth and income growth (Valin, *et al*. 2014). Thus, national income increase will impact export and consumption positively. The coefficient for GDP of the export and the import country should have a positive sign. Yet, the population could affect trade either negatively or positively, as a large population may represent a higher degree of self-sufficiency and less trade demands (Martinez-Zarzoso and Nowak-Lehman, 2003), or a larger consumer base which requires more importing commodities (Adas & Tussupova, 2016). Therefore, the coefficient for population of exporter and importer are negative or positive. The coefficient for group variable Z_m depends on the nature of the variable itself, and it could be either positive or negative. Finally, as a proxy of transportation costs or trade costs in general, the geographic distance Dij is proved to be negatively correlated with bilateral trade.

Among all these independent variables, although distance Dij plays an important role in the gravity model, its use of representing transportation costs or trade costs in general, is arguable. First of all, geographic distance is a static number which does not vary over time. Yet, with the development of efficient container shipping, information and technology, the global transportation has changed dramatically in terms of time and price in the last few decades. Thus, using a static number to represent a variable which is not consistent with time could be misleading. Second, in the real world, transportation fees are not the only costs occurring in international trade. Other factors like tariff and trade policy also influence international trade to a great degree. Therefore, the real impacts of trade costs on the trade flow might be underestimated due to the insufficient explanation power of the distance variable. In other words, the coefficient of Dij might be much lower than it should be. Anderson and van Wincoop (2004) remind us that distance is not dead. Trade costs are still large and important. It is necessary to explore trade costs in greater depth and find a better way to check their impact on international trade.

3.3 The measurements of trade costs

Since trade costs are important to international trade, researchers have been trying to measure and define their impact on trade flows for many years. In general, there are two ways to calculate trade costs, namely the direct approach and the indirect approach.

Direct approach:

There have been efforts to calculate the trade costs' components directly, such as transportation and insurance costs and tariffs. Owing to the great diversity of trade cost factors, however, there are several disadvantages of this approach.

First, the sources of those trade costs' components could be limited as well as problematic. For instance, in the absence of good data, many researchers use matched partner c.i.f/f.o.b ratios from IMF and UN data to represent transportation costs. In principle, comparing the valuation of the same aggregate flow reported by both the importer and exporter yields a difference equal to transport costs. However, this method has been criticized by Hummels (1999) for two reasons. First, a great deal of the observations is imputed. Second, the aggregation of the data might have compositional effects over time and some important trade cost variations may be covered. He concludes further research carried out by Hummels and Lugovskyy (2006) investigates the data usability of c.i.f/f.o.b by comparing its levels and variation to direct transport costs for the US and New Zealand. Their results confirm that "IMF c.i.f./f.o.b. ratios are badly error-ridden in levels, and contain no useful information for time-series or cross-commodity variation" (p.69).

Second, the data is limited across industries, countries, as well as years (Novy, 2013). Even some open data source run by trustworthy organizations would have the problems of specific data omission and delay, like TRAINS (the United Nations Conference on Trade and Development's Trade Analysis & Information System), and these data limitations would make available trade barrier information hard to interpret (Anderson and Van Wincoop 2004).

Third, it is hard to capture all the trade costs' components, especially for some non-tariff ones, like policy red tapes (Novy, 2013). Some costs might be omitted only because we have not recognized them, and the workload of aggregating all the trade cost components together is rather large.

Indirect Approach

Owing to limitations of direct measurement as discussed above, researchers have developed other ways to indirectly infer the level of trade impediments from trade flows.

Tinbergen (1962) first introduced distance as a trade cost variable in the gravity model and, since then, trade cost proxies have been widely used. McCallum (1995) uses the traditional gravity model to check the border effect between Canada and U.S. by using the dummy variable to represent interprovincial trade and province-to-state trade. He found that Canadian provinces trade up to 22 times more with each other than with the U.S., and these differences of trade flow could be interpreted as trade costs. Wei (1996), Chen (2004), and Olper & Raimondi (2008) also apply the same approach and find out the border effects within European countries and agricultural industry. Their results re-confirm that trade barriers do provide an explanation for this phenomenon.

Another well-known gravity model is introduced by Anderson and Van Wincoop (2004), having developed a conditional general equilibrium for international trade as the base for the deduction of trade costs. In this condition, each country produces only one product and each of these products is different from one another. The preferences of customers are identical across countries and are represented by constant elasticity of substitution. They obtain the trade flow equation with trade costs as follows:

$$x_{ij} = \frac{Y_i Y_j}{Y_w} \left[\frac{t_{ij}}{\Pi_i P_j} \right]^{1-\sigma} \qquad (2)$$

Where x_{ij} is bilateral trade flow, $Y_i$and $Y_j$are GDPs of country i and j, $Y_{\mathrm{w}}$is world GDP, $t_{ij}$is bilateral trade cost of country i and j, $\sigma > 1$ is the elasticity of substitution across goods. Π_i P_j are country i's and j's price indices, so called multilateral resistance. Specifically speaking, Π_i is the outward multilateral resistance which means high resistance to shipments from country i to its other markets, whereas P_j is the inward multilateral resistance which means high trade costs from other suppliers to country j. Π_i P_j Include trade costs with all other partners and could be seen as average trade costs.

In equation (1), bilateral trade flowx_{ij}, GDP variable $\mathrm{Y_i}$, $\mathrm{Y_j}$ and $\mathrm{Y_w}$ are not hard to gather. In order to get the value of average bilateral trade cost t_{ij} , the value of multilateral resistance $\Pi_\mathrm{i}\mathrm{P_j}$ and the elasticity of substitution σ need to be confirmed.

The direct measures for average trade costs are not available and it is hard to find other proper expressions for these multilateral resistances. Alternatively, Anderson and van Wincoop (2004) develop a bilateral trade cost function which includes two trade cost proxies (b and d): $t_{ij} = b_{ij}d_{ij}^k$. In this function, b_{ij} is a border related indicator, d_{ij} is bilateral distance and K is the distance elasticity. Meanwhile, they simplify the model by assuming that bilateral trade costs are symmetric (i.e.$t_{ij} = t_{ji}$). Under this assumption, the outward and inward multilateral resistance should be the same and thus Anderson and van Wincoop (2004) find a proper way to solve the multilateral resistance issue.

The estimation of the elasticity of substitution σ has been conducted by many researchers. One way is to use information from directly observed trade barriers. Hummels (1999) use theoretical gravity equations with information about tariffs and/or transport costs for 1992 data on sectorial industries. The estimated elasticity σ is 4.79 for one-digit SITC data and 8.26 for four-digit SITC data. Head and Ries (2001) conducted a similar method and obtained an estimate σ of 11.4 when assuming that Non-Tariff Barriers are the same for all industries and 7.9 when assuming there are industry fixed effects. Baier and Bergstrand (2001) used aggregate trade data for OECD countries during the time period of 1958-60 and the period 1986-88 and got the estimate of σ is 6.4. Overall, the estimate value of σ mostly falls within the range between 5 to 10 (Anderson, & van Wincoop, 2004).

Yet, Novy (2013) argue that the use of traditional gravity model and the gravity model provided by Anderson and van Wincoop both have several drawbacks. For the traditional gravity model approach, first, it needs to specify trade costs' components, and some non-tariff barriers might be omitted due to the lack of proper proxies. Second, as one of the most typical trade cost proxies, distance is a static number and therefore it is hard to illustrate the variation of trade costs over time. In terms of Anderson and van Wincoop's approach, first, the trade cost function they created might be mis-specified and has the potential of omitting trade cost variables. Second, bilateral trade costs might be asymmetric in the real world, for instance, one country might impose a higher tariff than the other. Thus, the use of multilateral resistance will be problematic.

By adjusting the theoretical gravity model developed by Anderson and Wincoop (2004), Novy (2013) provides a micro-founded measure of bilateral trade costs. The advantages of this trade cost measure are that first, it captures a brand range of trade cost variables; second, it is relatively easy to compute, since the issue of multilateral resistance has been solved. Novy (2013) also shows that this measure is consistent with a large variety of leading international trade models. Similar trade costs formulae could be derived from other famous models, for instance, the Ricardian model by Eaton and Kortum (2002), as well as the heterogeneous firm's model by Melitz and Ottaviano (2008). Based on this approach, Jacks et al. (2011) examined the growth of global trade flows across the Americas, Asia, Europe, and Oceania between the years 1870 to 2000 and found that declining trade costs is the major reason for the World War I trade boom, whereas the inter-war trade bust is explained by increases in trade costs. Arvis, J. (2016) analysed the trade costs in developing countries for the period of 1995 to 2010. The results show that trade costs have a reverse connection with per capita income and are falling faster in developed countries than in developing countries. In terms of an industrial and country-specific study, Shuwen Duan (2012) applies the same methodology to check global agricultural trade over the period 1965-2010. The study shows that agriculture trade costs in 1965 were as high as 285 percent ad-valorem equivalent and then dramatically declined to 118 percent in 2010. Free trade agreement and the GATT/WTO membership contribute to the reduction of trade costs by 36 percent and 20 percent respectively. Yu Miaozhi (2013) uses the revised model to analyse the agricultural trade costs between China and its major trading partners during 1996 and 2011. It again confirms the downward trend of trade costs in general, and shows that the growth of income and the decline in bilateral trade costs are two main factors contributing to China's agricultural trade growth.

3.4 Summary

This chapter reviewed empirical studies of what comprise trade costs and how we could measure them. Several trade cost factors have been introduced in detail, including transport costs, policy barriers, and language and cultural barriers. The measurement of trade costs is divided into two groups, one is the direct approach and another one is the indirect approach. The direct approach is highly criticized for its limitation on data sources and data availability. On the other hand, while the indirect approach is not perfect, it does overcome many shortages of the indirect approach. One indirect approach, the trade cost index proposed by Novy (2013) is chosen to be elaborated and applied later in this research. Besides, the application of traditional gravity model in agricultural product is also briefly reviewed in this chapter. In the traditional gravity model, distance is widely used as a trade cost proxy, yet it is static and not comprehensive enough to cover all the trade cost factors. Thus, a better replacement is needed.

Chapter 4: Methodology

To check how trade costs could influence trade flows, trade costs have to be calculated in a meaningful manner. In traditional gravity models, distance is used as a trade barrier proxy, yet it is static and not comprehensive. A better expression of trade costs is needed. A micro-founded bottom-down trade costs' measure developed by Novy has been applied recently in some studies. It is derived from the Anderson and van Wincoop (2004) gravity model, yet avoiding its drawbacks.

In this chapter, the trade costs' measure developed by Novy is examined in detail, and two ways of examining the relationship between trade growth and trade costs are also discussed. The remainder of this chapter is as follows. Section 4.1 explains the transformation from Anderson and van Wincoop's model to Novy's approach. Section 4.2 presents the specification of the traditional gravity model. Section 4.3 shows the decomposition of trade growth according to Novy's method. Section 4.4 is the summary of this chapter.

4.1 Trade Cost Index

The trade cost measure proposed by Novy (2013) is derived from Anderson and van Wincoop's (2004) gravity model as follows:

$$x_{ij} = \frac{Y_i Y_j}{Y_w} \left[\frac{t_{ij}}{\Pi_i P_j} \right]^{1-\sigma} \qquad (2)^{*}$$ [1]

The reasoning behind Novy's adjusted approach is simple. A change in bilateral trade barriers does not only affect international trade, but also intra-national trade. That is to say that when a country sells relatively less goods to its own customers than to foreigners, it shows the falling of trade costs, holding the other factors constant. Similarly, if a country sells more goods to its own residents than to foreigners, it means trade costs must have increased. Based on this understanding, the multilateral resistance of one country could be computed as follows:

$$\Pi_i P_i = (X_{ii}/Y_i) \,/ (Y_i/Y_w)^{1/(\sigma-1)} t_{ii} \qquad (3)$$

One of the drawbacks of equation (2)* is that the multilateral resistance of two countries $\Pi_i P_j$ is hard to get. As we already have equation (3) as the solution of multilateral resistance of one

[1] This equation is same to equation (2) on page27.

country, it is easy to multiply equation (2)* with the trade flow of the opposite direction and get:

$$X_{ij}X_{ji} = (\frac{Y_iY_j}{Y_w})^2(\frac{t_{ij}t_{ji}}{\Pi_iP_i\Pi_jP_j})^{1-\sigma} \quad (4)$$

In (4), X_{ij} and X_{ji} represent trade flows of country i to country j and country j to country i; Y_i and Y_j are nominal income of country i and j; Y_w is the world income; t_{ij} and t_{ji} are bilateral trade costs between country i and j; Π_iP_i *and* Π_jP_j are multilateral resistance of country i and j.

Substituting the solution of multilateral resistance Π_iP_i and Π_jP_j of equation (3) into (4) yields:

$$\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}} = (\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}})^{1/(\sigma-1)} \quad (5)$$

Trade costs like transportation costs could be asymmetric ($t_{ij} \neq t_{ji}$) and intra-national trade costs could be different from country to country ($t_{ii} \neq t_{jj}$). Thus, it is useful to take geometric mean of the trade costs in both directions and deduct one to get ad-valorem equivalent bilateral trade costsτ_{ij} as:

$$\tau_{ij} = (t_{ij}t_{ji})/(t_{ii}t_{jj})^{1/2} - 1 = (X_{ii}X_{jj}/X_{ij}X_{ji})^{1/2(\sigma-1)} - 1 \quad (6)$$

where

τ_{ij} Denotes geometric average bilateral trade cost between country i and j;

X_{ii} Denotes Intra-national trade of country i;

X_{jj} Denotes Intra-national trade of country j;

X_{ij} Denotes international trade from country i to country j;

X_{ji} Denotes international trade from country j to country i;

σ Denotes intra-sectoral elasticity of substitution

Among these components above, the international trade values between countries i and j are directly available (X_{ij}&X_{ji}), and can be gathered from United Nation Commodity Trade Statistics Database (UNCOMTRADE). Yet, the intra-national trade data (X_{ii}&X_{jj}) are not directly available and the elasticity of substitution σ needs to be ascertained.

Data Treatment and Parameter Assumptions

In this paper, three trading pairs' agricultural product bilateral trade is analysed, namely China & European Union (EU), China & Association of Southeast Asian Nations (ASEAN), and EU & ASEAN with a time period from 2001 to 2015. EU includes 27 countries except Croatia and ASEAN includes its five major countries (Malaysia, Singapore, Indonesia, Philippines, and Thailand). China only includes mainland, without HongKong. The reason for choosing EU-27 instead of EU-28 is because Croatia joined the EU family as the 28th member state in 2013, and its agricultural production data only started in 2005. In order to consistent data, Croatia was dropped from the picture.

-X_{ii}

In terms of market clearing, the trade value of country trading itself could be expressed as total production minus total exports to the rest of the world.

$$X_{ii} = Y_i - X_i \tag{7}$$

In this formula, the total exports to the rest of the world X_i could be obtained from numerous sources like the UNCOMTRADE. Y_i , the total agricultural production is not a ready value and needs to be calculated. Gross domestic product (GDP) data is not suitable to use as total production due to its value added nature, and GDP data also includes service industry which is not covered by the trade data (Novy 2013**).** Novy (2013) follows Wei (1996) in constructing Y_i as total goods production based on the OECD's structural analysis (STAN). Owing to the limitation of China's agriculture production data, Yu (2013) use the approach developed by Wei (1996) and define the intra-national trade flow as the following equation:

$$X_{ii} = S_i(GDP_i - X_i) \tag{8}$$

Here, the S_i is the fraction of tradable goods. Based on the studies of Novy (2006), Jacks, Meissner et al. (2010), the range of S_i is between 0.3-0.8. Thus, she assumes S_i as 0.64 and substitutes the equation (8) to (6) and gets:

$$\tau_{ij} = \left[\frac{S^2(GDP_i - X_i)(GDP_j - X_j)}{X_{ij}X_{ji}}\right]^{1/2(\sigma-1)} - 1 \tag{9}$$

Different from the approach taken by Miaozhi Yu (2013), the total agricultural production value of China used in this paper is from China Statistic Year Book, withdrawn from China

Integrated Knowledge Resources Database (Cnki.net). It is a sum of three subsectors, namely agriculture, forestry and fishery. The original data is in billions RMB and it is converted to US dollars by using currency data from International Financial Statistical (IFS) (See Appendix. A5).

The total agricultural production value of EU-27 is gathered from Euro Statistic. It is also a sum of several agricultural products' value, namely cereals, wheat, industrial crops, forage plants, fruits, and so forth. There are 75 items in total, covering most of the agricultural products. The original data is in Euros and it is converted to US dollars by using currency data from IFS (See Appendix. A6).

The total agricultural production value of ASEAN is taken from Food and Agricultural Organization Statistics (FAOSTAT). It is also an aggregated value. The original data only covers the time period from 2001 to 2014. In order to get the production value of 2015, a simple regression forecasting has been used. The original data is in millions current US dollars (See Appendix. A7).

-X_i

The export to the rest of the world X_i is taken from UNCOMTRADE. Product codes are from 01 to 24 based on Harmonized System, covering most of the agricultural products. All the data are in US dollars.

-X_{ij}&X_{ji}

The bilateral trade among trading partners are gathered from UNCOMTRADE. Same as the export value, the Harmonized Coding System has been used and products are from 01 to 24. All the data are in US dollars.

- σ

σ is the parameter value for the intra-sectoral elasticity of substitution. The lower the value, the higher degree of differentiation of products are and thus a larger degree of heterogeneity. In general, the range of elasticity of substitution is from 5 to 10. Hummels (1999) set it as 4.79 for one digit SITC data and 8.26 for four digit SITC data. Head and Ries (2001) set it as 11.4 and 7.9. Baier and Bergestrand (2001) get the estimate of σ is 6.4. The same estimation was also made by Yu (2013). Here, I follow the choice of Anderson and van Wincoop as well as Novy (2013) by setting σ=8. As Novy (2013) points out, this is a ballpark parameter value suitable for aggregate trade flows, and the overall results are not sensitive to this particular value.

4.2 The specification of gravity model

The gravity model used in this paper is traditional and simple, since the main purpose of the paper is to check the impact of trade costs on bilateral trade flows. Thus, the choice of other independent variables is controlled to a minimal size. Except for the trade costs' proxy distance, one country's GDP and population are selected as the other two comparable factors, and the gravity model is structured as follows:

$$X_{ij} = \alpha_0 + \alpha_1 GDP_{from} + \alpha_2 GDP_{to} + \alpha_3 Pop_{from} + \alpha_4 Pop_{to} + \alpha_5\, Dis + u_{ij} \qquad (10)$$

where, X_{ij} is bilateral trade flow between country i and j; GDP_{from} and GDP_{to} are the economic size of export and import country; Pop_{from} and Pop_{to} are the population size of export and import country; T_{cost} is the trade cost between country i and j; α_0 is the consistency and u_{ij} is the normal distributed error term. Generally, the determinants are multiplicative with different units. Thus, in order to keep the operational efficiency and consistency, the log-linear form was widely accepted as estimation.

The problem with estimating equation (10) is that distance is static and not comprehensive enough to represent trade costs alone. As argued earlier that the trade cost index developed by Novy (2013) is a better measurement, I therefore re-structured equation (10) by replacing distance into the trade cost index while keeping other variables the same and got:

$$X_{ij} = \alpha_0 + \alpha_1 GDP_{from} + \alpha_2 GDP_{to} + \alpha_3 Pop_{from} + \alpha_4 Pop_{to} + \alpha_5 T_{cost} + u_{ij} \qquad (11)$$

Where the values of X_{ij}, GDP_{from}, GDP_{to}, Pop_{from} and Pop_{to} are consistent with its counterparts in equation (10). The only difference here is the trade cost proxy. In equation (11) it is trade cost index developed instead of the geographic distance in the equation (10).

According to the literature (e.g. Linnemann, 1966), the economic size of a country is positively correlated with its exports and the effect of population could be either positive or negative, whereas the trade costs, as the impediment of trade by its definition, should be negatively correlated with trade costs. Therefore, the expected signs for each variables coefficient are as follows:

Table 2: The Expected Signs of Gravity Model

Variables	Log (GDP from)	Log (GDP to)	Log (Population from)	Log (Population to)	Log (Trade Cost)
Expected Signs	+	+	+ or -	+ or -	-

The bilateral trade value is obtained from the UNCOMTRADE database. Data on GDP and population came from the World Bank Development Indicators database. Both trade and GDP figures are in U.S. dollars. Data on trade distances among economies are geographic distances between capital cities; in particular, the capital city of China is Beijing. The capital cities of EU and ASEAN are the cities where the organizations are located, namely Brussels and Jakarta. The geographic distance is stated in kilometres and obtained from CEPII Geo Dist database. The trade cost index is calculated based on the method provided by Novy (2013) presented above.

4.3 The decomposition of trade growth

Apart from providing the micro-founded trade cost measure, Novy (2013) also deconstructs the Anderson and van Wincoop (2004)'s gravity model and uses it to examine whether the increase in trade is the result of the magnitude of economic growth or, if it could be related to the reducing trade frictions.

Taking the natural logarithm and the first difference of equation (4):

$$\Delta \ln\left(X_{ij}X_{ji}\right) = 2\Delta \ln\left(\frac{Y_iY_j}{Y_w}\right) + (1-\sigma)\Delta \ln\left(t_{ij}t_{ji}\right) - (1-\sigma)\Delta \ln\left(\Pi_i P_i \Pi_j P_j\right) \qquad (12)$$

Here, $\Delta \ln\left(X_{ij}X_{ji}\right)$ is the growth of bilateral trade between country i and j; $\Delta \ln(Y_iY_j/ Y_w)$ is two countries' economic size relative to world's output; $\Delta \ln\left(t_{ij}t_{ji}\right)$ is the change of bilateral trade cost; and $\Delta \ln\left(\Pi_i P_i \Pi_j P_j\right)$ is the change in the two countries' multilateral resistance.

Although the value of bilateral trade cost $\Delta \ln\left(t_{ij}t_{ji}\right)$ and multilateral resistance $\Delta \ln\left(\Pi_i P_i \Pi_j P_j\right)$ are not available directly, it could be yielded from equation (6) and equation (3) respectively and get:

$$\Delta \ln\left(X_{ij}X_{ji}\right) = 2\Delta \ln(\frac{Y_iY_j}{Y_w}) + 2(1-\sigma)\Delta \ln\left(1+\tau_{ij}\right) - 2(1-\sigma) \ln\left(\phi_i\phi_j\right) \qquad (13)$$

Where $\tau_{ij} = \left(\left(t_{ij}t_{ji}\right)/\left(t_{ii}t_{jj}\right)\right)^{\frac{1}{2}} - 1 = ((X_{ii}X_{jj})/(X_{ij}X_{ji}))^{\frac{1}{2}} - 1$, and $\phi_i = (\Pi_i P_i/t_{ii})^{\frac{1}{2}}$

Then both sides are divided by $\Delta \ln\left(X_{ij}X_{ji}\right)$ and yield:

$$100\% = \frac{2\Delta \ln(\frac{Y_iY_j}{Y_w})}{\Delta \ln\left(X_{ij}X_{ji}\right)} + \frac{2(1-\sigma)\Delta \ln\left(1+\tau_{ij}\right)}{\Delta \ln\left(X_{ij}X_{ji}\right)} - \frac{2(1-\sigma)\, \Delta\ln\left(\phi_i\phi_j\right)}{\Delta \ln\left(X_{ij}X_{ji}\right)} \qquad (14)$$

(1) (2) (3)

From the decomposition above, we can see that the growth of bilateral trade is driven by three contributions, (i) income growth, (ii) bilateral trade cost, and (iii) multilateral resistance (3). Specifically, if relative bilateral trade cost does not change over time which means τ_{ij} is zero, then the contribution of trade costs to trade growth is zero as well. However, if bilateral trade costs decrease which means$\Delta \ln\left(1+\tau_{ij}\right) < 0$, as $\sigma > 1$ and $2(1-\sigma)$ are also negative, the contribution of deduction of trade costs to trade growth will be positive. Similarly, if multilateral resistance decreases which means $\Delta\ln\left(\phi_i\phi_j\right) < 0$ and the contribution of (3) is negative. This negative could be explained asa trade diversion effect. When trade barriers with other countries drop, bilateral trading partners will trade less with each other and trade with other countries instead.

In this equation, data of economic growth could be obtained directly from sources like the World Bank. Y_i, Y_j and Y_w are the levels of GDP of countries i, j and the world respectively. The value of τ_{ij} in contribution (2) could be substituted by equation (6) and get: $2(1-\sigma)\Delta \ln\left(1+\tau_{ij}\right) = \Delta \ln\left(X_{ij}X_{ji}\right) - \Delta \ln\left(X_{ii}X_{jj}\right)$. Similarly, the value of $\Delta\ln\left(\phi_i\phi_j\right)$ could be solved by multilateral resistance in equation (3) and get: $2(1-\sigma)\, \Delta\ln\left(\phi_i\phi_j\right) = \Delta \ln((Y_i/Y_w)/(X_{ii}/Y_i)) + \Delta\ln((Y_j/Y_w)/(X_{jj}/Y_j))$.

Similar equations could be derived from other models too, like Eaton and Kortum's (2002) Ricardian trade model, Chaney(2008), and Melitz and Ottaviano (2008). This method has been used in many studies except Novy's own study in recent years. Miaozhi (2013) decomposes the agricultural trade growth between China and its major partners and finds out that growth of income and the decline in bilateral trade cost are the main contributors. Gaurav and Mathur (2016) applies it to the bilateral trade between India and the European Union and obtainasimilar result. The relative bilateral trade growth has been mainly driven by the decrease of trade costs between these two trading partners. It could explain 109% of the total trade growth. On the other hand, the decrease of multilateral resistance leads to a 35% negative contribution to the bilateral trade. It shows that the growing trade between India and other trading partners like United States divert its trade away from the EU.

4.4 Summary

This chapter explains three approaches in detail, which are used to analyse trade costs and their impacts among China, EU, and ASEAN in this study. The trade cost index developed by Novy (2013) is derived from Anderson and van Wincoop's (2004) model, but has been improved. It is calculated from accessible trade and production data of trading pairs. The change of data itself make trade cost index changes along time as well. Compared to distance which is static, it could be a better proxy in the gravity model. Thus, two gravity model specifications are set to be tested, in which distance and trade cost index are used as trade cost proxy respectively. The trade growth decomposition which is also introduced by Novy (2013) shows another perspective of trade growth and its contributors. Aside from economic size which is also used in gravity model, it introduces a new element: multilateral resistance. Here, the multilateral resistance could be understood as trade diversion effect. That is to say, when trade barriers with the rest of the world drop, bilateral trading partners will trade less with each other but trade with other countries instead.

Chapter 5: Data Analysis and Results

This chapter presents the empirical results of an examination of bilateral trade costs and their impact on the total trade flows of China & EU, China & ASEAN and EU & ASEAN using both the traditional gravity model and a bottom-down trade cost measure developed by Novy. Section 5.1 presents the results of the trade cost index based on Novy's method. Section 5.2 discusses the intra-national agricultural trade value that are derived from the calculation of trade costs in further detail. Section 5.3 is a general commentary on the gravity model, which includes two different trade cost proxies, namely distance and trade cost index. Section 5.4 shows the decomposition of trade growth, a new approach developed by Novy and provides a new aspect to understand the contribution of trade costs. Section 5.5 is the summary of this chapter.

5.1 Trade Cost Index

Table 3 reports the tariff-equivalent levels of bilateral agricultural product trade cost measure for China & EU, China & ASEAN, and EU & ASEAN based on equation (6). For more details about the calculation of trade costs, see Appendix 8 (a, b, c).

Table 3: Bilateral Agricultural Product Trade Cost Index among Three Trading Partners

Bilateral Agricultural Product Trade Costs Index			
			$\sigma = 8$
Year	China-EU	China-ASEAN	EU-ASEAN
2001	7.618	1.350	1.916
2002	7.545	1.270	1.924
2003	7.320	1.240	1.931
2004	7.177	1.263	1.935
2005	6.651	1.281	1.922
2006	6.378	1.220	1.949
2007	6.225	1.184	1.931
2008	6.280	1.207	1.914
2009	6.042	1.221	1.937
2010	5.930	1.208	1.924
2011	5.675	1.207	1.925
2012	5.649	1.218	1.908
2013	5.614	1.228	1.887
2014	5.549	1.241	1.896

2015	5.314	1.279	1.925
Average	6.331	1.241	1.922
Change (%)	30.24%	5.28%	-0.47%

Generally speaking, the changes of trade costs among these three partners are quite different. Over the past 15 years, trade costs between China and EU have decreased dramatically by 30.24%. The trade barriers between China and ASEAN have been reduced as well, yet only by 5.28%. In contrast, the trade costs between EU and ASEAN have hardly changed and have even increased by 0.47% in 2015 compared to 2001.

Compared to the study done by Miaozhi Yu (2013) which also focus on Agri-food trade among China, EU and ASEAN during 1996 and 2011, my results are similar but different.
In general, both studies showed that the bilateral agricultural product trade costs between China and its trading partners, specifically speaking, EU and ASEAN were going down year by year. Especially, the trade costs between China and EU had a large percentage decline of 30.75 from 1996 to 2011 in her study and decline of 30.24% from 2001 to 2015 in mine (See Table 3). During the same period of time (2001-2011), the trade costs between China and EU calculated in this paper are higher than Miaozhi's result, in both yearly values and in percentage of change over time (See Table 4).

Table 4: The Comparison between Miaozhi's Study and Mine

Trade costs in Miaozhi's paper			**Trade costs in this paper**		
	CH-EU	CH-ASEAN		CH-EU	CH-ASEAN
2001	2.715	1.819	2001	7.618	1.350
2011	2.227	1.559	2011	5.675	1.208
Change (%)	17.97%	14.29%	Change (%)	25.51%	10.52%

Among possible reasons for this are first, the data sources are different. Owing to the data limitations, Miaozhi obtains the intra-national trade value from the equation (8), whereas I use the data directly obtained from China Statistical Yearbook. There are significant differences between these two data sets (See Table 5). Based on the calculations of this paper, the intra-national trade of agricultural product in China is much bigger. From equation (6), we could see that as a country sells more goods to its own customers, the trade costs are higher.

Table 5: Comparison of The Intra-National Trade Value of China's Agricultural Products in Two Papers

The intra-national trade of China's Agricultural ProductsX_{ii} (in US dollars)		
Time	X_{ii} in Yu Miaozhi's study	X_{ii} in this paper
2001	8.51E+11	3.14834E+12
2015	7.11E+12	1.69644E+13
Method	$X_{ii} = S_i(GDP_i - X_i)$*in where*$S_i = 0.64$, $X_i =$ *export to the rest of the world*	$X_{ii} = Total\ Production - X_i$, *in where the Total production here is retrieved from China Statistic Book*

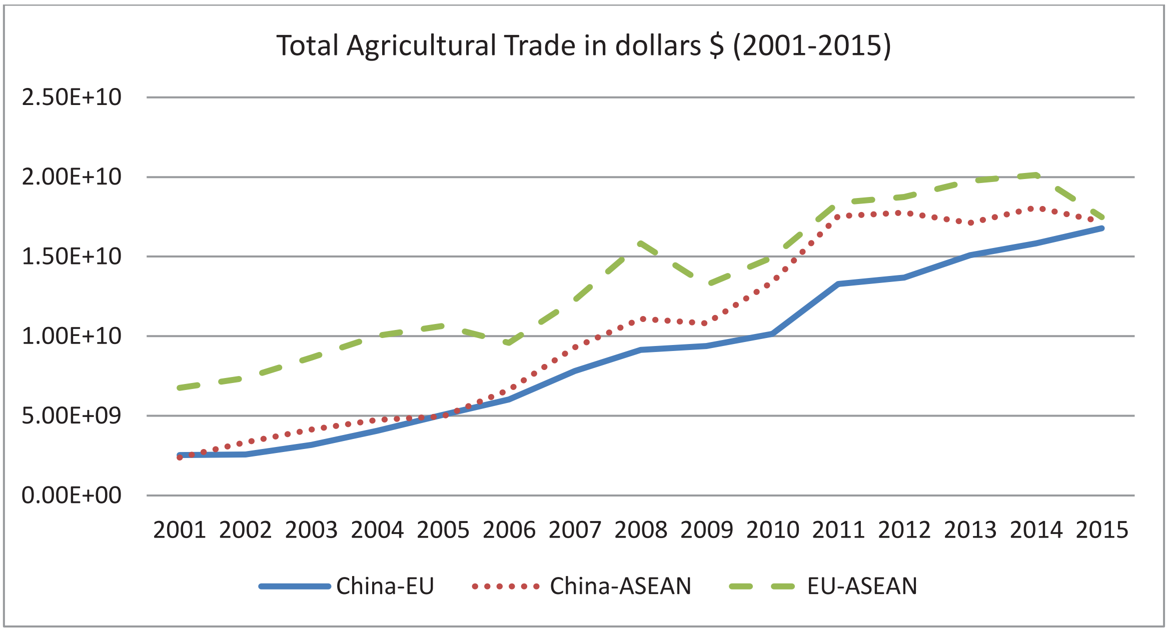
Second, the choice of parameter σ is different. In Yu Miaozhi's study, she assumed σ = 6.4 for agricultural product. While my study followed the setting of Novy's study (2013), in which the σ equals to eight. Although Novy (2013) points out that the changes of trade costs over time is considerably less dependent on σ, it still might be an important reason why the results are different.

Third, the scope of member nations in EU and ASEAN are different. In Yu Miaozhi's study, EU is represented by six countries, namely UK, Italy, France, Spain, Netherlands and Germany, whereas in this paper, the scope of EU is much wider and realistic. In other words, the member countries in EU have been growing over the years, from 15 in 2001 to 28 in 2015. Thus, the data of EU used in Yu's paper and here are fundamentally different. In the case of ASEAN, six countries are used in her paper, while only five (Indonesia, Philippine, Singapore, Thailand, and Malaysia) major countries are used in the present paper.

Among three trading partners, China and EU have the highest average trade costs. Several trade cost factors could contribute to this situation, like transportation costs, policy barriers, and cultural barriers. Unlike China and ASEAN who share a common border, the geographic distance between China and EU is much larger. Thus, a higher shipping cost is inevitable. Meanwhile, the high protection of agricultural products in industrial countries is still an issue. Based on Messerlin's research on trade policy barriers for the European Union, the tariff equivalent of policy barriers were 31.7% in agriculture, 22.1% in textiles, 30.6% in apparel, and much less in other industrial goods (Messerlin 2001). Apart from direct policy barriers like border protection and market price support, food safety and agricultural health standards posed by developed countries also impede the imports from developing countries (Aksoy and Beghin 2004). In terms of cultural barriers, language and colonial history are two main contributors. Compared to ASEAN countries like Singapore and the Philippines, the English proficiency in China is relatively low and, with the exception of Thailand, all countries in Southeast Asia were colonized by Europeans. This colonial history, no matter short or long, has had a profound impact on the countries' borders, administrations, political structures and economic foundations. These linguistic, familial and historical ties could help lower the cultural trade barriers between ASEAN and EU and further contribute to the relatively low, overall trade costs between these two partners. Similarly, for China, the centuries of contact with the people of Southeast Asia has left a significant legacy of Chinese origin in the local communities. The close sharing by China and ASEAN could also accelerate the bilateral trade, in other words, lower the trade costs.

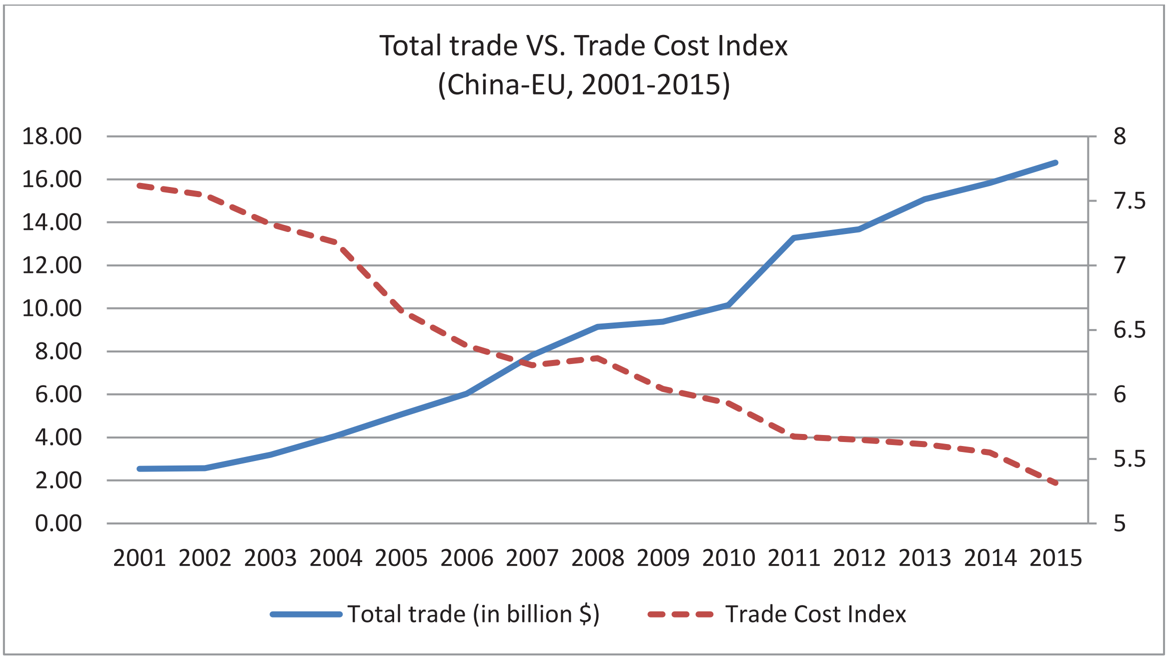
During the period 2001-2015, the bilateral trade between these three trading partners has grown strongly (see Figure 5). Specifically, the total agri-product trade between China & EU, China & ASEAN and EU & ASEAN has increased six-times, seven-times and three times respectively. There was a sharp decline of bilateral trade between EU and ASEAN in 2009 due to the global economic and financial crisis. The growth rate then picked up quickly after 2010 and maintained relatively small fluctuations during 2012 and 2015. A similar pattern can be seen from the trade between China and ASEAN - yet, the 2009 global and economic crisis shows less impact on this trade pair. Comparably, the growing trend of China and EU's bilateral trade is smoother than the other two pairs. It has kept a steady rise over the past 15 years. Besides, two significant trade growth periods are observed between China and ASEAN, which are 2006 to 2008 and 2009 to 2010. The establishment of China-ASEAN Free Trade Area (CAFTA) has made a great contribution toward this growth. It was initiated in 2002 and officially activated in 2010. The reduction of tariffs gradually started in 2005. Until2010, the tariffs of over 90% of imported goods have reduced to zero in both China and six original members of ASEAN: Brunei, Indonesia, Malaysia, the Philippines, Singapore and Thailand. Agricultural goods in particular, including live animals, meat, fruits and dairy products benefited from the zero tariff as early as 2004(ASEAN 2002).

Figure 5: The Bilateral Agri-Product Trade Between China &EU, China & ASEAN and EU&ASEAN



In case of China and EU, it is obvious that as trade costs are going down, and bilateral trade is increasing (See Figure 6), and there has not been much fluctuation over the years. Both trend lines are smooth and steady. There is a further rising tendency of bilateral trade along with the reduction of trade costs in the coming years.

Figure 6: Total Trade VS. Trade Costs (China-EU, 2001-2015)

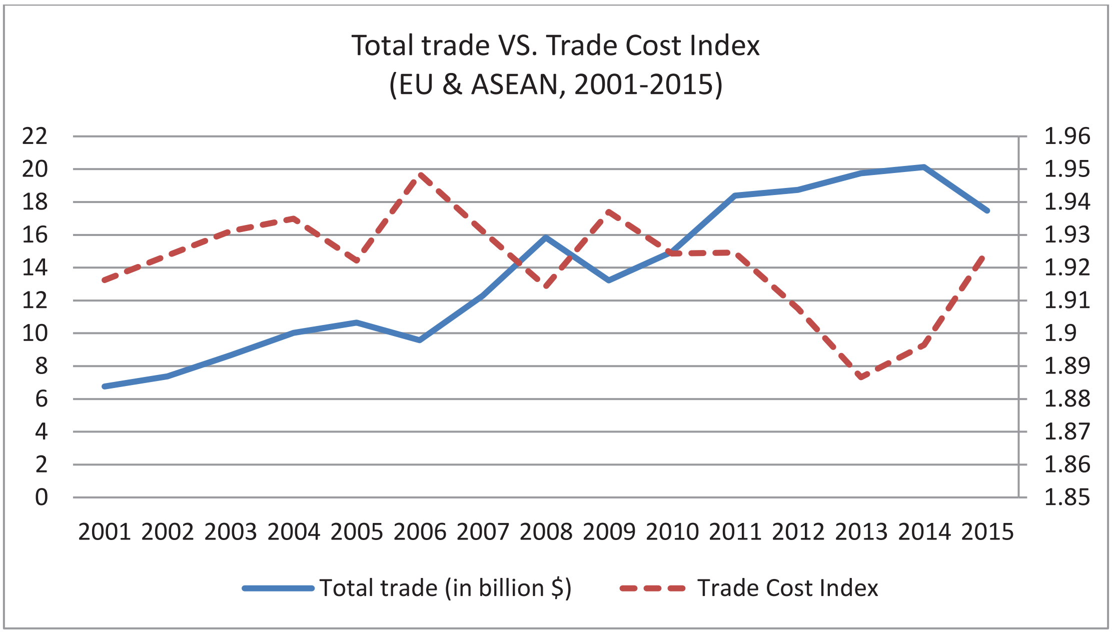


Generally speaking, bilateral trade between China and ASEAN has been growing over the past 15 years along with the reduction of trade costs between these two partners (See Figure 7). Yet, unlike trade costs between China and EU, it has had several ups and downs. During the periods of 2003 to 2005 and 2007 to 2009, trade costs have increased and, meanwhile, there were stagnation of total trade values in the 2004 and 2008 years respectively. Although there was a significant increase of trade flow between 2009 and 2011, the trade costs did not change much during the same period. There are other factors that have contributed to such growth. After 2011, the trade cost has gradually been rising again. Correspondingly, the bilateral trade value has been stagnating for a few years and showed signs of dropping in 2015.

Figure 7: Total Trade VS. Trade costs (China-ASEAN, 2001-2015)

There is no systematic relationship between the total trade and trade costs in the case of EU & ASEAN (Figure 8). In the first four years of the sample, trade costs are growing and so is the total trade value. Then, from 2005 to 2011, there is an apparent negative relationship between the trade costs and the total trade. In the last segment of the whole period (2012-2015), trade costs experience a sudden drop and follow with a sharp rise. Yet, it is worth noting that, although the change of trade cost index here seems dramatic, the difference between the highest point and the lowest point is only 0.062.

Figure 8: Total Trade VS. Trade Costs (EU-ASEAN, 2001-2015)



From the figures above, it is clear that there is a negative correlation between trade cost and total trade. It is important to question whether this increase in trade is related to reductions in trade frictions. In order to check the relationship between trade cost and bilateral trade more clearly. Further examination is needed. Therefore, I use traditional gravity model and a decomposed method developed by Novy (Novy 2013) to analysis the relationship between bilateral trade growth and trade cost as well as other influencing factors.

5.2 The intra-national trade VS. international trade

Based on equation (7), the intra-national trade of a country could be represented by its total production deducted by its total exports. Among these three trading partners, China and ASEAN both have a huge growth on intra-national trade in the past 15 years (Table 6). Similarly, their exports to the rest of the world also show a large increase in the same period.

Table 6: The Intra-National Trade & The International Trade of Agricultural Product

	Intra-national Trade			Export to the rest of the world		
Year	**China**	**EU**	**ASEAN**	**China**	**EU**	**ASEAN**
2001	3.15E+12	1.13E+12	7.03E+10	1.45E+10	4.81E+10	2.52E+10
2005	4.79E+12	1.51E+12	1.26E+11	2.65E+10	7.50E+10	3.90E+10
2010	1.02E+13	1.74E+12	2.55E+11	4.76E+10	1.11E+11	8.50E+10
2015	1.70E+13	1.61E+12	4.16E+11	6.82E+10	1.39E+11	9.72E+10
Change%	438.84%	42.36%	491.47%	369.34%	188.64%	285.71%

To be specific, the high growth of China’s intra-national trade and exports illustrates a more active domestic market and a further integration of international markets, while, in the case of ASEAN, the growing number of intra-national trade could be a result of the foundation of the Free Trade Area. Comparably, EU has the lowest growth rate, 42.36% on intra-national trade and 188.64% on exports. Yet, it does not mean it is not so good for either of them, but quite the opposite. In 2001, EU had 15 member countries and this number grew to 28 in 2015. As the enlargement of member countries, its intra-national trade does not yet grow very much as expected. It suggests that agricultural trade among member countries in European Area might be large and extensive even before they join the Union due to their geographic and economic proximity. It is also important to notice that although the growth of agricultural product exports of EU is relatively low. Its absolute value is still the largest among the three, no matter whether it is in 2001 or in 2015.

Comparing intra-national trade of one country with its exports, the results indicate a tendency towards autarky when it comes to agricultural products in China (Table 6). Most of its agricultural products are consumed within the nation rather than exported. It can be attributed to China’s agricultural policy which is focused on domestic food security.

5.3 The impact of trade cost via the traditional gravity model approach

In the traditional gravity model, distance is used as a proxy to trade cost and it is usually considered as a transportation cost. Although due to its static nature, the explanatory power of trade costs is arguable, it is still widely applied in literature. The trade cost index developed by Novy (2013) is considered to be more comprehensive and it changes over time. In analysing the trade pattern among China, EU and ASEAN, these two trade cost proxies are applied in the general gravity model defined in equations (10) and (11). The only difference between these two models is that one is using geographic distance and the other is using economic distance: trade cost index.

Table 7: Regression Results for Eq. (10)

Explanatory Variables	Coefficient	t-Statisitic	Prob.
$LGDP_{from}$	0.742014	22.13952	0.0000
$LGDP_{to}$	0.733117	4.293737	0.0001
$LPOP_{from}$	−2.095413	−4.989115	0.0000
$LPOP_{to}$	−2.717090	−1.973578	0.0555
LDis	−3.361462	−6.791910	0.0000
Const	107.5683	3.282997	0.0022
Adjusted R-squared:	0.972128		
Log likelihood:	41.28024		
F-Statistic	307.9253		
Observations:	45		
Heteroskedasticity- consistent *t*-values (White adjusted).			

Table 8: Regression Results for Eq. (11)

Explanatory Variables	Coefficient	t-Statisitic	Prob.
$LGDP_{from}$	0.557440	15.78639	0.0000
$LGDP_{to}$	0.734128	−6.484879	0.0001
$LPOP_{from}$	−0.068302	−0.789128	0.4348
$LPOP_{to}$	−1.988936	−2.158669	0.0371
LCOST	−0.956072	−10.61459	0.0000
Const	27.29438	1.660559	0.1048
Adjusted R-squared:	0.984356		
Log likelihood:	54.27453		
F-Statistic	554.7030		
Observations:	45		
Heteroskedasticity- consistent *t*-values (White adjusted).			

In the model that distance is used as a trade cost proxy (Table 8), the coefficient of GDP is positive and significant as expected. This implies that as economies grow, they have more demand for imports and greater ability to supply exports. It does not matter whether an economy is developed (EU) or developing (China & ASEAN). The bilateral trade between trading partners increase by 0.7% as the exporter or importer country's GDP increase by 1%.

The coefficients of population are found to be large and significant at 1% (Population of source country) and 5% level (Population of destination country). The negative sign though, shows that the population growth creates higher demand of food, and may also lower the per capita income and lead to a higher degree of self-sufficiency, In return, it reduces the demand of trade, for both imports and exports.

In regard to distance, its negative impact on trade flow is large and highly significant. The coefficient of distance is the largest among these four dependent variables. An increase of one unit of distance would lead to about three units of trade reduction.

The F-value and coefficient of determination (R^2) of this gravity equation are high. This means that the equation has a relatively high explanatory power. The value of the coefficient of determination is 0.97. The value indicates that selected variables explain 97% of the variance of its agricultural bilateral trade.

In the regression model that trade cost index is used to represent trade costs instead of distance (Table 9); the signs of GDP and population are the same as the model above, yet, the role of population is less important in this case. More specifically, the population of importers are only significant at the 5% level, whereas the exporters' population are not significant at all (Prob = 0.4348). The coefficient of trade costs here is still negative and significant, yet not as large as it is in the model above (-3.36 vs.-0.95). The differences show that the impact of trade costs on the overall trade flow could be quite varied if we use a different trade cost proxy.

In terms of F-value, both models are statistically significant. The R-square of the general regression model (0.98) is slightly larger that of the gravity model (0.97). However, it does not mean the former one is superior. In order to get a better understanding of these two models, I introduce the statistical approach. In statistics, a likelihood ratio test is used to compare the goodness of fit of two models. One of them is a special case of the other. The test is based on the likelihood ratio, which expresses how many times more likely the data are under one model than the other. The test statistic is twice the difference between the log form of likelihood ratio of the alternative model and null model:

$$D = 2[\log(likelihood\ ratio\ of\ alternative\ model) - \log(likelihood\ ratio\ of\ null\ model)]$$

Here, I set the null model as the model that uses distance to represent trade costs (equation 10), and the alternative one is the model that uses the trade cost index instead (equation 11). The log likelihoods of these two are 41.2802 and 54.27453 respectively. Thus, the difference between them is 25.98858. The freedom of degree here is one, since only one parameter has been changed between these two models. Following the chi-square distribution, the significance level of 1% is 6.63 which is much smaller than 25.98858. It means that the alternative model does have a better explanatory power.

In summary, the results I obtained are consistent with the literature. The economic size, population and trade costs are all important determinants of bilateral agricultural trade. As the GDP of EU, China and ASEAN are continually growing; more agricultural products are expected to be traded among them. In contrast, the population of both exporters and importers have a negative impact on bilateral trade. Similarly, trade costs impede trade flows significantly in both models.

Owing to the limitation of agricultural production data of China which is gathered from the China Statistic Year Book, the sample size of the regression is relatively small. There is the potential issue of over-fitting as there are too many parameters relative to the number of observations. Thus, I tried to set a robustness test which only uses export values between trading partners and enlarged the sample size to 90 (see Appendix 6). Although the adjusted-R squared is smaller, the overall results are still consistent. Thus, compared to geographic distance, the trade cost index developed by Novy (2013) could be a better choice as a trade cost proxy.

5.4 Decomposition of trade growth

The decomposition approach provided by Novy (2013) is another way to analyse the relationship between trade barriers and trade flow apart from the traditional gravity model. The benefits of this method are first that it is easy to compute. All the components that are needed can be calculated from the available data base. Second, the contribution of each factor to the overall growth is expressed by a percentage other than significance as in the gravity model. It provides a different angle from which to understand the determinants of trade. Third, it does not need to have a large amount of observations to meet the standard of statistics.

Apply equation (14) to decompose the bilateral trade growth among the country pairs: China & EU, China & ASEAN, and EU & ASEAN. Table 9 reports the decomposition results.

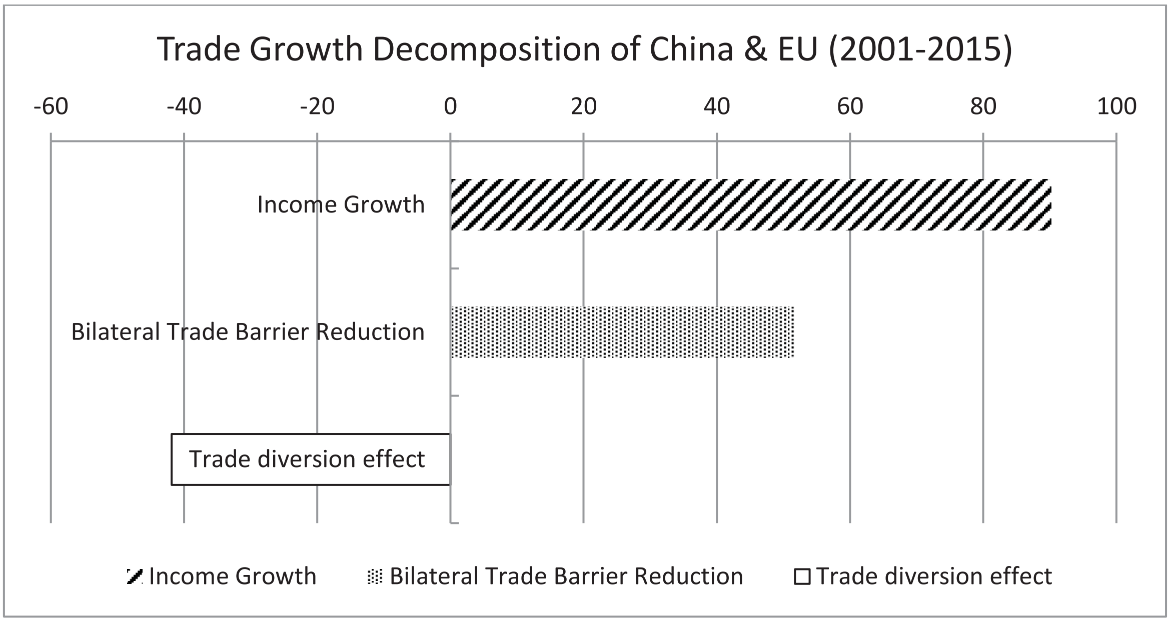
Table 9: Contributions of bilateral trade growth among China & EU, China & ASEAN, EU & ASEAN

	China & EU	**China & ASEAN**	**EU & ASEAN**
Income Growth	90.22	140.41	118.22
Bilateral Trade Barrier Reduction	51.65	11.07	-3.15
Trade diversion effect	-41.87	-51.48	-15.07
Total	100	100	100
Notes: Growth between 2001 and 2015. All numbers in percentage. Computations based on equation (14) and unified in two decimals. See also Appendix.9			

In general, for the period of 2001 to 2015, the income growth explains the majority of the bilateral trade increases among these three trading pairs. The bilateral trade cost reduction is the second contributor yet it various from one country pair to another. The trade diversion effect here is caused by the reduction of multilateral resistance. The decline of multilateral trade barriers diverts trade away from bilateral trading partners. It means the larger the number, the more a country trades with the rest of the world rather than with this particular trade partner. This negative effect is particularly obvious among China & EU and China & ASEAN.

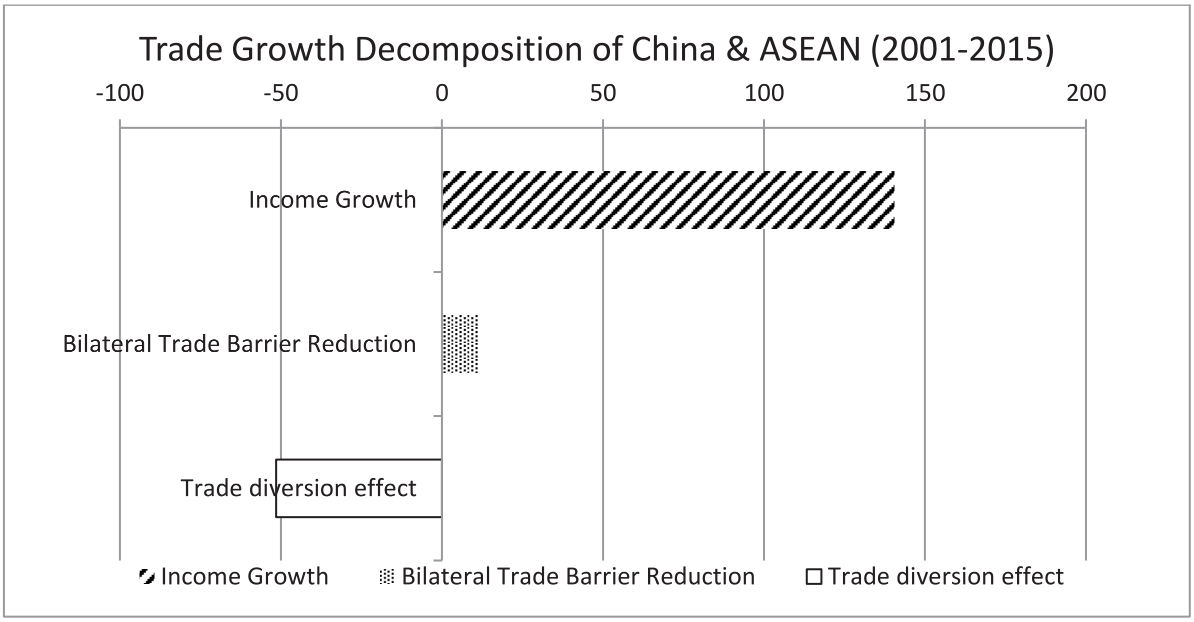
In the case of China and EU (see Figure 9), Over 90 percent of the trade growth came from income growth. The reduction of bilateral trade cost is the second major contributor, accounting 51.65 percent of the total growth. However, over 40 percent of the bilateral trade value is diverted due to the reduction of multilateral resistance.

Figure 9: Contributions of bilateral trade growth between China and EU



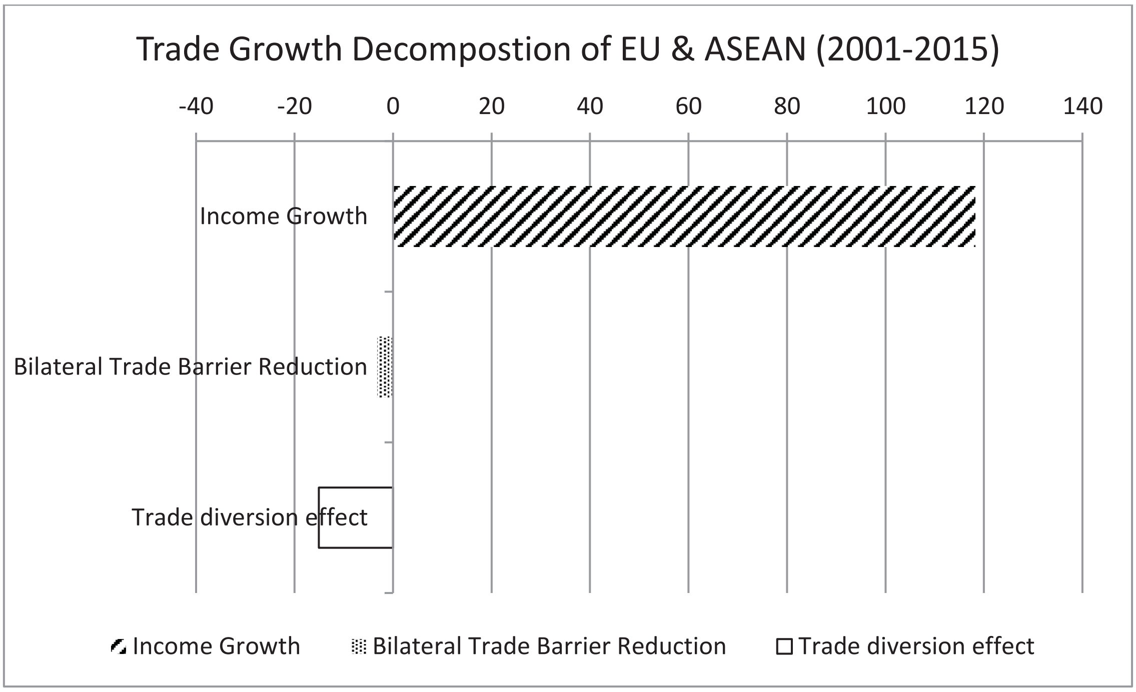
In the case of China and ASEAN (see Figure 10), the contribution of income growth is as high as 140%. The decline of bilateral trade barriers provides the second largest contribution to the growth of trade as well. However, compared to the trading pair China & EU, of which the reduction of bilateral trade cost explains over half of the growth (51.65%), here it only accounts 11.07%. The trade diversion effect in this trading pair cannot be ignored either. It reduces total trade value about 51.48 percent.

Figure 10: Contributions of bilateral trade growth between China and ASEAN



In the case of EU and ASEAN (see Figure 11), income growth is still the most important factor, accounting for 118.22 percent of total trade growth.

Figure 11: Contributions of bilateral trade growth between EU and ASEAN



The bilateral trade barrier effect is actually slightly negative for EU and ASEAN. This means that the trade cost between these two partners has increased over the years and it impedes the trade rather than promote it.

To make a cross comparison among these three trading pairs, we could see that the trade cost reduction is very important to China and EU's bilateral trade growth, yet not that important in the cases of China & ASEAN and EU & ASEAN. It is consistent with the changes of trade cost over the last fifteen years (see Table 3) and the results of gravity model (see Table.8). Specifically speaking, the trade cost between China and EU was large in both 2001 and 2015. It experienced a significant decrease of 30.24 percent during these fifteen years. While at the same period of time, the trade costs of China & ASEAN and EU & ASEAN only changed about 5.28 percent and 0.47 percent respectively. According to the results of gravity model, the effect of trade cost reduction is significant. Thus, the bilateral trade of China and EU benefits from its large trade cost reduction the most.

In terms of the large trade diversions happened between China & EU and China & ASEAN, one possible reason for this phenomenon is trade diversion effects caused by free trade agreement (FTA) and preferential trade agreement (PTA). Vinerian (1950) first brought the idea of trade diversion to the debate of FTA's effects. That is to say that trade preferences for higher cost producers with the FTA can exclude efficient third-party producers, resulting in trade diversion and efficiency losses. Based on this hypothesis, several trading blocs have been checked by researchers. Lambert and Mckoy (2009)'s finding support that PTA members have trade creation in most cases, yet diversion was observed for several associations composed primarily of developing countries. Sun and Reed (2010) also found out significant trade diversion happens in EU-15. The exports to outside non-member countries were lower by 6.8% while the imports from outside countries were reduced by 8.6%.

In 2001, China officially joined the World Trade Organization (WTO) and, from then on, it is further integrated into the global economy through several FTAs. Currently, China has 14 Agreements which have been signed and implemented already and 19 more FTAs are under construction. According to the data provided by UNCOMTRADE, the trade map of China's agricultural products has gradually changed in the last 15 years. Along with the expansion of the total trade value, more trading partners get involved and their shares have been growing over the past 15 years. In 2001, Oceania, Africa and South America only accounts for 4.7% of China's agricultural products export. This proportion has doubled and reached 10.5% in 2015. A similar situation also happened to China's agri-product imports. The proportion of these three trading areas has grown from 7.2% to 15.4%.

ASEAN also actively cooperate with other economies via FTAs and PTAs. These trade agreements include ASEAN-Republic of Korea Free Trade Area, ASEAN-Japan Free Trade Area, ASEAN-India Free Trade Area, and ASEAN-Australia New Zealand Free Trade Area.

5.4 Summary

In summary, the bilateral trades of agricultural products of China & EU, China & ASEAN, and EU & ASEAN have grown a lot from 2001 to 2015. Among these three trading pairs, China & ASEAN has the largest increment, about seven times larger. During the same period, trade costs between China & EU, China & ASEAN, and EU & ASEAN have been reducing gradually. Based on Novy's bottom-down trade cost calculation method, China and EU have an average tariff equivalent trade cost of 6.311, whereas the average trade barriers of China & ASEAN and EU & ASEAN are only 1.241 and 1.922 respectively.

In the traditional gravity model approach, I use the distance and trade cost index developed by Novy and the trade cost proxy respectively, and make a comparison. There is more bilateral trade along with the growing GDP of China, EU and ASEAN. The effect of economic size is positive and significant in both models. Yet, as the population gets larger, their trade volume decreases. The negative effect of population is also significant in these two models.

Similarly, there is a significant negative relationship between total bilateral trade and trade costs. The gravity model which uses the trade cost index has a better explanatory power than the one that uses distance as a trade cost proxy.

The trade growth decomposition approach developed by Novy provides another way to analyse the driven forces of bilateral trade. It is easy to compute and could be used as a supplement to the gravity model's results. Income growth and the reduction of bilateral trade costs are the main factors which contribute to the growth of bilateral trade flow between China and EU, while in the cases of China & ASEAN and EU & ASEAN, income growth is the only major driven force. The reduction of trade barriers contributes a little to the overall trade growth. In terms of trade diversion effects, so called multilateral resistance, it has a negative sign. When one country trades more with the rest of the world rather than one particular trading partner, the bilateral trade between these two will decrease. The trade diversion effects of China & EU and China & ASEAN are large; the growing number of China's regional free trade agreements might be one contributing reason.

Chapter 6: Conclusion and Recommendations

Trade costs are large and important. However, due to its diversity and complexity, its size and influences have not been fully recognized. By using a newly developed trade cost measure, this research examines the bilateral agricultural trade among three important trading partners, namely China, EU and ASEAN, during 2001 to 2015. It covers three main parts, which are first, the agricultural trade performances of these three economies; second, the trade costs among the bilateral trading pairs; third, the impacts of the trade costs reduction on the overall trade flows. This final chapter reviews the main findings as well as contributions of the research that corresponds with the research objectives stated at the beginning. Nevertheless, there are some limitations of this research that are stated in this section.

6.1 Main Findings

6.1.1 Main Findings on agricultural trade balance

The global agricultural trade has been expanding over the last fifteen years. As important market players, China, EU and ASEAN have not only experienced large growth in volume, but also in pattern and composition of agricultural trade.

Specifically, China switched its trade balance position from being a net exporter to a net importer recording deficits of 2.86 billion (US dollars) and 4.34 billion (US dollars) with EU and ASEAN respectively in 2015. China imports large amount of processed products like beverage, dairy produce, and animal as well as vegetable oils. It shows a strong domestic demand and diet change which are caused by its economic development and income growth. In the meantime, due to a large population employed in the agricultural sector, China still enjoys comparative advantage in labour intensive products like vegetables and fruits. Although China has been one of the world's top traders of agricultural goods, most of its agricultural production is consumed and traded within the country.

EU is the major exporter of high valued-added agricultural products among these three. Beverages, spirits, dairy produce, meat and edible meat, and cereal are its top exports. It has been a net exporter to China since 2012 while a net importer to ASEAN during 2001 and 2015. Its imports mainly focus on vegetables, fruits, and intermediate agricultural products like animal fats and vegetable oils.

Unlike China, ASEAN is a net exporter of agricultural products. It has the net trade surplus of 4.34 billion (US dollars) and 5.09 billion (US dollars) with China and EU respectively in 2015. Most of its exports are animal or vegetable fats and oils, accounting for over 40 percent of its total value. Similar to China, ASEAN also has the advantage in labour intensive products, yet, they are specialized in different product groups due to geographic differences. Thus, they still trade a large number of vegetables and fruits with each other.

In summary, the agricultural trades among China, EU and ASEAN have been growing steadily in the last fifteen years. With regard to the proportions of trade, EU focuses more on value-added products, like beverage and dairy. China and ASEAN has more focus on labour-intensive goods, like vegetables and fruits. Rapid economic development in China and ASEAN meant both of them demand more of high value-added products from EU.

6.1.2 Main findings on trade costs

Based on the trade cost measure developed by Novy (2013), the trade costs of agricultural goods among China, EU and ASEAN are still high. Specifically, China and EU has significantly higher average trade costs among these three trading partners. Trade costs in latter two regions are about six times as large as the equivalent tariff. Trade costs between EU and ASEAN is two times the equivalent tariff, second only to China and ASEAN at about 1.2 times of equivalent tariff, lowest trade cost in this exercise. The overall trend for bilateral trade cost is going down, yet not as large as desirable. The largest reduction is between China and EU, over 30 percent. In the case of China and ASEAN, the trade cost decreased about 5 percent over the years. On the other hand, there is little change of trade costs between EU and ASEAN. Compared to 2001, its bilateral trade costs of 2015 even increased 0.47 percent. Many trade cost factors might contribute to these differences, for example, transportation cost, policy barriers and cultural barriers.

Geographic distance as a representative of transportation cost is traditionally used as a proxy to trade cost. In this study, the coefficient of distant variable was found to be negative and large. A one unit increase in distance leads to a 3.36-unit reduction in trade, the largest impact among all four independent variables considered. The result of the gravity model demonstrates the importance of trade costs as an independent variable to trade flows. However, the drawbacks of using distance as trade cost proxy is also apparent. It is static and not comprehensive enough to cover all the trade cost factors. In order to avoid these issues, the trade cost index developed by Novy is used in an adjusted gravity model. In general, the results obtained in such adjusted gravity model were found to be consistent with those in their traditional counterpart. All independent variables are significantly correlated with bilateral trade flows. The trade cost index, in particular, has a negative sign and a coefficient of 0.96. It means one unit of trade cost increase leads to 0.96 units of trade reduction. To compare the goodness of fit of these two models, the likelihood ratio test is introduced. The results of the test show that the model which uses trade cost index instead of distance as trade cost proxy has a better explanatory power. Although this comparison is relatively rough and also arguable due to the close relationship between trade cost index and theoretical gravity model, it suggests the insufficiency of using distance as trade cost proxy that calls for a better measure.

6.1.3 Main findings on trade growth

The trade growth results from numerous factors. In the gravity models used in this study, both in their traditional the adjusted varieties, there are five independent variables: GDP of export country, GDP of import country, population of export country, population of import country, and trade costs. These five variables explain over 90 percent of the variance of bilateral agricultural trade. In particular, economic sizes of both exporter and importer positively correlate with agricultural trade growth. One unit of GDP increase contributes about 0.7 units of bilateral trade growth. In contrast, growth of population of both trade partners impede agricultural trade flows. One unit of population increase leads to about 2.0 units of trade reduction. Trade costs, as stated above, are also an impediment to the trade flow and their impact is relatively large.

Apart from the gravity model approach, Novy (2013) provides a decomposition method to evaluate the relationships between trade growth and trade cost reduction, as well as income growth and multilateral resistance. It differs from the gravity model which shows the big picture, the decomposition approach examines bilateral trade growth by country pairs. In general, the trade growth among these three trading partners is mainly due to economic growth. The contribution of income growth is as high as 140% in the case of China and ASEAN. Trade cost reduction is the second important contributor to agricultural trade growth between China and EU, which accounts for over 50 percent of the trade growth. Further reductions of transportation cost and policy barrier could possibly enhance the bilateral agricultural trade between these two partners. However, the trade cost reduction has little impact on the trade pairs of China & ASEAN and EU & ASEAN. In terms of multilateral resistance, also recognized as trade diversion effects, it plays an important role in reducing bilateral trade in all three trading pairs. As the multilateral resistance declines, countries trade more easily with the rest of the world. Correspondingly, its bilateral trade with a particular partner would be diverted. The development of FTAs could be the reason for this phenomenon. These trade diversion effects are especially obvious in bilateral trade involving China.

6.2 Contribution to the Literature by This Research

This research provides a supplement to present literature and its contributions are listed as follows:

Firstly, the trade costs' measure used in this study is still new to the field and there are only a handful of studies which have explored its application. Denis Novy, along with other co-authors contributed a great deal to the literature. Yet many of their studies focus on its application on developed economies and industrial products (e.g. Novy, 2006; David S. Jacks, et al. 2008; Jacks, Meissner et al, 2010; Jacks, Meissner et al. 2011). Miaozhi (Miaozhi 2013) and Wen & Zheng (Wen, Zheng et al. 2013) use this measure to check the agricultural trade between China and its major trading partners, during the period 1995-2011. Gaurav and Mathur (2016) apply this measure to examine determinants of trade costs and trade growth between EU and India. This research extends the scope of the current studies with new trading partners, new time period and specific industry.

Secondly, this study provides updated analysis of agricultural food trading patterns among China, EU and ASEAN. The chosen of trading partners and the period of 2001 to 2015 in this paper are new to literature. The results not only confirm many conclusions in the existing studies, but further prove the importance of trade cost reduction between China and EU. In general, the prosperity of agricultural trade highly depends on income growth. While the growing demand of high value products from the EU shows the diet changes of developing economies like China and ASEAN along with their income growth. In the case of China and EU, although they experienced substantial trade cost reduction over the years (30.24%), the trade costs between these two are still large. As their bilateral trade growth have benefitted from trade cost reduction significantly (51.65% of the trade growth). There is a great potential for future agricultural trade expansion between these two as the trade costs further decrease.

Thirdly, trade diversion effects are large among these three trading partners. China, EU, and ASEAN are all large and dynamic economies in the world. In terms of agricultural products, there are some other important players in the global market, like United States of America, Canada, Argentina, Australia and New Zealand. It is no surprise to see that bilateral agriculture trade among China, EU and ASEAN has been influenced strongly by their relationship changes with other trading partners. The growing number of FTAs could possibly contribute to this phenomenon, especially in the case of China.

6.3 Limitations of This Research

As with any other research, there are some limitations in this study. These are stated below: First, there is the potential over fitting the problem of the gravity model due to the small sample size. It is because the choice of economies and year period. Specifically, although the EU and ASEAN comprise several member countries, they are seen and treated as one region economy in this research. Consequently, there are only three economies, including China that has been examined in this paper. The chosen time period is chosen for two reasons. The year 2001 is the point that China officially joined WTO. Since then, China has become an important part of global trade. Furthermore, agricultural production data of China which is gathered from China Statistic Year Book starts from 2001, meaning there are only fifteen years that can be used. Thus, the sample size turns out relatively small.

Second, there is the potential issue of data inconsistency. The definitions of agricultural products are different among sources. For example, the agricultural production in China includes agricultural, fishing and forestry, while for the EU and ASEAN, they are a combination of several sub-sectors. Meanwhile, the bilateral trade value is collected from UN Comtrade which is categorized by harmonized system (HS). It is possible that data gathered from these different sources are mismatched or overlapped.

6.4 Directions for Future Research

In this study, the trade balance, trade cost and their relationships with trade growth among China, EU, and ASEAN have been examined with the newly developed trade cost measures. It is shown that the bilateral agricultural trade among these trading partners are important and they have grown over the years. Deduction of trade costs was shown to be one of the important reasons that have led to this trend. Based on major findings and limitations of this research, there are several possible improvements and extensions that could be made in the future.

First, we know that agricultural bilateral trade costs within these three trading partners are large and important, and trade cost factors like high policy protection, long distance and cultural barriers are possible main contributors. It is thus worth exploring what the major contributors are in each of the trading pairs and what exactly their relationships are.

Second, the trade costs and their role in trade growth between China and EU needs more attention. In 2013, China raised the initiative of jointly building the Silk Road Economic Belt and the 21st-Century Maritime Silk Road (so called One Belt One Road, OBOR). This blueprint is designed to connect the vibrant East Asia economic circle and developed European economy together, encompassing countries with great economic development potential along the Road and Belt region. It acknowledges that trade cooperation is a major task in this master plan. Along with the foundation of Asian Infrastructure Investment Bank (AIIB) and the open of China-Europe Railway Express, transportation between China and EU is expected to be more efficient. More cooperation could be done to boost trade between these two giant economies via trade reduction in the future.

Third, the multilateral resistance found in this study was rather large. Although it is assumed that the enlargement of FTA areas and its trade diversion effects account for this phenomenon, further explanations are welcomed.

Besides, a larger sample size which either has a longer period or covers more countries is another good way to extend the vision of this research. For example, a further breakdown of the member countries of EU and ASEAN would provide a more comprehensive picture of their agricultural relationships with China and, at the same meantime, a better understanding of the existence of a single market.

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Appendices

A.1 Production Description of HS 2-digit product categories chosen for this research

HS Code	Production Description
01	Animals, live
02	Meat and edible meat offal
03	Fish and Crustaceans, molluscs, and other aquatic invertebrates
04	Dairy Produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included
05	Animal originated products; not elsewhere specified or included
06	Trees and other plants, live; bulbs, roots and the like; cut flowers and ornamental foliage
07	Vegetables and certain roots and tubers; edible
08	Fruit and nuts, edible; peel of citrus fruit or melons
09	Coffee, tea, mate and spices
10	Cereal
11	Products of milling industry; malt, starches, inulin, wheat gluten
12	Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit, industrial or medicinal plants, straw and fodder
13	Lac; gums, resins and other vegetables saps and extracts
14	Vegetable plaiting materials; vegetable products not elsewhere specified or included
15	Animal or vegetable fats and oils and their cleavage products; Prepared animal fats; animal or vegetable waxes
16	Meat, fish or crustaceans, molluscs or other aquatic invertebrates; preparations thereof
17	Sugars and sugar confectionery
18	Cocoa and cocoa preparations
19	Preparations of cereals, flour, starch of milk; pastry cooks' products

20	Preparations of vegetables, fruit, nuts or other parts of plants
21	Miscellaneous edible preparations
22	Beverages, spirits, and vinegar
23	Food industries, residues and wastes thereof; prepared animal fodder
24	Tobacco and manufactured tobacco substitutes

A.2 Product shares of bilateral trade between EU and China (2001 & 2015)

	2001		2015	
HS Code	**Export**	**Import**	**Export**	**Import**
01	1.08%	0.37%	0.62%	0.12%
02	11.73%	1.98%	20.36%	0.34%
03	16.67%	24.30%	4.34%	23.03%
04	10.61%	1.78%	10.21%	2.72%
05	7.21%	11.38%	2.72%	9.13%
06	3.83%	1.07%	1.32%	0.80%
07	0.48%	11.63%	0.10%	8.65%
08	0.65%	2.82%	0.86%	6.24%
09	0.17%	3.70%	0.45%	6.97%
10	10.13%	0.43%	9.22%	0.14%
11	1.25%	0.07%	0.52%	0.27%
12	4.61%	11.11%	1.41%	9.19%
13	1.14%	0.84%	0.37%	2.88%
14	0.04%	1.12%	0.00%	1.10%
15	1.77%	0.96%	3.14%	1.49%
16	0.19%	3.45%	0.08%	3.98%
17	1.48%	1.09%	0.44%	1.04%
18	2.04%	0.07%	2.60%	1.09%
19	3.35%	2.53%	16.11%	2.49%
20	0.60%	13.95%	1.08%	8.38%
21	3.93%	1.26%	3.16%	3.72%
22	13.05%	1.08%	19.38%	0.80%
23	2.31%	1.58%	1.29%	4.06%

24	1.68%	1.43%	0.21%	1.38%

A.3 Product shares of bilateral trade between China and ASEAN-5(2001 & 2015)

	2001		2015	
HS Code	Export	Import	Export	Import
01	0.26%	0.19%	0.01%	0.01%
02	4.29%	0.67%	1.34%	0.05%
03	3.41%	7.20%	11.04%	3.99%
04	0.78%	0.18%	0.72%	0.45%
05	1.41%	0.14%	0.73%	0.07%
06	0.18%	0.13%	0.41%	0.06%
07	14.73%	9.60%	21.09%	14.16%
08	13.25%	6.79%	16.30%	6.40%
09	4.46%	0.35%	1.99%	0.76%
10	12.83%	7.59%	0.31%	4.39%
11	3.06%	1.08%	1.92%	5.24%
12	6.50%	0.72%	4.11%	1.32%
13	0.70%	0.18%	1.36%	0.18%
14	0.29%	0.70%	0.07%	0.48%
15	0.80%	46.68%	0.89%	42.65%
16	4.00%	0.51%	4.09%	0.29%
17	1.85%	9.22%	6.13%	3.44%
18	0.12%	2.21%	1.21%	2.26%
19	2.35%	0.33%	2.26%	5.02%
20	4.99%	0.64%	4.91%	1.16%
21	2.05%	0.53%	5.97%	3.14%
22	1.09%	1.52%	1.97%	2.20%
23	5.21%	0.78%	3.54%	1.93%

24	11.38%	2.05%	7.65%	0.07%

A.4 Product shares of bilateral trade between EU and ASEAN-5 (2001 & 2015)

	2001		2015	
HS Code	Export	Import	Export	Import
01	1.56%	0.11%	0.66%	0.02%
02	1.87%	6.44%	7.60%	2.49%
03	2.97%	11.82%	1.17%	4.28%
04	19.36%	0.01%	14.05%	0.10%
05	0.08%	0.16%	0.77%	0.07%
06	0.26%	0.86%	0.20%	0.43%
07	0.75%	6.45%	1.12%	0.34%
08	0.82%	1.82%	0.98%	2.18%
09	0.48%	5.98%	0.65%	5.19%
10	0.97%	2.22%	4.75%	2.10%
11	5.36%	0.24%	3.80%	0.24%
12	0.35%	0.79%	0.36%	0.52%
13	1.13%	1.38%	0.98%	0.87%
14	0.02%	0.28%	0.00%	0.08%
15	1.24%	28.65%	2.29%	46.82%
16	0.54%	11.76%	0.53%	13.60%
17	6.16%	0.25%	1.19%	0.48%
18	1.83%	1.73%	3.15%	2.33%
19	7.62%	1.56%	6.23%	2.58%
20	1.36%	7.46%	3.06%	5.21%
21	11.27%	1.50%	6.98%	3.00%
22	21.30%	0.60%	29.30%	0.74%
23	4.64%	5.37%	8.21%	4.41%

24	8.07%	2.54%	1.98%	1.93%

A5. Intra-National Trade of European Union's agricultural product

Intra-National Trade of EU agricultural product =Gross Output – Total Export to the World			
Year	Gross Output ($)	Export ($)	Intra-National Trade Value ($)
2001	1.18E +12	4.81E+10	1.13E +12
2002	1.21E +12	5.38E +10	1.16E +12
2003	1.45E +12	6.02E +10	1.39E +12
2004	1.68E +12	3.11E +09	1.68E +12
2005	1.58E +12	7.50E +10	1.51E +12
2006	1.59E +12	8.56E +10	1.50E +12
2007	1.91E +12	9.49E +10	1.82E +12
2008	2.16E +12	1.12E +11	2.05E +12
2009	1.80E +12	9.78E +10	1.71E +12
2010	1.85E +12	1.11E +10	1.74E +12
2011	2.13E +12	1.37E +11	1.99E +12
2012	2.03E +12	1.41E +11	1.89E +12
2013	2.16E +12	1.53E +11	2.00E +12
2014	2.11E +12	1.58E +11	1.96E +12
2015	1.75E +12	1.39E +11	1.61E +12

A6. Intra-National Trade of China's Agricultural Product

Intra-National Trade of China agricultural product =Gross Output – Total Export to the World			
Year	Gross Output ($)	Export ($)	Intra-National Trade Value ($)
2001	3.16E +12	1.45E +10	3.15E +12
2002	3.31E +12	1.74E +10	3.29E +12
2003	3.59E +12	2.06E +10	3.57E +12
2004	4.38E +12	2.25E +10	4.36E +12
2005	4.81E +12	2.65E +10	4.79E +12
2006	5.12E +12	3.02E +10	5.09E +12
2007	6.43E +12	3.55E +10	6.39E +12
2008	8.35E +12	3.88E+10	8.31E +12
2009	8.84E +12	3.82E +10	8.80E +12
2010	1.02E+13	4.76E +10	1.02E+13
2011	1.25E+13	5.86E +10	1.25E+13
2012	1.41E+13	6.11E +10	1.41E+13
2013	1.57E+13	6.54E +10	1.57E+13
2014	1.65E+13	6.94E +10	1.65E+13
2015	1.70E+13	6.82E +10	1.70E+13

A7. Intra-National Trade of ASEAN's Agricultural Product

Intra-National Trade of China agricultural product =Gross Output – Total Export to the World			
Year	Gross Output ($)	Export ($)	Intra-National Trade Value ($)
2001	9.55E +10	2.52E +10	7.03E +10
2002	1.10E +11	2.84E +10	8.16E +10
2003	1.28E +11	3.26E +10	9.54E +10
2004	1.48E +11	3.72E +10	1.11E +11
2005	1.65E +11	3.90E +10	1.26E +11
2006	1.85E +11	4.46E +10	1.40E +11
2007	2.28E +11	5.85E +10	1.70E +11
2008	2.79E +11	8.00E +10	1.99E +11
2009	2.74E +11	6.85E +10	2.06E +11
2010	3.40E +11	8.50E +10	2.55E +11
2011	4.51E +11	1.09E +10	3.42E +11
2012	4.48E +11	1.06E +10	3.42E +11
2013	4.17E +11	1.02E +10	3.15E +11
2014	4.74E +11	1.09E +10	3.65E +11
2015	5.13E +11	9.72E +10	4.16E +11

A8. Listed below are the Trade Cost Index between China & EU (a), China & ASEAN (b), and EU & ASEAN (c)

(a) Trade Cost Measure between China and EU

Time	**Xii** (Intra-National Trade of EU-27)	**Xjj** (Intra-National Trade of China)	**Xij** (Export from EU-China)	**Xji** (Import from EU-China)	**Elasticity σ**	**XiiXjj**	**XijXji**	**1/2(σ-1)**	**Trade Cost Index**	**Baseline (2001=100)**
2001	1.13E+12	3.15E+12	4.94E+08	2.05E+09	8	3.57E+24	1.01E+18	0.142857	7.618	100.00
2002	1.16E+12	3.29E+12	5.72E+08	2.00E+09	8	3.81E+24	1.15E+18	0.142857	7.545	99.05
2003	1.39E+12	3.57E+12	7.32E+08	2.46E+09	8	4.96E+24	1.80E+18	0.142857	7.320	96.09
2004	1.68E+12	4.36E+12	9.63E+08	3.11E+09	8	7.32E+24	2.99E+18	0.142857	7.177	94.22
2005	1.51E+12	4.79E+12	1.22E+09	3.85E+09	8	7.21E+24	4.70E+18	0.142857	6.651	87.31
2006	1.50E+12	5.09E+12	1.38E+09	4.65E+09	8	7.64E+24	6.42E+18	0.142857	6.378	83.72
2007	1.82E+12	6.39E+12	1.91E+09	5.91E+09	8	1.16E+25	1.13E+19	0.142857	6.225	81.72
2008	2.05E+12	8.31E+12	2.30E+09	6.84E+09	8	1.70E+25	1.57E+19	0.142857	6.280	82.44
2009	1.71E+12	8.80E+12	2.56E+09	6.82E+09	8	1.50E+25	1.75E+19	0.142857	6.042	79.31
2010	1.74E+12	1.02E+13	3.44E+09	6.72E+09	8	1.77E+25	2.31E+19	0.142857	5.930	77.85
2011	1.99E+12	1.25E+13	5.29E+09	7.99E+09	8	2.50E+25	4.23E+19	0.142857	5.675	74.49
2012	1.89E+12	1.41E+13	6.28E+09	7.41E+09	8	2.67E+25	4.65E+19	0.142857	5.649	74.15
2013	2.00E+12	1.57E+13	7.66E+09	7.42E+09	8	3.15E+25	5.69E+19	0.142857	5.614	73.69
2014	1.96E+12	1.65E+13	8.29E+09	7.55E+09	8	3.23E+25	6.25E+19	0.142857	5.549	72.85
2015	1.61E+12	1.70E+13	9.82E+09	6.96E+09	8	2.74E+25	6.83E+19	0.142857	5.314	69.76

(b) Trade Cost Measure between China and ASEAN

Time	**Xii** (Intra-National Trade of ASEAN)	**Xjj** (Intra-National Trade of China)	**Xij** (Export from ASEAN-China)	**Xji** (Import from ASEAN-China)	**Elasticity σ**	**XiiXjj**	**XijXji**	**1/2(σ-1)**	**Trade Cost Index**	**Baseline (2001=100)**
2001	7.03E+10	3.15E+12	1.10E+09	1.29E+09	8	2.21E+23	1.41E+18	0.071429	1.350	100.00
2002	8.16E+10	3.29E+12	1.55E+09	1.80E+09	8	2.69E+23	2.78E+18	0.071429	1.270	94.08
2003	9.54E+10	3.57E+12	2.24E+09	1.89E+09	8	3.40E+23	4.25E+18	0.071429	1.240	91.84
2004	1.11E+11	4.36E+12	3.04E+09	1.72E+09	8	4.83E+23	5.21E+18	0.071429	1.263	93.56
2005	1.26E+11	4.79E+12	3.08E+09	1.89E+09	8	6.03E+23	5.83E+18	0.071429	1.281	94.91
2006	1.40E+11	5.09E+12	4.27E+09	2.37E+09	8	7.14E+23	1.01E+19	0.071429	1.220	90.35
2007	1.70E+11	6.39E+12	6.18E+09	3.12E+09	8	1.08E+24	1.93E+19	0.071429	1.184	87.69
2008	1.99E+11	8.31E+12	7.83E+09	3.25E+09	8	1.65E+24	2.55E+19	0.071429	1.207	89.37
2009	2.06E+11	8.80E+12	7.32E+09	3.48E+09	8	1.81E+24	2.55E+19	0.071429	1.221	90.40
2010	2.55E+11	1.02E+13	8.97E+09	4.43E+09	8	2.60E+24	3.98E+19	0.071429	1.208	89.45
2011	3.42E+11	1.25E+13	1.21E+10	5.42E+09	8	4.28E+24	6.57E+19	0.071429	1.207	89.41
2012	3.42E+11	1.41E+13	1.20E+10	5.76E+09	8	4.83E+24	6.91E+19	0.071429	1.218	90.23
2013	3.15E+11	1.57E+13	1.11E+10	5.98E+09	8	4.95E+24	6.66E+19	0.071429	1.228	90.95
2014	3.65E+11	1.65E+13	1.17E+10	6.42E+09	8	6.03E+24	7.49E+19	0.071429	1.241	91.91
2015	4.16E+11	1.70E+13	1.08E+10	6.43E+09	8	7.05E+24	6.92E+19	0.071429	1.279	94.72

(c) Trade Cost Measure between EU and ASEAN

Time	**Xii** (Intra-National Trade of EU)	**Xjj** (Intra-National Trade of ASEAN)	**Xij** (Export from EU-ASEAN)	**Xji** (Import from EU-ASEAN)	**Elasticity σ**	**XiiXjj**	**XijXji**	**1/2(σ-1)**	**Trade Cost Index**	**Baseline (2001=100)**
2001	1.13E+12	7.03E+10	1.77E+09	4.99E+09	8	7.96E+22	8.85E+18	0.071429	1.916	100
2002	1.16E+12	8.16E+10	1.77E+09	5.62E+09	8	9.45E+22	9.94E+18	0.071429	1.924	100.3934
2003	1.39E+12	9.54E+10	1.97E+09	6.69E+09	8	1.33E+23	1.32E+19	0.071429	1.931	100.7799
2004	1.68E+12	1.11E+11	2.35E+09	7.68E+09	8	1.86E+23	1.81E+19	0.071429	1.935	100.9771
2005	1.51E+12	1.26E+11	2.47E+09	8.18E+09	8	1.90E+23	2.02E+19	0.071429	1.922	100.3079
2006	1.50E+12	1.40E+11	2.67E+09	6.92E+09	8	2.10E+23	1.85E+19	0.071429	1.949	101.6868
2007	1.82E+12	1.70E+11	3.51E+09	8.77E+09	8	3.09E+23	3.08E+19	0.071429	1.931	100.7778
2008	2.05E+12	1.99E+11	3.84E+09	1.20E+10	8	4.08E+23	4.60E+19	0.071429	1.914	99.90042
2009	1.71E+12	2.06E+11	3.43E+09	9.80E+09	8	3.52E+23	3.36E+19	0.071429	1.937	101.0825
2010	1.74E+12	2.55E+11	4.41E+09	1.06E+10	8	4.44E+23	4.65E+19	0.071429	1.924	100.4227
2011	1.99E+12	3.42E+11	5.55E+09	1.28E+10	8	6.82E+23	7.13E+19	0.071429	1.925	100.4371
2012	1.89E+12	3.42E+11	6.03E+09	1.27E+10	8	6.47E+23	7.66E+19	0.071429	1.908	99.54515
2013	2.00E+12	3.15E+11	6.66E+09	1.31E+10	8	6.31E+23	8.72E+19	0.071429	1.887	98.45469
2014	1.96E+12	3.65E+11	6.98E+09	1.31E+10	8	7.14E+23	9.18E+19	0.071429	1.896	98.96732
2015	1.61E+12	4.16E+11	6.19E+09	1.13E+10	8	6.71E+23	6.98E+19	0.071429	1.925	100.4665

A9. Listed below are the decompositions of bilateral trade growth

(a) China and EU

Bottom										
Year	Xij	Xji	Xij*Xji	**Δln(XijXji)**						
2001	4.94E+08	2.05E+09	1.01E+18	**4.214330793**						
2015	9.82E+09	6.96E+09	6.83E+19							
Income Growth										
Year	Yi	Yj	Yw	**2Δln(YiYj/Yw)**						
2001	9E+12	1.34E+12	3.32E+13	**3.801812825**						
2015	1.63E+13	1.1E+13	7.39E+13							
Bilateral trade barriers										
Year	Xii	Xjj	Xij	Xji	ln(XijXji)	Δln(XijXji)	ln(XiiXjj)	Δln(XiiXjj)	**Δln(XijXji) -Δln(XiiXjj)**	
2001	1.13E+12	3.15E+12	4.94E+08	2.05E+09	41.4565694	4.214330793	56.53339196	2.037439311	**2.176891482**	
2005	1.61E+12	1.7E+13	9.82E+09	6.96E+09	45.67090019		58.57083127			
Trade diversion effect										
Year	Yi	Yj	Yw	Xii	Xjj	(Yi/Yw)/(Xii/Yi)	ln(Yi/Yw)/(Xii/Yi)	(Yj/Yw)/(Xjj/Yj)	ln(Yj/Yw)/(Xjj/Yj)	**Δ1+Δ2**
2001	9E+12	1.34E+12	3.32E+13	1.13E+12	3.14834E+12	2.154520754	0.767568311	0.017163783	-4.064953728	**1.764374**
2015	1.63E+13	1.1E+13	7.39E+13	1.61E+12	1.69644E+13	2.233380296	0.803516266	0.096662653	-2.336528169	
							Δ1 (2015-2001)		Δ2 (2015-2001)	
							0.035947955		1.72842556	

%	
	Income Growth/Bottom
	90.2115%
	Bilateral trade barriers/Bottom
	51.6545%
	Trade diversion effect/Bottom
	-41.866%
Total	100%

Equation as follow:100% $= \frac{2\Delta \ln\frac{Y_iY_j}{Y_W}}{\Delta \ln(X_iX_j)} + \frac{2(1-\sigma)\Delta \ln(1+\tau_{ij})}{\Delta \ln(X_{ij}X_{ji})} - \frac{2(1-\sigma)\Delta \ln(\emptyset_i\emptyset_j)}{\Delta \ln(X_{ij}X_{ji})}$

In where

$$2(1-\sigma)\Delta \ln\left(1+\tau_{ij}\right) = \Delta \ln(X_{ij}X_{ji}) - \Delta \ln(X_{ii}X_{jj})$$

$$2(1-\sigma)\Delta \ln(\emptyset_i\emptyset_j) = \Delta \ln((Y_i/Y_w)/(X_{ii}/Y_i)) + \Delta \ln((Y_j/Y_w)/(X_{jj}/Y_j))$$

(b) China and ASEAN

Bottom

Year	Xij	Xji	Xij*Xji	**Δln(XijXji)**
2001	1.10E+09	1.29E+09	1.41E+18	**3.892841**
2015	1.08E+10	6.43E+09	6.92E+19	

Income Growth

Year	Yi	Yj	Yw	YiYj/Yw	**2Δln(YiYj/Yw)**
2001	6.46E+11	1.34E+12	3.32E+13	2.61E+10	**5.465997589**
2015	2.69E+12	1.10E+13	7.39E+13	4.01E+11	

Bilateral trade barriers

Year	Xii	Xjj	Xij	Xji	ln(XijXji)	Δln(XijXji)	ln(XiiXjj)	Δln(XiiXjj)	**Δln(XijXji)-Δln(XiiXjj)**
2001	7.03E+10	3.15E+12	1.10E+09	1.29E+09	41.79084	3.89284129	53.75393368	3.461676553	**0.431164738**
2005	4.16E+11	1.7E+13	1.08E+10	6.43E+09	45.68369		57.21561023		

Trade diversion effect

Year	Yi	Yj	Yw	Xii	Xjj	(Yi/Yw)/(Xii/Yi)	ln(Yi/Yw)/(Xii/Yi)	(Yj/Yw)/(Xjj/Yj)	ln(Yj/Yw)/(Xjj/Yj)	**Δ1+Δ2**
2001	6.46E+11	1.34E+12	3.32E+13	7.03E+10	3.15E+12	1.79E-01	-1.721967523	0.017163783	-4.064953728	**2.004321**
2015	2.69E+12	1.10E+13	7.39E+13	4.16E+11	1.7E+13	2.35E-01	-1.446072046	0.096662653	-2.336528169	
							Δ1 (2015-2001)		Δ2 (2015-2001)	
							0.275895477		1.72842556	

%		
%	Income Growth/Bottom	
	140.4115%	
	Bilateral trade barriers/Bottom	
	11.0758%	
	Trade diversion effect/Bottom	
	51.4874%	
Total	100%	

Equation as follow: 100% $= \frac{2\Delta\ln\frac{Y_iY_j}{Y_W}}{\Delta\ln(X_iX_j)} + \frac{2(1-\sigma)\Delta\ln(1+\tau_{ij})}{\Delta\ln(X_{ij}X_{ji})} - \frac{2(1-\sigma)\Delta\ln(\emptyset_i\emptyset_j)}{\Delta\ln(X_{ij}X_{ji})}$

In where

$$2(1-\sigma)\Delta\ln\left(1+\tau_{ij}\right) = \Delta\ln(X_{ij}X_{ji}) - \Delta\ln(X_{ii}X_{jj})$$

$$2(1-\sigma)\Delta\ln(\emptyset_i\emptyset_j) = \Delta\ln((Y_i/Y_w)/(X_{ii}/Y_i)) + \Delta\ln((Y_j/Y_w)/(X_{jj}/Y_j))$$

(c) EU & ASEAN

Bottom

Year	Xij	Xji	Xij*Xji	**Δln(XijXji)**
2001	4.99E+09	1.77E+09	8.85E+18	**2.06594517**
2015	1.13E+10	6.19E+09	6.98E+19	

Income Growth

Year	Yi	Yj	Yw	YiYj/Yw	**2Δln(YiYj/Yw)**
2001	9E+12	6.46E+11	3.32E+13	1.75E+11	**2.442471343**
2015	1.63E+13	2.69E+12	7.39E+13	5.94E+11	

Bilateral trade barriers

Year	Xii	Xjj	Xij	Xji	ln(XijXji)	Δln(XijXji)	ln(XiiXjj)	Δln(XiiXjj)	**Δln(XijXji)-Δln(XiiXjj)**
2001	1.13E+12	7.03E+10	4.99E+09	1.77E+09	43.6265578	2.065945166	52.73153355	2.131108796	-0.06516
2015	1.61E+12	4.16E+11	1.13E+10	6.19E+09	45.692503		54.86264235		

Trade diversion effect

Year	Yi	Yj	Yw	Xii	Xjj	(Yi/Yw)/(Xii/Yi)	ln(Yi/Yw)/(Xii/Yi)	(Yj/Yw)/(Xjj/Yj)	ln(Yj/Yw)/(Xjj/Yj)	**Δ1+Δ2**
2001	9E+12	6.46E+11	3.32E+13	1.13E+12	7.03E+10	2.15E+00	0.767568311	0.178714178	-1.72197	**0.311363**
2015	1.63E+13	2.69E+12	7.39E+13	1.61E+12	4.16E+11	2.23E+00	0.803516266	0.235380263	-1.44655	
							Δ1 (2015-2001)		Δ2 (2015-2001)	
							0.035947955		0.275415	

%	
	Income Growth/Bottom
	118.2254%
	Bilateral trade barriers/Bottom
	-3.154%
	Trade diversion effect/Bottom
	-15.0712%
Total	100%

Equation as follow: 100% $= \frac{2\Delta\ln\frac{Y_iY_j}{Y_W}}{\Delta\ln(X_iX_j)} + \frac{2(1-\sigma)\Delta\ln(1+\tau_{ij})}{\Delta\ln(X_{ij}X_{ji})} - \frac{2(1-\sigma)\Delta\ln(\emptyset_i\emptyset_j)}{\Delta\ln(X_{ij}X_{ji})}$

In where

$$2(1-\sigma)\Delta\ln\left(1+\tau_{ij}\right) = \Delta\ln(X_{ij}X_{ji}) - \Delta\ln(X_{ii}X_{jj})$$

$$2(1-\sigma)\Delta\ln(\emptyset_i\emptyset_j) = \Delta\ln((Y_i/Y_w)/(X_{ii}/Y_i)) + \Delta\ln((Y_j/Y_w)/(X_{jj}/Y_j))$$

A10. The Robust Test Results based on equation (9) and (10)

Table.10 Distance as Trade Cost Proxy

Explanatory Variables	Coefficient	t-Statisitic	Prob.
$LGDP_{from}$	0.672670	13.74665	0.0000
$LGDP_{to}$	0.889965	14.38392	0.0000
$LPOP_{from}$	−2.489892	19.03042	0.0000
$LPOP_{to}$	−2.583935	−13.00536	0.0000
Distance	−0.000589	−13.49657	0.0000
Const	84.33292	6.134800	0.0000
Adjusted R-squared:	0.806095		
Log likelihood:	-19.91117		
F-Statistic:	74.99737		
Observation:	90		
Heteroskedasticity- consistent *t*-values (White adjusted).			

Table.11 Trade Cost Index as Trade Cost Proxy

Explanatory Variables	Coefficient	t-Statisitic	Prob.
$LGDP_{from}$	0.404784	13.74665	0.0000
$LGDP_{to}$	0.622079	14.38392	0.0000
$LPOP_{from}$	0.698194	19.03042	0.0000
$LPOP_{to}$	0.604151	−13.00536	0.0000
Trade Cost Index	−0.3000947	−13.49657	0.0000
Const	−33.37139	-9.506432	0.0000
Adjusted R-squared:	0.840708		
Log likelihood:	-13.66470		
F-Statistic:	88.66656		
Observation:	90		
Heteroskedasticity- consistent *t*-values (White adjusted).			