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IMPACTS OF FREE TRADE AGREEMENTS ON THAILAND DAIRY IMPORTS

A thesis
submitted in partial fulfilment
of the requirements for the Degree of
Doctor of Philosophy in Agricultural Economics

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by
Patcharee Suriya

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Abstract of a thesis submitted in partial fulfilment of the requirements for the Degree of Doctor of Philosophy in Agricultural Economics.

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by

Patcharee Suriya

Thai dairy industry is heavily intervened by the government and depended on a large proportion of dairy product imports. New Zealand and Australia are the most important suppliers to Thailand dairy import market. Both countries together contribute more than 50 percent to Thailand total dairy import market. In 2005, Thailand signed free trade agreements with Australia (Thailand-Australia Free Trade Agreement: TAFTA) and New Zealand (Thailand-New Zealand Closer Economic Partnership: THNZCEP). Both agreements include tariff liberalisation in dairy products which directly affect Thai dairy industry. It is debatable whether both agreements create or divert resource allocation efficiency for Thailand dairy production.

This study assessed the welfare impacts of the implementation of THNZCEP and TAFTA. The modified gravity model was employed to assess trade creation and trade diversion effects of both agreements in seven dairy product categories: non-concentrated milk and cream, concentrated milk and cream, buttermilk and yogurt, whey, butter, cheese and curd and total dairy products. The modified gravity model for each dairy product was estimated by pooling the data from 1991:Q1-2009:Q4 across Thailand top five trading partners using Time Series and Cross Sections (TSCS) estimation. In addition, the study employed the import price model to examine effects of the Thailand tariff reduction for New Zealand and Australian dairy products on the prices of New Zealand and Australian dairy products and the relative price of non-FTA member to New Zealand (Australian) dairy products in Thailand market.

The results show that the implementation of THNZCEP and TAFTA leads to net positive trade creation in most dairy product categories which indicates their members' welfare improvement, except in whey for THNZCEP and concentrated milk and cream for TAFTA. In addition, it is found that the reduction in tariffs for dairy products from New Zealand and

Australia has negligible effects on the Thailand import prices of dairy products from both countries while other factors such as exchange rate, competitor price, and drought have significantly larger effects. Furthermore, the reduction in tariffs for dairy products from New Zealand and Australia significantly increases the ratio of non-FTA member to New Zealand (Australian) prices in some dairy products in Thailand market. This finding indicates that the dairy product prices of non-FTA members are relatively high in Thailand market after the implementation of THNZCEP and TAFTA.

Keywords: Free trade agreement, trade creation, trade diversion, exchange rate pass-through, tariff rate pass-through.

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Chapter 1

Introduction

1.1 Research Background

The international trade system has become more liberal over recent years. Many countries have formed regional and bilateral trade agreements, e.g. Customs Unions (CUs), Preferential Trade Agreements (PTAs), Free Trade Agreements (FTAs) and Closer Economic Partnerships (CEPs), with their trading partners. In particular, countries that are members of the World Trade Organization (WTO) must pursue their commitment to the WTO and establish regional and bilateral trade agreements (Thailand Department of Trade Negotiations, 2005). FTAs may improve or reduce economic welfare of member and non-member countries (Krueger, 1999). In each country, effects of FTAs across industries are dissimilar, depending on their economic structures and resource endowments (Karemera and Koo, 1994).

Thailand supports free and fair trade policy and is now in the process of implementing FTAs with many countries such as Australia, New Zealand, Japan, India and Peru. The benefits of FTAs are associated with the reduction of tariff rates, the elimination of non-tariff barriers, and the economic cooperation to facilitate trade and economic development (Thailand Department of Trade Negotiations, 2005).

In the past, Thai government protected local dairy industry by imposing high tariff rates and limited import quotas for dairy products. Following Thailand's commitment to the WTO agreement initiated in the GATT/Uruguay Round, it has reduced tariffs rates and expanded import quotas for a few dairy products such as skim milk powder and whole milk powder (Jiemanukoonkit, Waraarporn, Maisuwan, and Iemaram, 2003). Recently, Thailand implemented FTAs with Australia and New Zealand in 2005, namely Thailand-Australia Free Trade Agreement (TAFTA) and Thailand-New Zealand Closer Economic Partnership (THNZCEP), respectively (Thailand Department of Trade Negotiations, 2005). Both agreements significantly affect Thai dairy industries. Under the agreements, Thailand dairy products are put on sensitive product lists therefore tariff elimination for Australian and New Zealand dairy products are to be phased out over a longer period than other products. Tariff rates for dairy products from the two countries will be steadily reduced to 0% within 2025 (Australian Department of Foreign Affairs and Trade, 2004; New Zealand Ministry of Foreign Affairs and Trade, 2005).

1.2 Thailand Trade Situation with Australia and New Zealand

1.2.1 Thailand and Australian Trade

Thailand and Australia have been trading partners for a long time and their trading values have increased consistently. Thailand was Australia 12th ranked export market in 2010 while Australia was Thailand 3rd ranked export market (Thailand Customs Department, 2010). In 2000, the value of bilateral trade between the both countries was valued at US\$ 2,800 million and this increased to US\$ 15,278 million in 2010, with an annual average growth rate of 18%. Interestingly, after 2005, the values of Thai and Australian exports have risen rapidly as a consequence of the operation of the TAFTA (See Table 1.1).

Table 1.1 Trade flows of Thailand and Australia between 2000 and 2010

| Year | Total Trade | | Thai Exports to AU | | AU Exports to Thailand | |
|----------------|----------------------|------------|----------------------|------------|------------------------|------------|
| | Value (US\$ million) | Growth | Value (US\$ million) | Growth | Value (US\$ million) | Growth |
| 2000 | 2,800 | 23% | 1,636 | 24% | 1,164 | 20% |
| 2001 | 2,708 | -3% | 1,362 | -17% | 1,346 | 16% |
| 2002 | 3,136 | 16% | 1,642 | 21% | 1,494 | 11% |
| 2003 | 3,728 | 19% | 2,160 | 32% | 1,568 | 5% |
| 2004 | 4,665 | 25% | 2,468 | 14% | 2,197 | 40% |
| 2005 | 6,428 | 38% | 3,175 | 29% | 3,253 | 48% |
| 2006 | 7,760 | 21% | 4,350 | 37% | 3,410 | 5% |
| 2007 | 9,738 | 25% | 5,937 | 37% | 3,800 | 11% |
| 2008 | 13,147 | 35% | 7,983 | 34% | 5,165 | 36% |
| 2009 | 12,404 | -6% | 8,579 | 7% | 3,825 | -26% |
| 2010 | 15,278 | 23% | 9,369 | 9% | 5,908 | 54% |
| Average | 7,436 | 18% | 4,424 | 19% | 3,012 | 18% |

Source: Thailand Customs Department (Various years)

Thailand main exports to Australia are manufactured goods including motor vehicles and parts, air conditioners and air conditioning machines, plastic products, canned seafood and steel products, whereas Thailand mainly imports primary products and manufactured metals from Australia. In 2010, copper, aluminium, iron and steel accounted for nearly 36% of total exports to Thailand. Primary products such as cereal, cotton and dairy products accounted for approximately 13%. Only dairy products were 3% of total exports to Thailand. However, Australia was Thailand 2nd ranked supplier of dairy products whereas Thailand was Australia 10th ranked export market for dairy products (Thailand Customs Department, 2010).

1.2.2 Thailand and New Zealand Trade

Thailand and New Zealand have dissimilar export structures. Major Thailand exports to New Zealand are motor vehicles and parts, and electronic goods, while New Zealand exports mainly agricultural products and processing foods (New Zealand Ministry of Foreign Affairs and Trade, 2005). Table 1.2 shows the trade flows between Thailand and New Zealand from 2000 to 2010. Total trade for both countries has increased gradually over the period, with an annual average growth rate of 13%. Thai exports stood at US\$ 203 million in 2000 and have significantly increased to US\$ 800 million in 2010, with an annual average growth rate of 15%. While New Zealand exports to Thailand have fluctuated between US\$ 197 million in 2000 and US\$ 511 million in 2010, with an annual average growth rate of 10%. Similar to Thailand-Australia trade, there has been a significant growth in the value of total trade between the both countries after 2005.

Table 1.2 Trade flows of Thailand and New Zealand between 2000 and 2010

| Year | Total Trade | | Thai Exports to NZ | | NZ Exports to Thailand | |
|----------------|----------------------|------------|----------------------|------------|------------------------|------------|
| | Value (US\$ million) | Growth | Value (US\$ million) | Growth | Value (US\$ million) | Growth |
| 2000 | 400 | 4% | 203 | -2% | 197 | 11% |
| 2001 | 424 | 6% | 214 | 5% | 210 | 7% |
| 2002 | 451 | 6% | 262 | 22% | 189 | -10% |
| 2003 | 530 | 18% | 335 | 28% | 195 | 3% |
| 2004 | 567 | 7% | 330 | -2% | 237 | 22% |
| 2005 | 774 | 37% | 521 | 58% | 253 | 7% |
| 2006 | 847 | 9% | 526 | 1% | 321 | 27% |
| 2007 | 1,052 | 24% | 640 | 22% | 412 | 28% |
| 2008 | 1,395 | 33% | 743 | 16% | 652 | 58% |
| 2009 | 853 | -39% | 542 | -27% | 311 | -52% |
| 2010 | 1,310 | 54% | 800 | 48% | 511 | 64% |
| Average | 782 | 13% | 465 | 15% | 317 | 10% |

Source: Thailand Customs Department (Various years)

New Zealand is the largest supplier of dairy products to Thailand while Thailand is the eleventh largest dairy export market of New Zealand (Thailand Ministry of Commerce and New Zealand Ministry Foreign Affairs and Trade, 2004). Nearly 40% of New Zealand trade with Thailand is in dairy products. New Zealand dairy exports to Thailand include whole milk powder, skim milk powder, buttermilk, butter, whey and cheese (Thailand Customs Department, 2010). Most of the imported dairy products are used in Thai food processing.

Processors use imported ingredients because their prices are lower than domestic raw milk and imported milk is better quality (Rabobank, 2004).

1.3 Problem Statement

Thailand is one of the main milk product producers and consumers in Asia but is a small player compared to the rest of the world market (Peng and Cox, 2005). The number of dairy cows and raw milk production in Thailand has dramatically increased. However, an average annual raw milk yield of Thailand is about 3,000 litres per cow. This number shows that Thailand milk productivity is far below international standards (Garcia *et al.*, 2005; Thailand Office of Agricultural Economics, 2010). Most Thai dairy farmers are smallholders who have fewer than 20 cows per farm (Rabobank, 2004). They regularly face many production constraints, such as poor management, lack of feed, breeding problems, diseases, inappropriate climate factors, and limited technology (Hall, Ehui and Shapiro, 2004; Murphy and Tisdell, 1996).

As a result, Thailand has high production costs for raw milk compared to World's major milk producers such as the United States, Germany, France, New Zealand and Australia. Therefore, the government tries to help and protect dairy farmers via production assistance programmes using technical and financial support. The Thai government also intervenes in the dairy market through policies such as a price guarantee for raw milk, the school milk programme and a local content regulation for processors.

In terms of milk processing, Thailand produces few categories of milk products, such as ready-to-drink milk, butter, cheese, yogurt and condensed milk. The majority of the raw milk is used for ready-to-drink milk production; 33% of domestic raw milk used in the school milk programme and 67% used in the commercial milk market. However, Thailand domestic raw milk production is insufficient to meet its domestic manufacturing demand and the shortage is supplied by imported milk ingredients (Dong, 2005; Rabobank, 2004; Thailand Office of Industrial Economics, 2010).

Total milk consumption in Thailand exceeds domestic production. Most consumption is in fluid milk (Food and Agricultural Policy Research Institute: FAPRI, 2010). The school milk programme plays an important role in increasing fluid milk consumption in Thailand (Dong, 2005; Rabobank, 2004). Cheese and butter consumption in Thailand is dominated by the tourism sector such as hotels, restaurants and bakery shops who supply Western foods for foreign tourists (Murphy and Tisdell, 1996). Concentrated milk and cream, namely skim milk powder and whole milk powder, cannot be produced in Thailand due to the lack of raw

ingredients and limited technology. These ingredients are in demand for manufacturing other dairy products.

Thailand is a net importer of dairy products. Concentrated milk and cream (milk powder) and whey were major dairy imports in Thailand, with 65 and 15 percent of total dairy imports in 2010, respectively. These dairy imports are the main ingredients used in milk processing. While non-concentrated milk and cream are imported in small quantities, they comprise only 0.1 percent of total dairy imports. The main milk suppliers to Thailand are New Zealand, Australia, the United States, the Netherlands, France, the Czech Republic and Ireland. New Zealand and Australian dairy products, together, made up over half of Thailand total dairy import market (Thailand Customs Department, 2010).

The Thai dairy market is intervened by the government and depends on a large proportion of imported ingredients from New Zealand and Australia. Further, the free trade agreements with both countries in dairy products directly affect the Thai dairy market. There are, therefore, both advantages and disadvantages for Thai stakeholders. For example, a joint study investigating the benefits of a Closer Economic Partnership (CEP) agreement between Thailand and New Zealand showed that consumers and processors in Thailand benefit from the CEP agreement in dairy products. Thai consumers consume higher quality dairy products at lower prices while processors work to reduce their production costs and improve their export competitiveness to Southeast Asian countries in dairy products. This leads to an increase in the demand for imported dairy ingredients (Thailand Ministry of Commerce and New Zealand Ministry Foreign Affairs and Trade, 2004). On the other hand, Rabobank (2004) argued that the THNZCEP has a negative effect on the Thai raw milk market. Thai dairy farmers will lose price competitiveness since the pledged price of Thai raw milk is higher than the imported dairy ingredients. Furthermore, processors prefer to use imported dairy ingredients because of their higher quality and lower prices.

A change in trade policy affects the dairy products market equilibrium, domestic production, consumption and price. Trade barriers, in general, increase domestic prices and domestic production while decrease domestic consumption. On the other hand, tariff elimination leads to a reduction in the domestic price benefiting domestic consumers while domestic producers reduce their production. This leads to an increase in consumer surplus/welfare and a decrease in producer surplus/welfare (Francois and Reinert, 1997; Wijegunawardane, 2002). In addition, FTAs can affect the economic welfare of non-FTA countries. They are likely to reduce their export prices to compete with FTA countries (Chang and Winters, 2002).

It is debatable whether Regional Trade Agreements (RTAs) or Free Trade Agreements (FTAs) represent building or stumbling blocks in the global liberalisation of trade (Bhagwati, 1991). Previous studies have shown contradictory results of the impacts of FTAs. For example, Krugman (1991) stated that natural trading blocs based on geographical proximity can increase efficiency and economic welfare. On the other hand, regional trade groups which are motivated by political reasons can reduce benefits for member and non-member countries. Most studies on the effects of FTAs focus on the aggregate bilateral trade (Elliott and Ikemoto, 2004). However, Jayasinghe and Sarker (2004) suggested that the effects of FTAs should be measured across product categories because the effect will be different for various products. The existing literature on the impact assessment of the THNZCEP and TAFTA does not specifically estimate dairy products. This study is the first empirical study to evaluate the effects of the THNZCEP and TAFTA on dairy import flows and prices from FTA member and non-FTA member countries after the implementation of both agreements.

Under the floating exchange rate system, export and import prices are affected by exchange rate movements and tariff changes. Exporters who have market power in destination markets can practise pricing-to-market (PTM) by adjusting their mark-ups in the domestic currency according to exchange rate variations and tariff changes. As a result, import prices are partially affected in the importing country currency (Lee and Tcha, 2005; Tantirigama, 2006).

New Zealand and Australia play major roles in the Thai dairy import market. Both countries have the market power to influence import price changes in the Thai dairy market. When free trade agreements are in force, they compete fiercely with each other in regard to dairy export prices. There is a gap in the research on pricing-to-market or pass-through behaviour focusing on New Zealand and Australian dairy exports to Thailand. Studying pricing-to-market and pass-through reinforces the importance of understanding pricing behaviour of New Zealand and Australian dairy exporters.

1.4 Research Objectives

The objectives of this research include:

1. To provide an overview of dairy trade patterns and policy in Thailand.
2. To assess the welfare impacts of THNZCEP and TAFTA in terms of trade creation and trade diversion effects.
3. To examine the effects of THNZCEP and TAFTA on Thailand dairy import prices from New Zealand and Australia.

4. To examine the effects of THNZCEP and TAFTA on Thailand dairy import prices from non-FTA members.

1.5 Contribution of the Research

This research is a first *ex post* study to capture the welfare effects of THNZCEP and TAFTA on Thailand dairy imports and focuses on the adjustments in Thailand dairy import prices from FTA and non-FTA member countries. The research findings will provide useful information for understanding the dairy trade between Thailand and its trading partners and the significant effects of the THNZCEP and TAFTA on Thai dairy industry.

1.6 Outline of the Research

This study is organised in seven chapters as follows: Chapter 1 presents the introduction to the research. Chapter 2 discusses the overview of Thailand free trade agreements and dairy industry. Chapter 3 presents a review of regional trade integration theories and empirical studies. Chapter 4 describes pass-through theories and empirical studies. Chapter 5 presents empirical models and research methodology. The research results and findings are discussed in Chapter 6. Lastly, Chapter 7 summarises the major findings, academic and policy implications, limitations and recommendations for future research.

Chapter 2

An Overview of Thailand Free Trade Agreements and the Dairy Industry

This chapter provides an overview of Free Trade Agreements (FTAs) and the dairy industry in Thailand. Sections 2.1 and 2.2 describe the history of regional trade agreements in the world and Thailand. The Thailand-Australia Free Trade Agreement (TAFTA) and the Thailand-New Zealand Closer Economic Partnership (THNZCEP) are explained in Section 2.3. Thailand economy background is described in Section 2.4. Thailand dairy production, consumption and trade are discussed in Sections 2.5, 2.6 and 2.7. Lastly, Section 2.8 discusses structural and behavioural aspects of dairy exporters in New Zealand and Australia.

2.1 History of Regional Trade Agreements in the World

Regional Trade Agreements (RTAs) have become an important trade policy tool in the global trading system. The proliferation of RTAs is driven by the WTO agenda. Most WTO members participate in one or more trade arrangements (Fiorentino, Verdeja and Toqueboeuf, 2007). Figure 2.1 shows the number of RTAs including Free Trade Agreements (FTAs), Custom Unions (CUs) and Partial Scopes that have been notified to the WTO. The number of RTAs in the world has significantly increased over the last 10 years. As of 2006, there were 367 RTAs notified to the WTO, of which 214 currently exist. However, many other RTAs are under negotiation (Fiorentino *et al.*, 2007). The general objective of RTAs is to reduce trade barriers between members, but the structure of trade liberalisation is different from one RTA to another. Some agreements cover only tariff reduction on a limited range of products with their members but others include extra provisions, such as services, investment rules, safety standards and intellectual property rights (Jayasinghe, 2003).

The most common RTA is the FTA, accounting for 84% of all RTAs, whereas the Customs Unions and Partial Scopes each account for 8% (See Figure 2.2). FTAs are widely spread because they have considerable flexibility in terms of the desired trade policy scope and choice of partners. However, most FTAs are cross-regional FTAs that focus on strategic market access or political alliances and are not usually concerned with geographical factors (Fiorentino *et al.*, 2007).

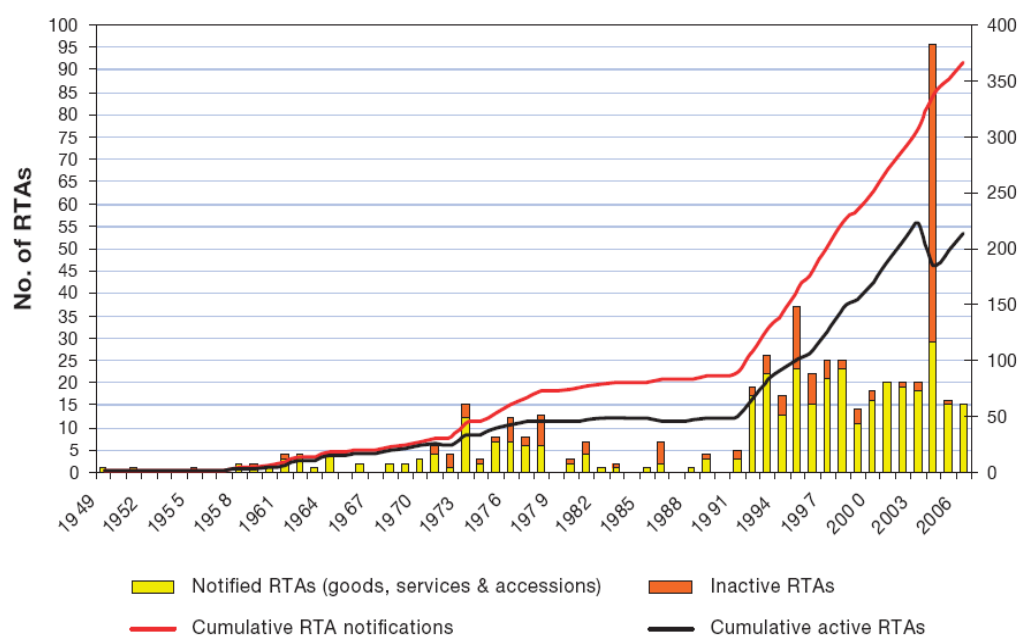


Figure 2.1 Regional trade agreements (RTAs) notified to the GATT/WTO during 1949-2006
Source: Fiorentino *et al.* (2007)

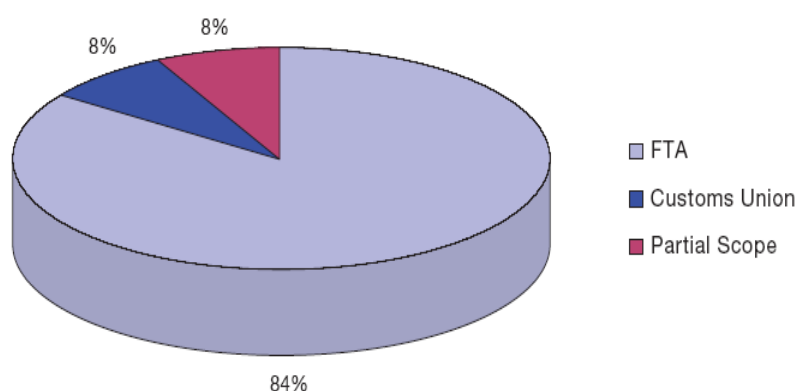


Figure 2.2 All notified regional trade agreements (RTAs) in force, as of December 2006, by type of agreement

Source: Fiorentino *et al.* (2007)

The proliferation of bilateral and regional trade agreements has led to an intense debate among economists. Bhagwati (1998) questioned whether RTAs help or hinder trade liberalisation. Summers (1991) and Ethier (1998) stated that RTAs support the success of an open multilateral system and world trade liberalisation. On the other hand, Bhagwati (1998) and Panagariya (1999) argued that RTAs generate lower trade barriers for members while

raising trade barriers to non-members and, consequently, hinder free trade and decrease the world economic welfare.

Fiorentino, *et al.* (2007) stated that an expansion of RTAs promotes trade liberalisation and benefit economic development but that the development of complex networks in trade relation increases discrimination and could undermine transparency and predictability in international trade systems. However, the impacts of trade agreements depend on the characteristics and complexity of the agreements. According to Krugman (1991), if trade is determined by natural factors such as comparative advantage and geographical proximity, the formation of RTAs would lead to the improvement of world economic welfare. Moreover, for each country, the effects of FTAs or RTAs across industries are different, depending on their economic structures and resource endowments (Karemera and Koo, 1994).

2.2 Regional and Bilateral Trade Agreements in Thailand

Thailand has been a strong supporter of free and fair trade. Thailand is a member of various regional trade associations such as the WTO, Asia-Pacific Economic Cooperation (APEC), Asia-Europe Meeting (ASEM) and the Association of Southeast Asian Nations (ASEAN), and is currently in the process of establishing FTAs with many countries throughout the world (Thailand Department of Trade Negotiations, 2005).

For example, Thailand has signed FTAs with Australia and New Zealand. The Thailand-Australia Free Trade Agreement (TAFTA) was launched on January 1, 2005 (Australian Department of Foreign Affairs and Trade, 2004), and the Thailand-New Zealand Closer Economic Partnership (THNZCEP) was implemented on July 1, 2005 (New Zealand Ministry of Foreign Affairs and Trade, 2005). Recently, the FTA with Japan was signed on November 1, 2007. Thailand is also in negotiation for FTAs with India, Peru, the United States, Bahrain, the Bay of Bengal Initiative for Multi-sectoral Technical and Economic Cooperation (BIMSTEC) and the European Free Trade Area (EFTA). The general scope of Thailand FTAs covers trade liberalisation in goods, services and investment, the elimination of non-tariff barriers, and economic cooperation to facilitate trade and economic development (Thailand Department of Trade Negotiations, 2005).

Besides being a party to the ASEAN Free Trade Area (AFTA), Thailand is also working closely with other ASEAN members to establish FTAs with other countries including Australia and New Zealand, China, the European Union (EU), India, Japan and Korea. However, only the agreement between ASEAN and China is in operation, and others are under consideration (Thailand Department of Trade Negotiations, 2005).

Although there are widespread FTAs with Thailand, only two FTAs: TAFTA and THNZCEP, involve trade liberalisation for dairy products. Both agreements impact Thailand dairy industry considerably. The details of both agreements are described in the next section.

2.3 The Contents of the TAFTA and THNZCEP

Generally, the FTAs consist of three main parts: opening up the markets, establishing rules for facilitating trade and promoting economic cooperation between the two countries (Australian Department of Foreign Affairs and Trade, 2004; New Zealand Ministry of Foreign Affairs and Trade, 2005).

1) Opening up the markets

According to the TAFTA, Thailand has eliminated tariffs for 2,724 imported items from Australia, accounting for 49% of all Australian imported products whereas 5,083 products from Thailand to Australia have had tariffs abolished, 83% of Thailand imported products (Australian Department of Foreign Affairs and Trade, 2004). Through the THNZCEP agreement, Thailand has cut tariffs to zero for 2,978 New Zealand products, amounting to 54% of New Zealand imported products, whereas New Zealand has removed tariffs from 5,878 of Thailand products, amounting to 79% of the products from Thailand (New Zealand Ministry of Foreign Affairs and Trade, 2005). The tariffs on the rest of the products will be phased out over a longer period, especially those products that are from sensitive sectors of Thailand economy such as dairy and beef products. These will be duty- free and non-quota by 2025 whereas Australia and New Zealand will be completely liberalised for products from Thailand by 2015. In addition, all products that qualify for tariff reduction must be under Rules of Origin.

2) Rules for facilitating trade

Each country has different technical barriers and customs procedures that impede international trade and investment such as the sanitary and phytosanitary measures (SPS measures) of each country. Under the TAFTA and THNZCEP, the two parties agree to set up procedures to resolve business obstacles in terms of Rule of Origin, SPSs, customs processes, intellectual property, electronic commerce, competition policy and transparency. In addition, both countries agree to share information and cooperate in these areas to develop their business environment (Australian Department of Foreign Affairs and Trade, 2004; New Zealand Ministry of Foreign Affairs and Trade, 2005).

3) Economic cooperation

The TAFTA and THNZCEP established cooperation between both parties in terms of service and investment. For the service sector, Thai chefs and Thai masseurs, for example, who have specialist certificates, may apply for the Australian and New Zealand work visa without skill testing. Similarly, Australian and New Zealand business people and their spouses can easily enter Thailand.

For foreign direct investment, according to the TAFTA, Australia permits 100% Thai ownership of companies that operate any businesses in Australia, excluding the audio-visual, broadcasting or media sectors and Australian international or domestic airlines, Australian airports or Telstra. Thailand, however, allows up to 50% Australian ownership in any businesses and provides greater market access of up to 60% for Australian companies in mining, distribution, construction, management consulting and hospitality ventures, science and technology institutions and maritime cargo services. Under the THNZCEP, Thailand and New Zealand support access for 100% equity participation from overseas investors. Thailand allows New Zealand entrepreneurs to invest in manufacturing sectors, such as machinery, appliances, software production, food processing, paper products, and furniture whereas Thai entrepreneurs may invest in any business in New Zealand except fisheries (New Zealand Ministry of Foreign Affairs and Trade, 2005).

The content on dairy products of both agreements is very similar. Thailand include their dairy products on sensitive product lists, therefore tariff elimination for Australian and New Zealand dairy products is to be phased out over a longer period than for other products. Tariff rates for dairy products from the two countries will gradually decrease to 0% over different time periods. For instance, tariffs on skim milk powder and liquid milk will be eliminated in 2025 because these products significantly impact Thai dairy farmers. Tariffs on whole milk powder, butter and cheese will be eliminated in 2020. Tariffs for butter milk and evaporated milk will be eliminated in 2015. Tariffs on whey will be eliminated in 2009 and tariffs for butter fat in 2008. However, tariffs on other dairy products such as milk powder and milk food for infant feeding, caseinates and lactose, which Thailand does not produce, will be eliminated once the agreement is implemented (See Table 2.1).

Some dairy products such as whole milk powder, butter milk, cheese, sweetened whole milk powder, butter and evaporated milk are protected by Special Safeguards (SSGs) and Tariff Rate Quotas (TRQ), which reduce tariff rates step by step and increase the trigger volume by 5% annually. However, if import volumes are larger than the trigger volume, the surplus

volume will be taxed at 90% of the Most Favoured Nation (MFN) tariff clause of the WTO agreement (New Zealand Ministry of Foreign Affairs and Trade, 2005). Therefore, domestic producers will have time to adjust their production efficiency and improve their competitive ability before facing duty-free imports milk.

Table 2.1 Tariff reduction programme for dairy products under the TAFTA and THNZCEP

| Dairy products | Previous tariff | Phase-out |
|--|---------------------------------------|--|
| Milk powder and milk food for infant feeding | 5% | Eliminated 1/7/2005 |
| Skim milk powder | 5% (under quota) 216% (over quota) | Tariff and quota removed 1/1/2025 |
| Whole milk powder | 18% | Reduced to 15% 1/7/2005 Phased to zero 1/1/2020 (SSG) |
| Butter fat | 5% | Eliminated 1/1/2008 |
| Butter milk | 18% | Reduced to 15% 1/7/2005 Phased to zero 1/1/2015 (SSG) |
| Cheese | 30% | Phased to zero 1/1/2020 (SSG) |
| Sweetened whole milk powder | 18% | Reduced to 15% 1/7/2005 Phased to zero 1/1/2020(SSG) |
| Other dairy preparations | 5% | Eliminated 1/7/2005 |
| Caseinates | 5% | Eliminated 1/7/2005 |
| Lactose | 1% (under quota) 10% (over quota) | Eliminated 1/7/2005 |
| Butter | 30% | Phased to zero 1/1/2020 (SSG) |
| Whey | 5% | Reduced to 3% 1/1/2008 Eliminated 1/7/2009 (SSG) |
| Evaporated milk | 30% | Phased to zero 1/1/2015 (SSG) |
| Liquid milk and cream | 20% (under quota) 41% (over quota) | Tariff and quota removed 1/1/2025 |

Sources: Australian Department of Foreign Affairs and Trade, (2004); New Zealand Ministry of Foreign Affairs and Trade, (2005)

2.4 Thailand Economy

Thailand was predominantly an agriculture country. Rice and other primary agricultural products generated considerable foreign exchange earnings for the country. Since the 1970, land has become scarce and foreign investment has rapidly expanded in Thailand.

Consequently, Thailand economic structure has transformed from agricultural dominance toward industrial dominance (Kaosa-ard, 1998).

The initial stage of Thailand industrialization (in the 1970s) was for import substitution, in which consumer goods had a high market share. Since 1980, Thailand industries have become more export oriented. Manufacturing exports, including automobile parts, machinery, electrical appliances and components, hide products, basic metal products, preserved and canned food, textiles and garments, and gems and jewellery, rapidly expanded between 1987 and 1993 driven by foreign direct investment, especially Japanese investors (Kaosa-ard, 1998; Thaiprasert, 2006). According to Kaosa-ard (1998), the manufacturing sector grew at a high rate, with an average annual growth rate of 14% during 1988-1993. Since then, Thailand has become a semi-industrial country with its industrial sector taking on a leading role in generating the Gross Domestic Product (GDP) of the country.

Thailand has had an upward trend in real GDP between 1980 and 2009 rising from 913.7 billion baht to 4,263.1 billion baht (see Figure 2.3). Thailand was the World and Asian fastest growing economy in 1988 with a GDP growth rate of 13.29%, which was also the highest record for Thailand (see Figure 2.4). Thai economy continued to grow until 1996 (Kaosa-ard, 1998; Khorchurklang, 2005).

During 1997-1998, Thailand confronted a financial crisis and the economy collapse. In 1997, the Thai currency (baht) was intensively attacked by currency speculators, which caused overvaluation of the baht and a drop in Thailand export competitiveness. Hence, Thailand decided to float the baht in July 2, 1997. The baht devalued against US dollar from THB25: US\$1 to THB47: US\$1 by the first quarter of 1998 (Thaiprasert, 2006). Thailand economy fell severely with a devalued stock market, rising private debt, and large increases in business failure and unemployment. Its GDP growth slumped to its lowest rate, -10.51% in 1998 (see Figure 2.4). The impacts of the financial crisis quickly spread to several Asian countries, such as Indonesia, Malaysia, Philippines, South Korea, Hong Kong, Taiwan, Singapore and Japan in a snowball effect (Karunatileka, 1999).

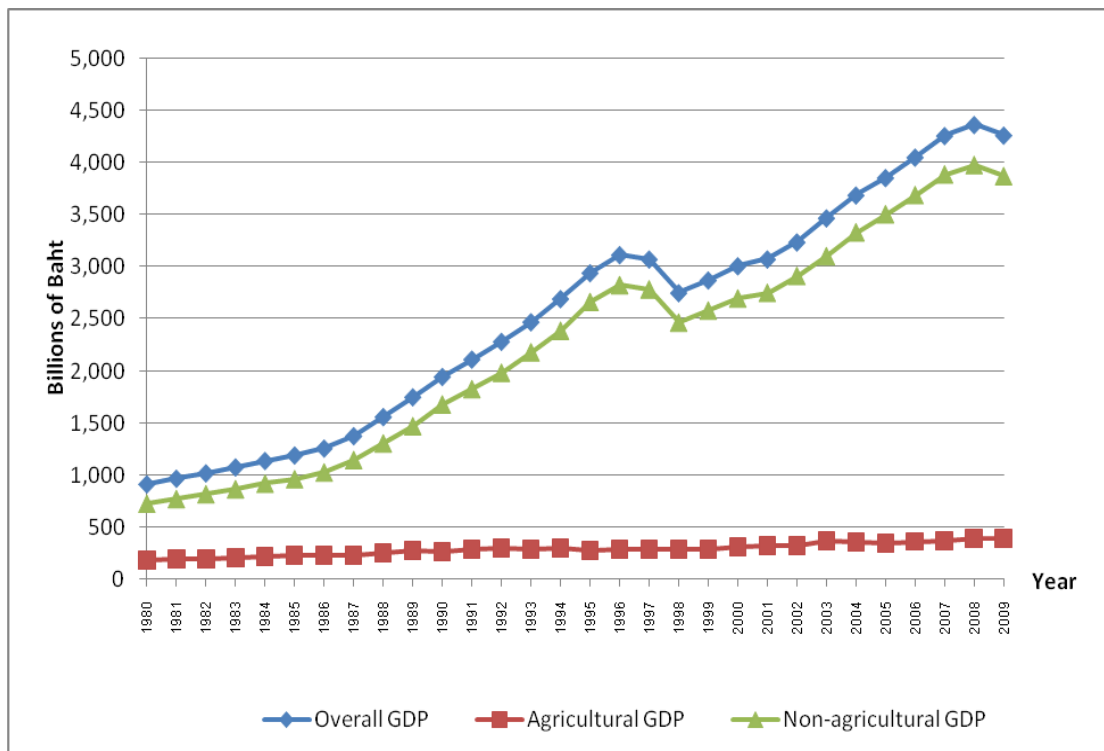


Figure 2.3 Thailand Gross Domestic Product (GDP) at constant 1988 prices by sectors between 1980 and 2009

Source: Bank of Thailand (Various years)

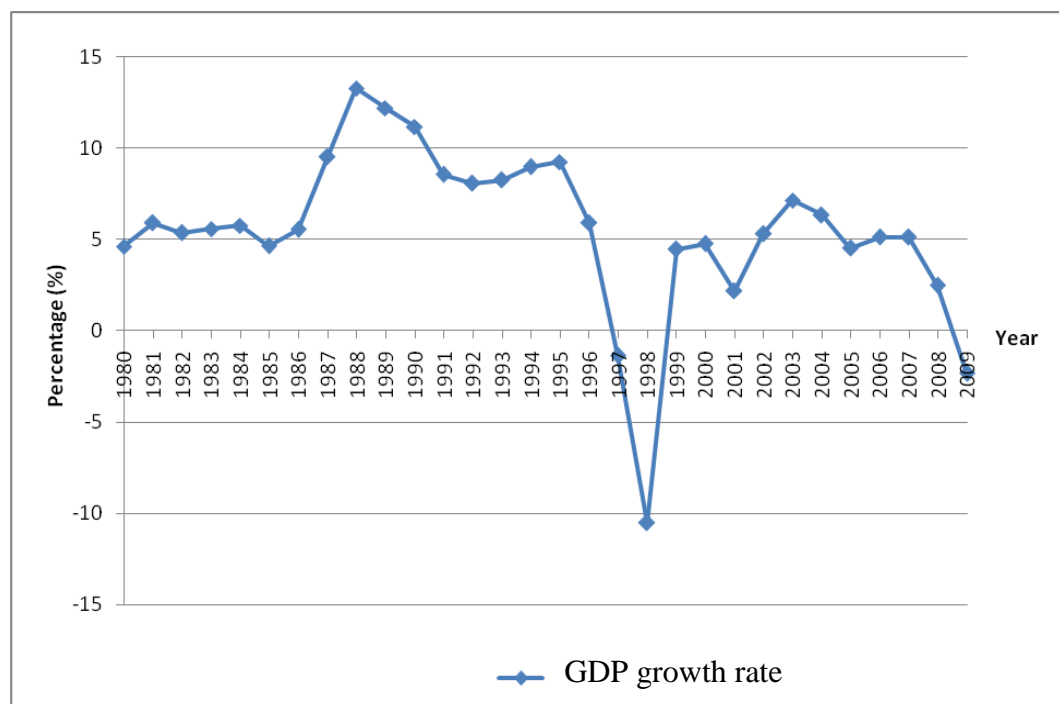


Figure 2.4 Growth rate of Thailand Gross Domestic Product (GDP) at constant 1988 prices between 1980 and 2009

Source: Bank of Thailand (Various years)

However, Thailand GDP began to increase slightly in 1999 with a growth rate of 4.45%. Since then, the GDP has gradually risen with an annual average growth rate of 4.06% during 2000-2009 (see Figure 2.4). The recovery of Thailand economy was stimulated by a rescue package from the International Monetary Fund (IMF) and a dual-track economic policy launched from 2001 to 2006 by Mr Thaksin Shinawatra, Thailand's twenty-third prime minister. This policy was known as Thaksinomics. It focused on boosting the grassroots economy and enhancing international competitiveness at the same time (Karunatileka, 1999; Wikipedia, 2008).

The population of Thailand in 2009 was 63.53 million people, of which 60.49% was working population. The agricultural sector provided employment for 14.69 million people or 38.96% of the working population whereas the manufacturing and service sectors together employed 23.02 million people or 61.04% of the working population (see Table 2.2).

Table 2.2 Thailand population, labour force and employment by sectors from 2001 to 2009

| Year | Population (Million people) | Labour force (Million people) | Sector Employment | | |
|------|--------------------------------|----------------------------------|---------------------------------|-------------------------------------|---------------------------|
| | | | Agriculture (Million people) | Non-agriculture (Million people) | Total (Million people) |
| 2001 | 62.31 | 33.81 | 13.61 | 18.49 | 32.10 |
| 2002 | 62.80 | 34.26 | 14.04 | 19.02 | 33.06 |
| 2003 | 63.08 | 34.90 | 13.88 | 19.96 | 33.84 |
| 2004 | 61.97 | 35.72 | 13.63 | 21.10 | 34.73 |
| 2005 | 62.42 | 36.13 | 13.62 | 21.64 | 35.26 |
| 2006 | 62.83 | 36.43 | 14.17 | 21.52 | 35.69 |
| 2007 | 63.04 | 36.94 | 14.31 | 21.94 | 36.25 |
| 2008 | 63.39 | 37.70 | 14.70 | 22.32 | 37.02 |
| 2009 | 63.53 | 38.43 | 14.69 | 23.02 | 37.71 |

Source: Thailand National Economic and Social Development Board (Various years)

Although most of Thailand labour force is engaged in the agricultural sector, the relative contribution of agriculture to overall GDP is insignificant (Thaiprasert, 2006). The data in Table 2.3 shows the agricultural sector contributed only 9.16% of total GDP in 2009 but the share for non-agricultural sectors was 90.84%. Overall, there has been a decrease in agricultural share of the total GDP between 1980 and 2009 whereas the non-agriculture sector's share of the total GDP has risen over the same period. In terms of Thailand dairy GDP, domestic dairy products are a minor component of agricultural GDP that contributed approximately 1% to agricultural GDP in 2003 (Knips, 2006).

Table 2.3 Values and shares of Thailand GDP at constant 1988 prices by sectors from 1980 to 2009

| Year | Total GDP (Billion baht) | Agricultural GDP | | Non-agricultural GDP | |
|------|-----------------------------|-------------------------|------------|-------------------------|------------|
| | | Value (Billion baht) | Percentage | Value (Billion baht) | Percentage |
| 1980 | 913.7 | 184.5 | 20.19 | 729.1 | 79.80 |
| 1981 | 967.7 | 194.0 | 20.05 | 773.6 | 79.94 |
| 1982 | 1,019.5 | 198.8 | 19.50 | 820.6 | 80.49 |
| 1983 | 1,076.4 | 208.3 | 19.35 | 868.1 | 80.65 |
| 1984 | 1,138.3 | 217.5 | 19.11 | 920.8 | 80.89 |
| 1985 | 1,191.2 | 227.3 | 19.08 | 963.9 | 80.92 |
| 1986 | 1,257.1 | 228.1 | 18.14 | 1,028.9 | 81.85 |
| 1987 | 1,376.8 | 228.3 | 16.58 | 1,148.5 | 83.42 |
| 1988 | 1,559.8 | 252.3 | 16.18 | 1,307.4 | 83.82 |
| 1989 | 1,749.9 | 276.5 | 15.80 | 1,473.3 | 84.19 |
| 1990 | 1,945.3 | 263.6 | 13.55 | 1,681.7 | 86.45 |
| 1991 | 2,111.8 | 282.7 | 13.39 | 1,829.1 | 86.61 |
| 1992 | 2,282.5 | 296.2 | 12.98 | 1,986.3 | 87.02 |
| 1993 | 2,470.9 | 289.0 | 11.70 | 2,181.8 | 88.30 |
| 1994 | 2,692.9 | 303.3 | 11.26 | 2,389.6 | 88.74 |
| 1995 | 2,941.7 | 276.5 | 9.40 | 2,665.1 | 90.60 |
| 1996 | 3,115.3 | 288.8 | 9.27 | 2,826.5 | 90.73 |
| 1997 | 3,072.6 | 286.8 | 9.33 | 2,785.7 | 90.66 |
| 1998 | 2,749.6 | 282.6 | 10.28 | 2,467.0 | 89.72 |
| 1999 | 2,871.9 | 289.1 | 10.07 | 2,582.8 | 89.93 |
| 2000 | 3,008.4 | 309.9 | 10.30 | 2,698.4 | 89.70 |
| 2001 | 3,073.6 | 320.0 | 10.41 | 2,753.5 | 89.59 |
| 2002 | 3,237.0 | 322.1 | 9.95 | 2,914.8 | 90.05 |
| 2003 | 3,468.1 | 363.0 | 10.47 | 3,105.1 | 89.53 |
| 2004 | 3,688.1 | 354.4 | 9.61 | 3,333.7 | 90.39 |
| 2005 | 3,855.1 | 347.8 | 9.02 | 3,507.2 | 90.98 |
| 2006 | 4,052.0 | 361.1 | 8.91 | 3,690.8 | 91.09 |
| 2007 | 4,259.0 | 369.7 | 8.68 | 3,889.2 | 91.32 |
| 2008 | 4,364.8 | 385.2 | 8.83 | 3,979.6 | 91.17 |
| 2009 | 4,263.1 | 390.3 | 9.16 | 3,872.7 | 90.84 |

Source: Bank of Thailand (Various years)

The GDP growth of Thailand was caused by the growth in exports. Thailand exports have gradually expanded from 583.21 billion baht in 1990 to 5,260.61 billion baht in 2007 with an average growth rate of 13.81% (see Table 2.4). In 2009, nearly 80% of the total value of exports comprised of non-agricultural products. The top five Thai exports were computers and parts, automobiles and parts, electronic integrated circuits, rubber, and gems and jewellery. Main export markets were the United States, Japan, the People's Republic of China, Singapore and Hong Kong (Thailand Customs Department, 2010).

Table 2.4 Value of exports, imports and balance of trade of Thailand 1980-2007

| Year | Exports and Re-Exports (Million baht) | | Imports (Million baht) | | Balance of Trade (Million baht) | |
|------|--|-------------|---------------------------|-------------|------------------------------------|-------------|
| | Total | Agriculture | Total | Agriculture | Total | Agriculture |
| 1990 | 583,206 | 224,168 | 838,342 | 102,244 | -255,136 | 121,924 |
| 1991 | 720,545 | 256,038 | 967,808 | 125,710 | -247,263 | 130,328 |
| 1992 | 824,643 | 285,264 | 1,033,245 | 158,454 | -208,602 | 126,810 |
| 1993 | 940,862 | 279,857 | 1,170,846 | 159,889 | -229,984 | 119,968 |
| 1994 | 1,137,601 | 336,290 | 1,369,034 | 179,857 | -231,433 | 156,433 |
| 1995 | 1,406,310 | 407,218 | 1,834,537 | 213,538 | -428,227 | 193,680 |
| 1996 | 1,411,039 | 412,677 | 1,832,825 | 216,833 | -421,786 | 195,844 |
| 1997 | 1,806,932 | 485,198 | 1,924,263 | 228,831 | -117,331 | 256,367 |
| 1998 | 2,248,777 | 591,690 | 1,774,050 | 226,827 | 474,727 | 364,863 |
| 1999 | 2,214,249 | 556,498 | 1,907,391 | 228,097 | 306,858 | 328,401 |
| 2000 | 2,768,064 | 626,911 | 2,494,133 | 275,459 | 273,931 | 351,452 |
| 2001 | 2,884,704 | 686,384 | 2,752,346 | 323,320 | 132,358 | 363,064 |
| 2002 | 2,930,173 | 695,896 | 2,774,840 | 325,961 | 155,333 | 369,935 |
| 2003 | 3,331,092 | 805,296 | 3,138,776 | 363,374 | 192,316 | 441,922 |
| 2004 | 3,880,154 | 883,671 | 3,801,067 | 398,356 | 79,087 | 485,315 |
| 2005 | 4,446,366 | 937,199 | 4,754,025 | 437,576 | -307,659 | 499,623 |
| 2006 | 4,944,550 | 1,071,931 | 4,942,923 | 434,541 | 1,627 | 637,390 |
| 2007 | 5,302,119 | 1,129,485 | 4,870,186 | 456,743 | 431,933 | 672,742 |
| 2008 | 5,851,371 | 1,054,074 | 5,962,483 | 319,467 | -111,111 | 734,607 |
| 2009 | 5,194,597 | 964,945 | 4,601,982 | 272,294 | 592,615 | 692,651 |

Source: Thailand Office of Agricultural Economics (Various years)

Thailand imports have predominantly been intermediate products and raw materials. Between 1990 and 2007, there was a substantial growth in Thailand imports, rising from 838.34 billion baht to 4,872.00 billion baht (see Table 2.4). Major imports in 2009 were crude oil, industrial machines, chemicals, electronic integrated circuits and electrical machines. The top five suppliers for Thai imports were Japan, the People's Republic of China, the United States, Malaysia and United Arab Emirates (Thailand Customs Department, 2010). Thailand experienced many years of trade deficits until the Asian financial crisis in 1997. From 1997 to 2004, there was a surplus in its balance of trade. This happened partly from the baht depreciation that led to an increase in Thailand exports. In regards to agricultural trade, the value of Thailand agricultural exports has exceeded the value of Thailand agricultural imports during 1990-2007 (see Table 2.4). The main agricultural exports of Thailand in 2007 were natural rubber, fishery products, rice, sugar and products, and livestock products (see Table 2.5). The major agricultural imports were fishery products, soya beans and products, rubber

products and dairy products, which were used in domestic food manufacturing and livestock feed industry (see Table 2.6).

Table 2.5 Value of the major agricultural exports of Thailand 2003-2007

| Items | Value of Thailand exports by Year (Billion baht) | | | | |
|----------------------|--|--------|--------|--------|--------|
| | 2003 | 2004 | 2005 | 2006 | 2007 |
| Rice | 72.74 | 104.49 | 83.85 | 87.24 | 107.34 |
| Cassava and | 17.89 | 23.24 | 22.14 | 31.25 | 32.36 |
| Sugar and products | 40.39 | 34.28 | 30.70 | 29.70 | 41.21 |
| Rubber and products | 123.97 | 148.84 | 162.70 | 228.88 | 198.72 |
| Pineapple and | 17.38 | 16.97 | 18.08 | 20.24 | 17.68 |
| Livestock and | 41.50 | 23.27 | 28.50 | 30.33 | 34.10 |
| Fishery and products | 87.15 | 84.89 | 101.37 | 109.49 | 109.66 |

Source: Thailand Office of Agricultural Economics (Various years)

Table 2.6 Value of the major agricultural imports of Thailand 2003-2007

| Items | Value of Thailand imports by Year (Billion baht) | | | | |
|----------------------|--|-------|-------|-------|-------|
| | 2003 | 2004 | 2005 | 2006 | 2007 |
| Rubber products | 23.85 | 26.09 | 31.27 | 34.72 | 35.07 |
| Soya beans and | 37.41 | 34.85 | 37.95 | 33.67 | 41.09 |
| Dairy products | 10.59 | 12.18 | 13.64 | 13.19 | 16.19 |
| Fishery and products | 47.33 | 50.73 | 59.75 | 60.63 | 61.43 |

Source: Thailand Office of Agricultural Economics (Various years)

2.5 Thailand Milk Production

In 2009, Thailand dairy production involved 17,837 families, of which 68.62% are located in central Thailand (Table 2.7). The largest number of dairy farms is in Ratchaburi province, followed by Nakhon Ratchasima, Lop Buri, Saraburi and Nakhon Pathom (Thailand Department of Livestock Development, 2010). Table 2.8 shows the number of dairy farms, dairy cattle and raw milk production in Thailand from 1991 to 2009. The number of dairy animals rose from 191,194 heads in 1991 to 483,899 heads in 2009. Raw milk production expanded from 193,895 tonnes to 840,691 tonnes, with an annual average growth rate of 8.03%. The number of dairy cows and amount of raw milk reached a peak at 478,836 heads and 888,220 tonnes, respectively, in 2005 and decreased in the following year. The reduction in dairy production in 2006 was partly caused by the establishment of the TAFTA and THNZCEP (Thailand Office of Agricultural Economics, 2010).

Table 2.7 Number of dairy farms and cows in Thailand by region in 2009

| Region | Dairy farms (households) | Percentage | Dairy cows (head) | Percentage |
|---------------|-----------------------------|------------|----------------------|------------|
| Northern | 1,697 | 9.51 | 46,288 | 9.57 |
| North-eastern | 3,723 | 20.87 | 101,271 | 20.93 |
| Central | 12,240 | 68.62 | 332,898 | 68.79 |
| Southern | 177 | 0.99 | 3,442 | 0.71 |
| Total | 17,837 | 100.00 | 483,899 | 100.00 |

Source: Thailand Department of Livestock Development (2010)

Table 2.8 Number of dairy farms, dairy cows and quantity of raw milk in Thailand 1991 - 2009

| Year | Dairy Farms ⁽¹⁾ (households) | Dairy Cows ⁽¹⁾ (heads) | Raw Milk Production ⁽²⁾ (tonnes per year) |
|-------------------------|--|--------------------------------------|---|
| 1991 | 15,027 | 191,194 | 193,895 |
| 1992 | 14,814 | 222,499 | 227,784 |
| 1993 | 19,249 | 237,189 | 293,255 |
| 1994 | 17,900 | 231,618 | 326,381 |
| 1995 | 19,920 | 287,247 | 350,196 |
| 1996 | 16,693 | 276,381 | 375,302 |
| 1997 | 16,762 | 302,872 | 385,477 |
| 1998 | na. | 295,345 | 437,116 |
| 1999 | 15,471 | 282,655 | 464,514 |
| 2000 | 17,513 | 307,927 | 494,692 |
| 2001 | na. | 343,679 | 587,700 |
| 2002 | 17,893 | 358,440 | 660,297 |
| 2003 | 20,101 | 380,203 | 731,923 |
| 2004 | 23,439 | 408,350 | 842,611 |
| 2005 | 23,374 | 478,836 | 888,220 |
| 2006 | 20,568 | 412,804 | 826,464 |
| 2007 | 21,230 | 489,593 | 822,211 |
| 2008 | 19,214 | 469,937 | 786,186 |
| 2009 | 17,837 | 483,899 | 840,691 |
| Average Growth Rate (%) | 0.91 | 5.01 | 8.03 |

Source: ⁽¹⁾ Thailand Department of Livestock Development (2010)

⁽²⁾ Thailand Office of Agriculture Economics (2010)

Note: na. = not available

However, dairy production in Thailand is low compared with the world main dairy producers. Most Thai dairy farms can be classified as small-scale farming, with a dairy herd size of 11-20 cows (Rabobank, 2004). Generally, smallholder dairy farms in Thailand are mixed farm, which integrates their dairy operation with the production of rice, upland crops or orchard crops (Knips, 2006). Crossbred cows (Holstein Friesian with local breeds) are the major dairy

cattle in Thailand. They are suitable to tropical climate country. The average yield of raw milk per cow is approximately 3,000 litres per year (Garcia et al., 2005). It is relatively small compared with the world major dairy producers. Thai dairy farmers face many problems: low feed availability, low technology, uneconomical farm size, poor farm management, low milk yield and high production costs (Dong 2005; Hall et al., 2004; Murphy and Tisdell, 1996). Additionally, dairy production in Thailand varies by season with relatively plentiful milk supply in the rainy season and low quantities in the dry season. This leads to bottlenecks in the processing and marketing chains during the dry season. However, supply shortfalls are met by imported dairy products (Knips, 2006).

Figure 2.5 shows the structure of the Thai dairy industry chain, which is similar to other Asian countries. Milk collection in Thailand is mostly operated by local dairy cooperatives. These cooperatives act as middlemen to collect raw milk in a local area and sell it to processors; few cooperatives have processing activities. Processors use both domestic raw milk and imported milk powder to produce their products. For example milk products are distributed to domestic consumers through retail outlets and a school milk programme. The school milk programme is sponsored by the Thai government to provide free ready-to-drink milk to students from kindergarten up to Grade 4. Milk products such as ready-to-drink milk, condensed milk and yogurt are also exported to other Asian countries (Rabobank, 2004).

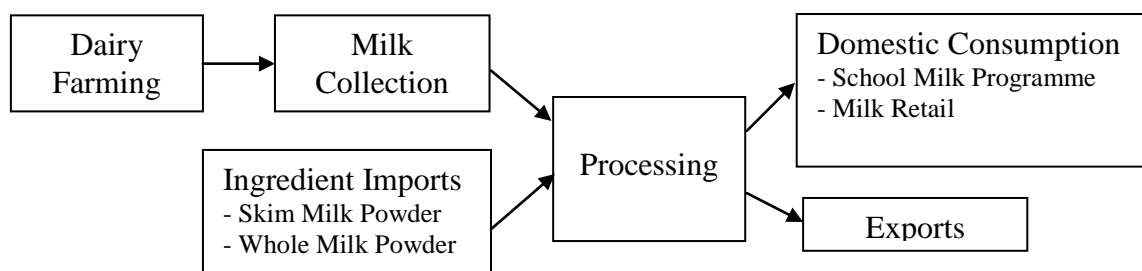


Figure 2.5 Dairy Chain of Thailand

Source: Adapted from Rabobank (2004)

Dairy farmers sell their raw milk to local milk collection centres with 180 centres throughout the country. Of these, 117 centres are owned by dairy cooperatives and the rest are operated by the private sector (see Table 2.9). The functions of Thai dairy cooperatives are to collect local milk, to provide extension services, to educate in farm management and to facilitate credit and other inputs for farmers (Rabobank, 2004). At present, there are 109 dairy cooperatives, 16 of which operate milk processing plants (see Table 2.9). For example, Nong

Pho Dairy Cooperative, the biggest dairy cooperative and an outstanding milk processor in Thailand, has run its dairy plant for almost 40 years. The cooperative now has 4,500 members and produces various milk products: pasteurised milk, Ultra Heat Treatment (UHT) milk, drinking yoghurt, yoghurt, butter and ice cream. UHT milk is distributed throughout the country but other products are marketed only in the local areas and other nearby provinces. The daily dairy production capacity for raw milk is approximately 10 tonnes, plus 5 tonnes for pasteurised milk, 2 tonnes for UHT milk, and 1 tonne for yoghurt and ice-cream (Nongpho Dairy Cooperative Ltd., 2005)

Table 2.9 Number of milk collection units and dairy cooperatives in Thailand in 2007

| Items | Number of units | Percentage |
|--------------------------------------|-----------------|------------|
| Milk collection units ⁽¹⁾ | 180 | 100 |
| 1) operated by dairy cooperatives | 117 | 65 |
| 2) operated by state corporations | 63 | 35 |
| Dairy cooperatives ⁽²⁾ | 109 | 100 |
| 1) without processing activities | 93 | 85 |
| 2) with processing activities | 16 | 15 |

Source: ⁽¹⁾ Leenanuruxsa *et al.* (2008)

⁽²⁾ Thailand Cooperative Promotion Department (2007)

Figure 2.6 shows the production costs and prices of Thailand raw milk from 1998 to 2007. Over that period, production costs for raw milk increased significantly but raw milk prices rose only slightly. However, dairy farmers still had profits but the size of the profits has diminished. The Thai government has controlled the minimum factory-gate prices for raw milk over time but prices vary slightly depending on the raw milk quality. During 1998-2006, the factory-gate price for raw milk was fixed at THB 12.50 per litre but milk collectors purchased the milk from dairy farmers between THB 10.50 and THB 11.50 per litre. In 2007, the cost of raw milk production was THB 12.31 per litre, an increase of 16% from the previous year. As a result, smallholder dairy farmers faced a loss and some stopped production. The Thai government then assisted dairy farmers by increasing the pledged price. The minimum price was adjusted to THB 13.58 and increased significantly to THB 16.50 per litre in 2009. The average farm-gate price of raw milk in 2009 was higher than the average production cost, with profit of THB 2.79 per litre (see Figure 2.6).

THB per litre

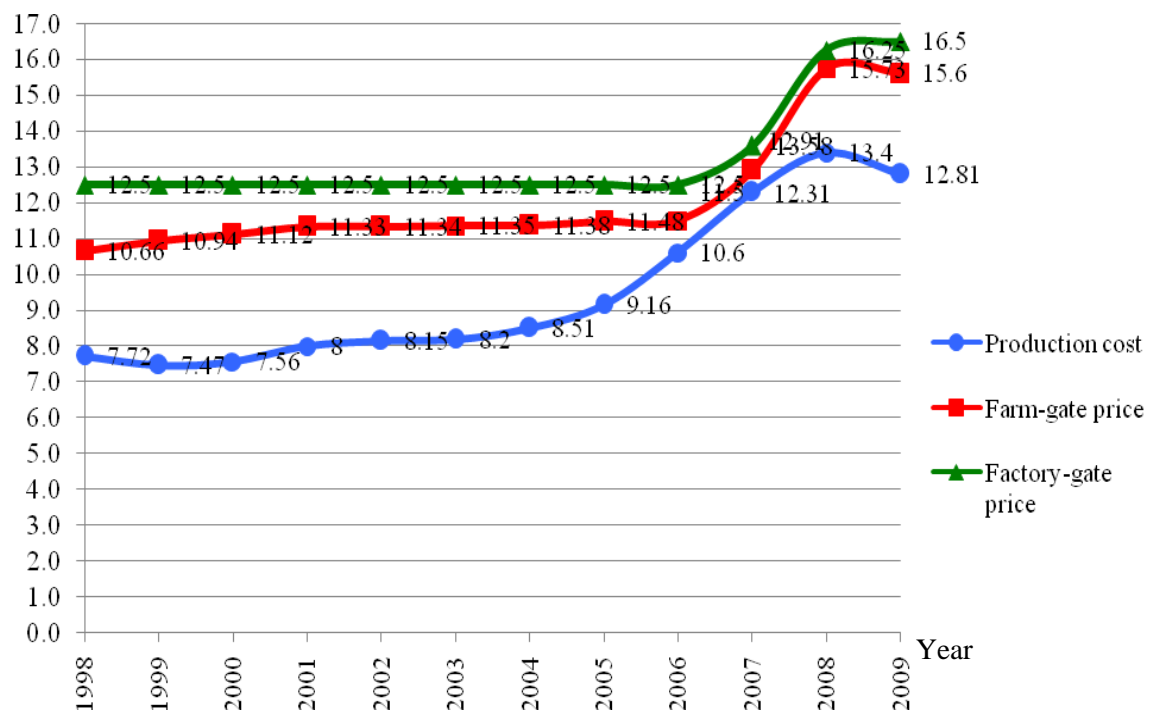


Figure 2.6 Average annual production costs and prices of Thailand raw milk from 1998 to 2009

Source: Thailand Office of Agriculture Economics (2010)

Thailand produces a few categories of dairy products such as ready-to-drink milk, cheese, yoghurt, butter and condensed milk. In addition, milk powder, whey and infant food are reproduced in the country by mixing imported dairy ingredients and some of those are re-exported to neighbouring countries (Thailand Office of Industrial Economics, 2006). In 2005, there were 165 milk factories in Thailand of which 75 are ready-to-drink milk (RTD) plants, including 15 UHT milk plants and 60 pasteurised milk plants (see Table 2.10). The utilization of Thailand raw milk for RTD milk production between 2001 and 2007 is shown in Table 2.11. Over that period, there was an increase in raw milk demand for RTD milk production, with annual average growth rate of 7.27%. In 2007, 656,540 tonnes or 80% of domestic raw milk was supplied to RTD milk factories. However, this was only 69% of the demand for raw milk for RTD milk production. The other 20% of domestic raw milk was used to process into other dairy products, mainly cheese. The shortage of raw milk met by imported milk powder. In the same year, RTD milk production in Thailand totalled 929,432 tonnes or 2,546 tonnes per day (see Table 2.11).

Table 2.10 Number and type of milk factories in Thailand in 2005

| Items | Number of units | Percentage |
|--------------------------------|-----------------|------------|
| UHT milk plants | 15 | 9 |
| Pasteurised milk plants | 60 | 36 |
| Cheese plants | 8 | 5 |
| Milk-related processing plants | 82 | 50 |
| Total | 165 | 100 |

Source: Thailand Ministry of Agricultural and Cooperatives (2006)

Table 2.11 Utilization of Thailand raw milk for RTD milk production 2001-07

| Year | Raw milk demanded by processors for RTD milk (tonnes) | Supply of raw milk to RTD milk factories (tonnes) | Raw milk shortfall (tonnes) | RTD milk production (tonnes) |
|-------------------------------|---|---|-----------------------------|------------------------------|
| 2001 | 627,769 | 564,200 | 63,569 | 610,000 |
| 2002 | 679,740 | 633,885 | 45,855 | 660,500 |
| 2003 | 703,510 | 702,646 | 864 | 683,600 |
| 2004 | 796,120 | 808,905 | -12,785 | 773,582 |
| 2005 | 833,350 | 852,690 | -19,340 | 809,760 |
| 2006 | 892,700 | 744,935 | 147,765 | 867,420 |
| 2007 | 956,500 | 656,540 | 299,960 | 929,432 |
| Average growth rate(%) | 7.27 | 2.56 | - | 7.27 |

Source: Thailand Office of Agriculture Economics (Various years)

Approximately 2,000 tonnes of cheese is produced per year by eight domestic cheese factories but domestic demand for cheese is around 5,000- 6,000 tonnes per year. Minor Cheese Co. Ltd is the largest cheese processor in Thailand (Goss, 2002; Thailand Ministry of Agricultural and Cooperatives, 2006). The 82 milk-related processing factories manufacture milk products such as butter, condensed milk, milk powder and infant food (Thailand Ministry of Agricultural and Cooperatives, 2006).

According to Rabobank (2004), Thailand milk processing industry is a combination of local producers and multinational companies. The major local milk processors are Dutch Mill, Thai Dairy Industry (TDI), Nong Pho, Dairy Farming Promotion Organisation of Thailand (DPO) and CP Meiji. Thailand is also an important dairy manufacturing hub for multinational companies such as Foremost, Nestlé, Dumex and Mead Johnson for distributing dairy products to neighbouring and Asian countries. Nestlé is the biggest milk processing company in Thai milk market (see Table 2.12), but its product strength is more in milk powder than in RTD milk. The RTD milk market is led by Foremost, Dutch Mill, TDI and Nong Pho. The market

for condensed milk is dominated by one company, TDI, which has around 60% of the market, followed by Foremost and Nestlé with 20 and 10% respectively (Itsaranuwat and Robinson, 2003).

Table 2.12 Main products of major dairy manufacturers in Thailand

| Company | Turnover in 2002 (USD million) | Main products |
|--|---|---|
| Nestlé (Thailand) | 150 | Sterilised milk, milk powder, UHT milk, pasteurised milk, cup yoghurt, condensed milk |
| Foremost Friesland (Thailand) | 139 | UHT milk, pasteurised milk, drinking yoghurt, cup yoghurt, condensed milk |
| Dutch Mill | 132 | Drinking yoghurt, cup yoghurt, UHT milk, pasteurised milk |
| Thai Dairy Industry (TDI) | 93 | UHT milk, condensed milk, milk powder |
| Dumex (Thailand) | 61 | Milk powder, UHT milk |
| Nong Pho Dairy Cooperative | 53 | UHT milk, drinking yoghurt |
| Dairy Farming Promotion Organisation of Thailand (DPO) | 51 | UHT milk, pasteurised milk, drinking yoghurt |
| CP Meiji | 51 | UHT milk, pasteurised milk, drinking yoghurt, cultured milk, milk powder |
| Mead Johnson (Thailand) | 50 | Milk powder, UHT milk |

Source: Rabobank (2004)

The Thai dairy product market is very competitive and driven by the multinational milk processing companies in terms of product differentiation and innovation. Innovation in dairy products regarding to health benefits plays an increasingly important role in market competition. Thai government intervenes heavily on the milk processing via the establishment of the local content regulation and the imposition of a ceiling price for UHT milk at THB 25 per litre (Rabobank, 2004).

2.6 Thailand Consumption of Milk Products

Thailand dairy consumption is still low compared to Western countries because most Thai people do not have a milk consumption habit. In 1980, Thailand annual consumption of milk products was very low levels of less than 8 kg per capita and gradually increased to 20 kg per capita in 2002 (Knips, 2006). The significant growth in Thai milk consumption is a result of the milk consumption promotion policies of the Thai government. For instance, the National Milk Drinking Campaign Board began a milk consumption campaign in 1985. This provided monthly coupons for purchasing milk at 25% less than the market price of milk to children and teenagers in selected areas of Bangkok and Chiangmai. It also encouraged Thai milk consumption with the slogan “Have you had your milk today” (Itsaranuwat and Robinson, 2003; Oupadissakoon, 2007; Suwanabol, 2005).

Subsequently, a school milk programme was established in 1992. The school milk programme provides free ready-to-drink milk to students from kindergarten up to Grade 4 throughout the country (Itsaranuwat and Robinson, 2003; Rabobank, 2004; Suwanabol, 2005). According to Suwanabol (2005), the school milk programme is managed by a zoning system. There are three school-milk zones, zones 1, 2 and 3. The requirements are that all school milk programme must be produced only from domestic raw milk, and that consumers and suppliers must be in the same zone. For example, raw milk in zone 1 must be processed by a dairy factory in zone 1 and be supplied to schools in zone 1 as well. The school milk programme made up of more than 30% of the national liquid milk market (Suwanabol, 2005). This shows that the programme plays an important role in Thai dairy industry, and leads to an increase of per capita milk consumption and a generation of long term demand for dairy products.

Population growth, income growth and tourism are the main influential factors of the growth in demand for dairy products in Thailand (Knips, 2006). Between 1984 and 2007, the total consumption of dairy products in Thailand has increased dramatically from 88 to 800 thousand tonnes (Food and Agricultural Policy Research Institute: FAPRI, 2010). The data in Table 2.13 shows the consumption of selected dairy products including liquid milk, cheese, butter, skim milk powder and whole milk powder for selected countries in 2007. The highest total milk consumption was in the EU with 42,893 thousand tonnes, followed by the US and Russia with 33,606 and 13,360 thousand tonnes respectively. It is evident that the milk consumption pattern in Thailand differs from Western countries. Western milk consumption pattern tends to be in liquid milk, cheese and butter whereas Thailand milk consumption is mostly in liquid milk, skim milk powder and whole milk powder. Cheese and butter consumption in Thailand is low; and is dominated by the Thai tourism sector such as hotels,

Western-style restaurants and bakery shops (Murphy and Tisdell, 1996). Skim milk powder and whole milk powder consumption in Thailand is for processing to RTD milk, yoghurt, condensed milk, ice cream and infant food (Rabobank, 2004).

In Thailand, RTD milk is the most important milk product made from domestic liquid milk and skim milk powder. Thailand RTD milk consumption has gradually increased between 2001 and 2007 with an average growth rate of 7.27% (see Table 2.14). In 2007, RTD milk consumption accounted for approximately 917 thousand tonnes or 14 litres per capita per year (Thailand Office of Agriculture Economics, 2010). Although, Thailand RTD milk consumption per capita has increased over the period, it is still relatively low because it is confined only to urban areas such as the well-educated and young people (Khorchurklang, 2005).

Table 2.13 Consumption of selected dairy products for selected countries in 2007

| Country | Dairy Products (Thousand Tonnes) | | | | | |
|----------------|----------------------------------|--------|--------|------------------|-------------------|--------|
| | Fluid milk | Cheese | Butter | Skim milk powder | Whole milk powder | Total |
| United States | 28,011 | 4,507 | 660 | 405 | 23 | 33,606 |
| Brazil | 10,170 | 576 | 80 | 128 | 503 | 11,457 |
| European Union | 33,334 | 6,319 | 2,014 | 814 | 412 | 42,893 |
| Russia | 12,000 | 675 | 420 | 150 | 115 | 13,360 |
| Ukraine | 3,641 | 194 | 97 | 33 | 17 | 3,982 |
| Australia | 2,162 | 215 | 55 | 42 | 27 | 2,501 |
| New Zealand | 360 | 28 | 26 | 5 | 1 | 420 |
| Thailand | 657 | 5 | 16 | 81 | 40 | 800 |

Sources: FAPRI (2010)

Table 2.14 Thailand RTD milk consumption between 2001 and 2007

| Year | RTD milk consumption (tonnes) | RTD milk consumption per capita (litres) |
|-------------------------|-------------------------------|--|
| 2001 | 602,070 | 9.57 |
| 2002 | 651,910 | 10.19 |
| 2003 | 674,700 | 10.46 |
| 2004 | 763,526 | 12.03 |
| 2005 | 799,078 | 12.63 |
| 2006 | 856,150 | 13.36 |
| 2007 | 917,360 | 14.00 |
| Average growth rate (%) | 7.27 | 6.55 |

Source: Thailand Office of Agriculture Economics (2010)

For the domestic milk market, the total market value of milk products in 2007 was 35,000 million baht. RTD milk had the greatest market share with 45.6%, including 29.8% of UHT milk, 9.4% of pasteurised milk, 4.9% of sterilised milk and 1.5% of high calcium milk. The market share for yoghurt was the second largest (32.4%), followed by condensed milk and butter and cheese 11.4 and 10.6% respectively (see Figure 2.7). Domestic consumption of yoghurt, UHT milk, pasteurised milk and high calcium milk has grown substantially since 2005 (Kasikorn Research Centre, 2007; Khorchurklang, 2005). However, the milk market in Thailand is highly competitive. There are many dietary beverages competing in the domestic market, such as soya milk, green tea and vegetable and fruit juices (Itsaranuwat and Robinson, 2003; Kasikorn Research Centre, 2007).

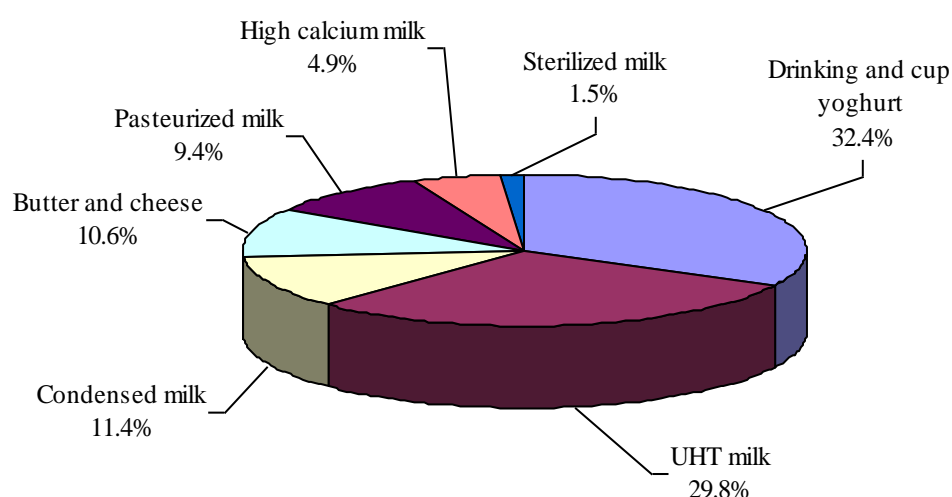


Figure 2.7 Market share of Thailand milk products in 2007

Source: Kasikorn Research Centre (2007)

2.7 Overview of Thailand Dairy Product Trade

Thailand international trade in dairy products can be classified into six main product groups according to the Harmonized System (HS): non-concentrated milk and cream, concentrated milk and cream, buttermilk and yoghurt, whey, butter and butterfat, and cheese and curd. Table 2.15 shows the value of Thailand dairy exports and imports for the six main product groups between 1991 and 2007. Both Thailand total dairy exports and imports have increased from US\$ 12.18 million and US\$ 157.59 million, respectively, in 1991 to US\$ 131.33 million and US\$ 466.98 million in 2007, with average growth rates of 16.02% and 7.03%. In the same period, Thailand total dairy imports have significantly exceeded exports; however, Thailand dairy trade deficit fluctuated, reaching a peak at US\$ 336.22 million in 1997 before

decreasing to US\$ 100.89 million in 2002. Since then, the dairy trade deficit has widened to US\$ 335.65 million in 2007.

Export and import values of all dairy product groups increased from 1991-2007. The highest growth of Thailand dairy exports was cheese and curd (43%) but the largest growth of dairy import was non-concentrated milk and cream (56%). Over the same period, the balance of trade in five dairy product categories: concentrated milk and cream, buttermilk and yoghurt, whey, butter and butterfat, and cheese and curd, was in deficit. In contrast, liquid milk and cream experienced a trade surplus because of an excess supply for liquid milk such as UHT milk (see Table 2.15). According to Itsaranuwat and Robinson (2003), Thailand has become an important exporter of UHT milk to neighbouring countries such as Cambodia, Myanmar and Lao PDR.

Dairy trade is a small proportion of Thailand total trade. In 2007, Thailand dairy export was 0.09% of total exports while Thailand dairy import share was 0.33% (see Table 2.15).

However, there was a significant growth in both Thailand dairy exports and imports. Thailand becomes an important dairy supplier to neighbouring and Asian countries but Thailand dairy industry depends heavily on imported dairy ingredients because of inadequate domestic production (Khorchurklang, 2005).

2.7.1 Thailand Dairy Exports

Figure 2.8 exhibits the share of Thailand dairy export for the six dairy product categories from 1991 to 2007. The most important dairy export in 1991 was concentrated milk and cream, comprise of 85% of total dairy exports, followed by whey, non-concentrated milk and cream, and buttermilk and yoghurt 9, 4 and 2 percent respectively. Butter and butterfat, and cheese and curd were minor dairy export. Most of Thailand dairy exports were repacked and sold them to neighbouring Asian countries (Preechajarn, 2003).

In 2007, concentrated milk and cream still had the highest export share but its share decreased almost halved to 49%. The share of non-concentrated milk and cream and buttermilk and yoghurt significantly increased, being the second and third largest proportion 22 and 19 percent respectively. UHT milk, cup yoghurt and drinking yoghurt became popular exports to neighbouring countries. Whey's share remained stable at 10%; butter and butterfat, and cheese and curd still had the lowest share with 0.4% each (see Figure 2.8).

Table 2.15 Thailand dairy exports and imports by selected products from 1991 to 2007

| Year | Dairy Products (Million US Dollar) | | | | | | | | | | | | | |
|---------------------|------------------------------------|--------|-----------------------------|--------|------------------------|--------|--------|--------|----------------------|--------|-----------------|--------|--------|--------|
| | non-concentrated milk and cream | | concentrated milk and cream | | Buttermilk and yoghurt | | Whey | | Butter and butterfat | | Cheese and curd | | Total | |
| | Export | Import | Export | Import | Export | Import | Export | Import | Export | Import | Export | Import | Export | Import |
| 1991 | 0.49 | 0.00 | 10.31 | 122.90 | 0.23 | 2.90 | 1.06 | 6.11 | 0.10 | 21.88 | 0.00 | 3.81 | 12.18 | 157.59 |
| 1992 | 0.39 | 0.02 | 12.40 | 177.82 | 0.97 | 4.37 | 0.43 | 5.58 | 0.03 | 27.06 | 0.01 | 4.20 | 14.22 | 219.05 |
| 1993 | 1.17 | 0.47 | 17.43 | 164.72 | 1.56 | 4.30 | 0.72 | 7.60 | 0.04 | 22.73 | 0.00 | 3.77 | 20.92 | 203.59 |
| 1994 | 2.19 | 0.07 | 28.92 | 193.26 | 2.22 | 7.72 | 0.38 | 7.99 | 0.05 | 31.83 | 0.01 | 5.26 | 33.76 | 246.12 |
| 1995 | 2.76 | 0.91 | 28.16 | 266.25 | 2.35 | 9.76 | 0.42 | 8.25 | 0.03 | 38.64 | 0.28 | 6.30 | 33.99 | 330.12 |
| 1996 | 3.03 | 0.13 | 29.24 | 295.42 | 2.24 | 12.09 | 0.57 | 12.86 | 0.19 | 43.24 | 0.01 | 5.76 | 35.27 | 369.51 |
| 1997 | 2.57 | 0.08 | 29.17 | 311.60 | 2.60 | 9.56 | 1.27 | 16.35 | 0.17 | 28.56 | 0.08 | 5.91 | 35.86 | 372.07 |
| 1998 | 2.28 | 0.03 | 28.56 | 226.91 | 2.29 | 9.62 | 0.49 | 11.56 | 0.04 | 21.64 | 0.13 | 4.22 | 33.79 | 273.97 |
| 1999 | 3.80 | 0.02 | 25.30 | 199.64 | 2.73 | 5.90 | 0.62 | 15.00 | 0.11 | 21.79 | 0.45 | 4.42 | 33.01 | 246.77 |
| 2000 | 2.47 | 0.02 | 27.79 | 192.02 | 3.97 | 12.82 | 1.71 | 18.84 | 0.12 | 20.32 | 0.04 | 4.53 | 36.09 | 248.55 |
| 2001 | 6.87 | 0.11 | 74.05 | 211.10 | 6.88 | 24.65 | 1.54 | 24.98 | 0.03 | 20.19 | 0.03 | 6.98 | 89.41 | 288.01 |
| 2002 | 15.68 | 0.02 | 114.33 | 176.05 | 8.20 | 14.77 | 1.61 | 23.97 | 0.09 | 19.40 | 0.08 | 6.66 | 139.99 | 240.88 |
| 2003 | 18.16 | 0.06 | 58.27 | 180.85 | 9.81 | 16.80 | 2.65 | 26.07 | 0.47 | 21.06 | 0.11 | 8.30 | 89.47 | 253.14 |
| 2004 | 21.60 | 0.17 | 76.07 | 204.96 | 13.20 | 25.90 | 7.29 | 29.36 | 0.15 | 31.06 | 0.15 | 10.41 | 118.47 | 301.87 |
| 2005 | 20.59 | 0.23 | 79.66 | 228.73 | 16.84 | 28.52 | 9.66 | 39.54 | 0.20 | 29.96 | 0.31 | 10.86 | 127.26 | 337.85 |
| 2006 | 18.10 | 0.30 | 59.11 | 220.97 | 21.18 | 31.34 | 9.08 | 49.51 | 0.33 | 28.30 | 0.74 | 14.83 | 108.54 | 345.24 |
| 2007 | 28.56 | 0.52 | 64.53 | 302.23 | 24.82 | 41.54 | 12.46 | 71.64 | 0.48 | 30.95 | 0.48 | 20.11 | 131.33 | 466.98 |
| Average Growth Rate | 28.99 | 56.44 | 12.15 | 5.79 | 34.14 | 18.11 | 16.68 | 16.64 | 10.44 | 2.19 | 42.82 | 10.95 | 16.02 | 7.03 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

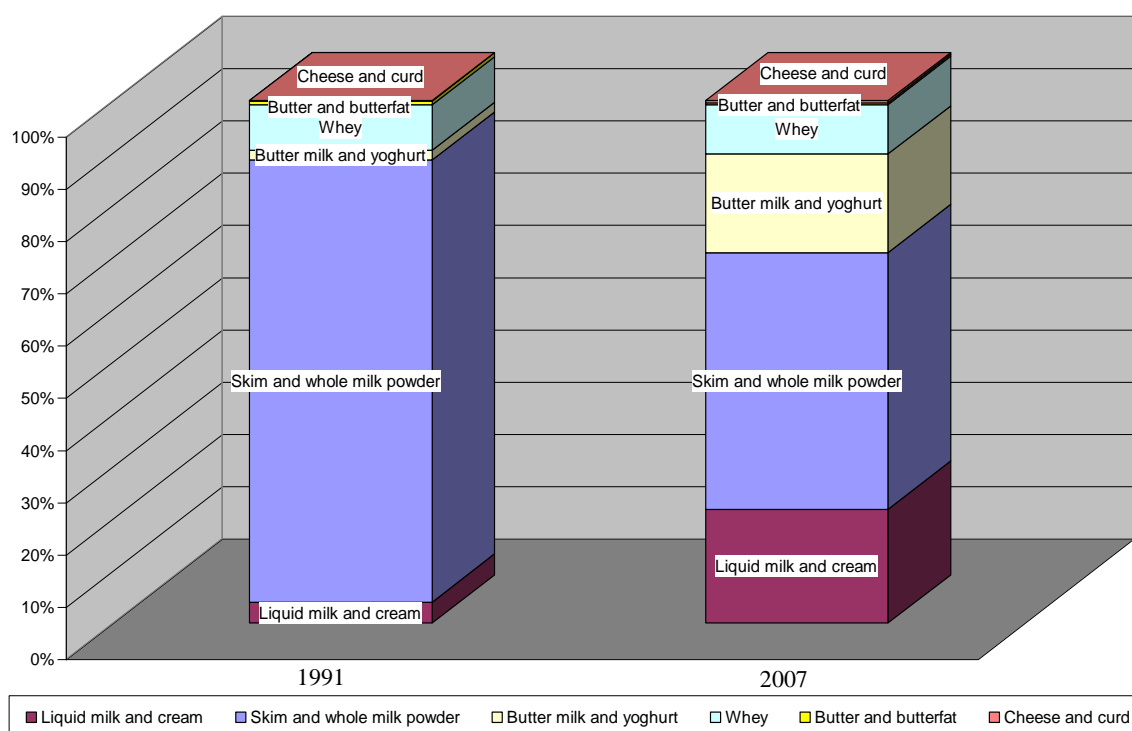


Figure 2.8 Thailand dairy categories export share between 1991 and 2007

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

The export markets for Thailand dairy products are dominated by Asian countries. In 2007, the main export markets of Thailand non-concentrated milk and cream were Indonesia (42%), Cambodia (21%), Philippines (17%), Singapore (12%) and China (4%). Only 3.7 percent was exported to other countries (see Table 2.16). Most concentrated milk and cream was re-exported to Asian countries. The greatest export market share for Thailand concentrated milk and cream was Philippines (27%), followed by Malaysia (18%), Cambodia (12%), Hong Kong (11%) and Lao (10%) (see Table 2.17). Buttermilk and yoghurt was mainly exported to Singapore (42%), followed by Lao PDR (18%), Cambodia (12%), Philippines (12%) and Malaysia (5%) (see Table 2.18).

Table 2.16 Thailand top five export destinations for non-concentrated milk and cream from 2005 to 2007

| Country | Year | | | | | | |
|-----------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|---------------|
| | 2005 | | 2006 | | 2007 | | |
| | Quantity (Tonnes) | Value (1,000 USD) | Quantity (Tonnes) | Value (1,000 USD) | Quantity (Tonnes) | Value (1,000 USD) | % Share |
| Indonesia | 8,396.60 | 7,971.25 | 7,414.11 | 7,247.83 | 11,171.17 | 11,935.28 | 41.79 |
| Cambodia | 1,235.52 | 1,307.64 | 3,435.65 | 3,700.35 | 4,309.05 | 6,090.96 | 21.33 |
| Philippines | 9,157.36 | 8,165.13 | 5,779.65 | 5,165.60 | 4,478.81 | 4,983.45 | 17.45 |
| Singapore | 733.06 | 769.24 | 1,299.51 | 1,421.94 | 2,482.22 | 3,450.26 | 12.08 |
| China | - | - | - | - | 680.00 | 1,045.74 | 3.66 |
| Other countries | 2,803.29 | 2,377.85 | 573.36 | 563.53 | 712.42 | 1,056.34 | 3.70 |
| Total | 22,325.83 | 20,591.11 | 18,502.27 | 18,099.25 | 23,833.68 | 28,562.03 | 100.00 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

Table 2.17 Thailand top five export destinations for concentrated milk and cream from 2005 to 2007

| Country | Year | | | | | | |
|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|---------------|
| | 2005 | | 2006 | | 2007 | | |
| | Quantity | Value | Quantity | Value | Quantity | Value | % Share |
| | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | |
| Philippines | 26,400.76 | 22,373.72 | 22,285.46 | 19,327.81 | 15,425.37 | 17,344.40 | 26.88 |
| Malaysia | 13,908.53 | 11,459.24 | 13,483.98 | 11,981.74 | 8,159.93 | 11,470.22 | 17.77 |
| Cambodia | 11,126.48 | 10,788.76 | 8,658.39 | 8,989.74 | 5,039.46 | 8,024.14 | 12.43 |
| Hong Kong | 3,765.44 | 3,640.73 | 1,106.71 | 1,255.38 | 4,973.40 | 6,905.61 | 10.70 |
| Lao PDR | 2,808.07 | 4,553.74 | 1,817.20 | 4,441.55 | 1,921.23 | 6,308.44 | 9.78 |
| Other countries | 25,004.73 | 26,844.99 | 8,873.34 | 13,116.70 | 8,440.19 | 14,481.24 | 22.44 |
| Total | 83,014.01 | 79,661.17 | 56,225.07 | 59,112.91 | 43,959.58 | 64,534.06 | 100.00 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

Table 2.18 Thailand top five export destinations for buttermilk and yoghurt from 2005 to 2007

| Country | Year | | | | | | |
|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|---------------|
| | 2005 | | 2006 | | 2007 | | |
| | Quantity | Value | Quantity | Value | Quantity | Value | % Share |
| | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | |
| Singapore | 7,113.80 | 6,020.73 | 9,966.37 | 8,530.24 | 11,411.59 | 10,350.29 | 41.71 |
| Lao PDR | 6,240.70 | 3,706.56 | 5,784.16 | 3,681.08 | 5,762.72 | 4,435.27 | 17.87 |
| Cambodia | 5,838.48 | 3,771.90 | 5,465.43 | 3,755.56 | 4,024.52 | 3,087.66 | 12.44 |
| Philippines | 6.47 | 4.34 | 3,705.53 | 2,781.95 | 3,836.17 | 2,905.40 | 11.71 |
| Malaysia | 1,668.70 | 1,354.97 | 579.94 | 466.74 | 1,225.50 | 1,250.48 | 5.04 |
| Other countries | 2,716.10 | 1,980.34 | 2,617.47 | 1,967.67 | 3,524.59 | 2,788.68 | 11.24 |
| Total | 23,584.25 | 16,838.83 | 28,118.89 | 21,183.24 | 29,785.09 | 24,817.77 | 100.00 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

The top five highest export destinations for whey are Cambodia (43%), Lao PDR (14%), Singapore (13%), Mozambique (12%) and Vietnam (5%) (see Table 2.19). Most of Thailand butter and butterfat is exported to Lao PDR (46%) and China (30%). Cambodia (12%) is the third highest, followed by Singapore (1%) and Myanmar (0.7%) (see Table 2.20). The export markets for Thailand cheese and curd are different from other products. The main export markets are Saudi Arabia (46%), Arab Emirates (13%) and U.S.A. (12%). Thai cheese is also exported to franchisee of Thai pizza restaurants in Asian countries such as China and Cambodia (see Table 2.21).

Table 2.19 Thailand top five export destinations for whey from 2005 to 2007

| Country | Year | | | | | | |
|-----------------|------------------|-----------------|------------------|-----------------|------------------|------------------|---------------|
| | 2005 | | 2006 | | 2007 | | |
| | Quantity | Value | Quantity | Value | Quantity | Value | % Share |
| | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | |
| Cambodia | 5,108.32 | 3,627.63 | 6,345.82 | 4,858.81 | 5,770.61 | 5,399.09 | 43.33 |
| Lao PDR | 2,367.20 | 1,182.62 | 1,731.94 | 1,087.68 | 2,151.89 | 1,732.93 | 13.91 |
| Singapore | 222.84 | 208.59 | 574.99 | 751.25 | 986.25 | 1,607.49 | 12.90 |
| Mozambique | 157.25 | 127.84 | 742.06 | 677.55 | 1,389.96 | 1,443.03 | 11.58 |
| Vietnam | 0.40 | 3.96 | 0.15 | 3.60 | 692.54 | 627.48 | 5.04 |
| Other countries | 10,497.26 | 4,507.80 | 1,612.17 | 1,698.69 | 1,571.90 | 1,649.96 | 13.24 |
| Total | 18,353.26 | 9,658.44 | 11,007.13 | 9,077.59 | 12,563.13 | 12,459.99 | 100.00 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

Table 2.20 Thailand top five export destinations for butter and butterfat from 2005 to 2007

| Country | Year | | | | | | |
|-----------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | 2005 | | 2006 | | 2007 | | |
| | Quantity | Value | Quantity | Value | Quantity | Value | % Share |
| | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | |
| Lao PDR | 73.30 | 135.57 | 92.81 | 170.84 | 105.38 | 220.52 | 46.05 |
| China | 0.05 | 0.03 | - | - | 57.83 | 145.74 | 30.43 |
| Cambodia | 21.34 | 26.28 | 22.96 | 27.55 | 45.70 | 55.68 | 11.63 |
| Singapore | 0.07 | 0.85 | 0.02 | 0.01 | 16.80 | 47.64 | 9.95 |
| Myanmar | 0.46 | 1.21 | 121.91 | 120.94 | 4.69 | 5.83 | 1.22 |
| Other countries | 4.91 | 35.95 | 1.67 | 8.19 | 0.59 | 3.47 | 0.72 |
| Total | 100.12 | 199.89 | 239.36 | 327.54 | 230.99 | 478.88 | 100.00 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

Table 2.21 Thailand top five export destinations for cheese and curd from 2005 to 2007

| Country | Year | | | | | | |
|-----------------|--------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | 2005 | | 2006 | | 2007 | | |
| | Quantity | Value | Quantity | Value | Quantity | Value | % Share |
| | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | |
| Saudi Arabia | - | - | 23.09 | 94.55 | 45.70 | 221.72 | 46.23 |
| Arab Emirates | - | - | 20.23 | 78.29 | 15.50 | 64.72 | 13.49 |
| U.S.A. | 18.90 | 20.98 | 113.40 | 149.06 | 37.80 | 56.59 | 11.80 |
| China | 21.17 | 82.38 | 32.63 | 135.58 | 9.32 | 56.51 | 11.78 |
| Cambodia | 1.52 | 2.31 | 0.74 | 12.48 | 28.63 | 47.97 | 10.00 |
| Other countries | 44.85 | 207.17 | 175.81 | 273.90 | 5.40 | 32.06 | 6.68 |
| Total | 86.44 | 312.84 | 365.90 | 743.86 | 142.35 | 479.57 | 100.00 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

2.7.2 Thailand Dairy Imports

Figure 2.9 shows the share of Thailand dairy imports of the six dairy product categories between 1991 and 2007. Concentrated milk and cream has the largest import in 1991 with 78% of total dairy imports, followed by butter and butterfat with 14%. The import share of whey, cheese and curd, and buttermilk and yoghurt is small with 4, 2 and 2% respectively. Imports of non-concentrated milk and cream are very low (0.0003 % share).

In 2007, concentrated milk and cream still had the highest import share but it decreased to 65%. Whey and buttermilk and yoghurt were second and third with 15 and 9%, respectively. Butter and butterfat share halved to 7% whereas cheese and curd slightly increased to 4%. The import share for non-concentrated milk and cream remained the lowest with 0.1% (see Figure 2.9). Imported concentrated milk and cream has been the major raw material in Thai dairy processing industries. However, the demand for imported whey is growing because it is used instead of concentrated milk and cream in manufacturing Thai dairy and other food products, such as yoghurt, ice cream, chocolate, and bakery products (Khorchurklang, 2005).

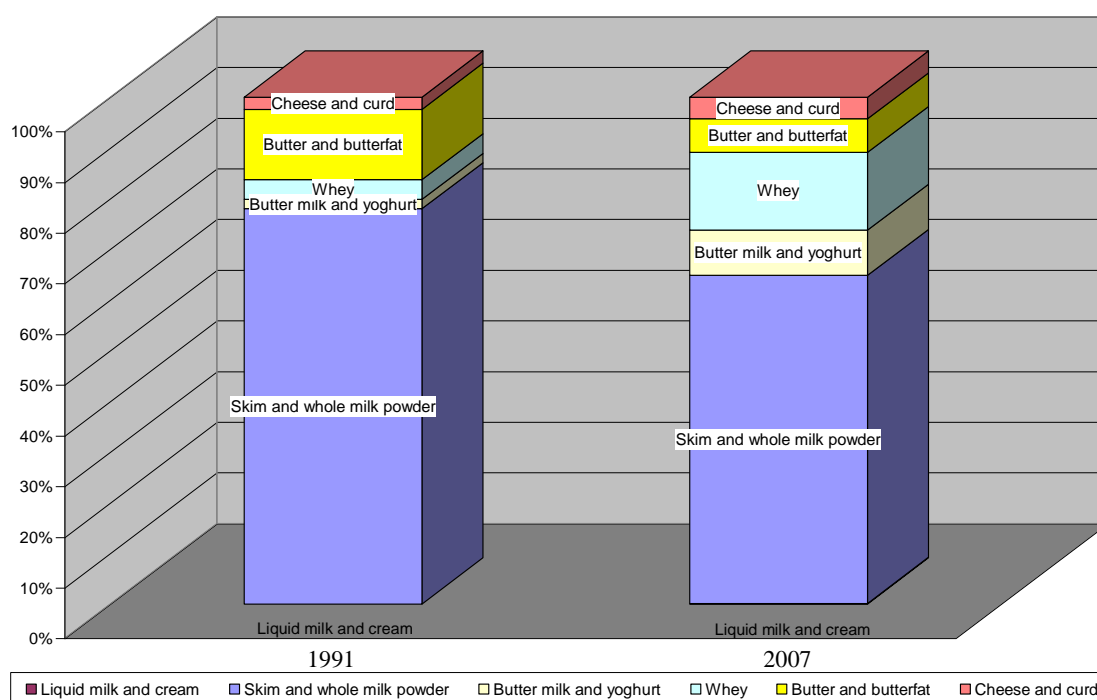


Figure 2.9 Thailand dairy categories import share between 1991 and 2007

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

The main dairy import sources of Thailand six dairy product categories are different each year. The top five import sources of non-concentrated milk and cream in 2007 include Australia (82%), Japan (8%), Indonesia (6%), Malaysia (2%) and New Zealand (1%). Only 0.3 percent was imported from other countries (see Table 2.22). The main exporter of concentrated milk and cream to Thailand was New Zealand (45%), followed by Australia (16%), U.S.A. (12%), the Czech Republic (5%) and Germany (5%) (see Table 2.23). Over two thirds of total buttermilk and yoghurt imports came from New Zealand (67%). The rest of the buttermilk and yoghurt was imported from Australia (10%), Netherlands (9%), Ireland (7%), U.S.A. (2%) and 'other countries' (4%) (see Table 2.24).

Whey was imported from France (31%), U.S.A. (29%), Australia (11%), Netherlands (10%) and Germany (6%) (see Table 2.25). For butter and butterfat imports, New Zealand and Australia were the most important import suppliers for Thailand with import shares of 55 and 27%, respectively. Netherlands was third highest with 5%, followed by Argentina and France with 4 and 2%, respectively (see Table 2.26). Thailand imports most of its cheese and curd from Australia and New Zealand followed by Denmark, Netherlands and France (see Table 2.27).

Table 2.22 Thailand top five import sources for non-concentrated milk and cream from 2005 to 2007

| Country | Year | | | | | | |
|-----------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | 2005 | | 2006 | | 2007 | | |
| | Quantity | Value | Quantity | Value | Quantity | Value | % Share |
| | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | |
| Australia | 86.71 | 159.35 | 174.38 | 297.53 | 194.97 | 424.36 | 82.41 |
| Japan | 0.00 | 0.01 | - | - | 31.15 | 40.79 | 7.92 |
| Indonesia | - | - | - | - | 15.11 | 32.31 | 6.27 |
| Malaysia | - | - | 0.99 | 2.70 | 5.42 | 10.01 | 1.94 |
| New Zealand | 14.06 | 47.78 | 0.08 | 0.32 | 3.30 | 6.11 | 1.19 |
| Other countries | 31.87 | 25.31 | 0.06 | 0.25 | 0.30 | 1.38 | 0.27 |
| Total | 132.64 | 232.45 | 175.51 | 300.79 | 250.25 | 514.96 | 100.00 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

Table 2.23 Thailand top five import sources for concentrated milk and cream from 2005 to 2007

| Country | Year | | | | | | |
|-----------------|-------------------|-------------------|-------------------|-------------------|------------------|-------------------|---------------|
| | 2005 | | 2006 | | 2007 | | |
| | Quantity | Value | Quantity | Value | Quantity | Value | % Share |
| | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | |
| New Zealand | 38,247.01 | 83,161.13 | 45,396.24 | 98,930.05 | 44,953.73 | 137,125.44 | 45.37 |
| Australia | 55,414.52 | 55,881.74 | 29,774.26 | 63,306.74 | 13,053.87 | 48,120.32 | 15.92 |
| U.S.A. | 7,298.23 | 15,841.05 | 6,215.05 | 13,393.87 | 8,604.04 | 37,780.77 | 12.50 |
| Czech Republic | 8,870.44 | 21,038.55 | 5,482.10 | 14,035.75 | 3,931.15 | 16,197.96 | 5.36 |
| Germany | 703.42 | 1,688.01 | 385.04 | 863.19 | 3,411.03 | 13,632.53 | 4.51 |
| Other countries | 23,007.27 | 51,122.07 | 13,105.52 | 30,437.67 | 13,813.65 | 49,375.38 | 16.34 |
| Total | 133,540.89 | 228,732.56 | 100,358.22 | 220,967.26 | 87,767.46 | 302,232.41 | 100.00 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

Table 2.24 Thailand top five import sources for buttermilk and yoghurt from 2005 to 2007

| Country | Year | | | | | | |
|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|---------------|
| | 2005 | | 2006 | | 2007 | | |
| | Quantity | Value | Quantity | Value | Quantity | Value | % Share |
| | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | |
| New Zealand | 5,336.54 | 10,826.15 | 7,861.27 | 15,569.86 | 8,591.80 | 27,985.28 | 67.37 |
| Australia | 1,543.73 | 3,015.73 | 2,362.39 | 4,557.30 | 1,760.01 | 4,279.14 | 10.30 |
| Netherlands | 1,903.85 | 4,040.95 | 925.02 | 1,974.56 | 809.18 | 3,594.96 | 8.65 |
| Ireland | 1,468.00 | 3,089.85 | 1,008.98 | 2,022.76 | 783.00 | 2,958.89 | 7.12 |
| U.S.A. | 0.07 | 2.27 | 2,045.31 | 3,811.38 | 293.68 | 984.20 | 2.37 |
| Other countries | 3,335.43 | 7,541.80 | 1,679.43 | 3,400.30 | 389.46 | 1,737.64 | 4.18 |
| Total | 13,587.62 | 28,516.75 | 15,882.40 | 31,336.16 | 12,627.12 | 41,540.11 | 100.00 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

Table 2.25 Thailand top five import sources for whey from 2005 to 2007

| Country | Year | | | | | | |
|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|---------------|
| | 2005 | | 2006 | | 2007 | | |
| | Quantity | Value | Quantity | Value | Quantity | Value | % Share |
| | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | |
| France | 11,143.15 | 11,522.83 | 11,231.24 | 13,646.27 | 11,172.40 | 22,046.94 | 30.77 |
| U.S.A. | 16,496.00 | 11,943.73 | 20,859.26 | 16,456.75 | 13,590.87 | 20,494.18 | 28.61 |
| Australia | 9,921.86 | 6,976.34 | 9,258.69 | 8,440.94 | 4,786.83 | 7,545.98 | 10.53 |
| Netherlands | 2,429.66 | 3,029.51 | 2,959.65 | 3,854.77 | 4,086.20 | 7,110.79 | 9.93 |
| Germany | 2,951.02 | 2,123.23 | 3,170.54 | 2,675.20 | 3,143.73 | 4,015.04 | 5.60 |
| Other countries | 5,104.50 | 3,946.18 | 3,893.58 | 4,435.27 | 9,061.30 | 10,427.98 | 14.56 |
| Total | 48,046.18 | 39,541.82 | 51,372.95 | 49,509.20 | 45,841.33 | 71,640.90 | 100.00 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

Table 2.26 Thailand top five import sources for butter and butterfat from 2005 to 2007

| Country | Year | | | | | | |
|-----------------|------------------|------------------|------------------|------------------|------------------|------------------|---------------|
| | 2005 | | 2006 | | 2007 | | |
| | Quantity | Value | Quantity | Value | Quantity | Value | % Share |
| | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | |
| New Zealand | 3,643.13 | 9,525.01 | 7,632.72 | 16,618.85 | 6,487.00 | 17,000.93 | 54.94 |
| Australia | 3,846.83 | 10,029.76 | 4,416.45 | 9,168.66 | 3,172.62 | 8,240.78 | 26.63 |
| Netherlands | 975.00 | 2,632.32 | 160.01 | 388.77 | 512.00 | 1,610.17 | 5.20 |
| Argentina | - | - | - | - | 301.80 | 1,218.23 | 3.94 |
| France | 392.07 | 1,080.74 | 111.59 | 365.14 | 149.30 | 656.25 | 2.12 |
| Other countries | 2,541.37 | 6,692.53 | 544.42 | 1,754.86 | 666.81 | 2,220.68 | 7.18 |
| Total | 11,398.40 | 29,960.36 | 12,865.19 | 28,296.27 | 11,289.53 | 30,947.04 | 100.00 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

Table 2.27 Thailand top five import sources for cheese and curd from 2005 to 2007

| Country | Year | | | | | | |
|-----------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|---------------|
| | 2005 | | 2006 | | 2007 | | |
| | Quantity | Value | Quantity | Value | Quantity | Value | % Share |
| | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | (Tonnes) | (1,000 USD) | |
| Australia | 930.77 | 3,404.48 | 1,400.51 | 4,603.15 | 1,869.39 | 7,066.10 | 35.14 |
| New Zealand | 1,200.53 | 3,737.89 | 1,505.71 | 4,959.45 | 1,769.57 | 6,259.88 | 31.13 |
| Denmark | 160.02 | 887.17 | 223.54 | 1,044.23 | 281.69 | 1,573.61 | 7.83 |
| Netherlands | 94.39 | 461.63 | 189.05 | 916.21 | 189.43 | 1,102.93 | 5.48 |
| France | 81.34 | 606.97 | 86.65 | 702.12 | 122.02 | 1,019.13 | 5.07 |
| Other countries | 394.54 | 1,765.57 | 582.44 | 2,608.85 | 613.59 | 3,086.63 | 15.35 |
| Total | 2,861.59 | 10,863.72 | 3,987.90 | 14,834.01 | 4,845.68 | 20,108.28 | 100.00 |

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

2.8 Structural and Behavioural Aspects of Dairy Exporters in New Zealand and Australia

New Zealand was the world's largest exporter of dairy products (35 percent world market share) in 2009, followed by the European Union (32 percent) (PricewaterhouseCoopers Foundation, 2011). Approximately 95 percent of New Zealand total dairy product is for export. The most important dairy export is concentrated milk and cream particularly whole milk powder and skim milk powder (58 percent of New Zealand total dairy exports), followed by butter (21%) and cheese and curd (11%). Buttermilk and yoghurt, whey and non-concentrated milk and cream have a small share of New Zealand total dairy exports (New Zealand Trade and Enterprise, 2012).

In the past, all dairy products manufactured in New Zealand were exported by New Zealand Dairy Board (NZDB). The NZDB was a single desk exporter which was accused of monopolistic behaviour in foreign dairy markets (Dobson, 1997; Evans, 2004; Conforte *et al.*, 2008). The NZDB practised price discrimination on cheese exported to the U.S. and butter to the EU quota market. The NZDB sold these dairy products in the U.S and EU at premium prices while sold similar products in other markets at lower prices (Dobson, 1997). Since 2001, New Zealand has reformed the dairy industry due to the establishment of the Dairy Industry Restructuring Act 2001. This Act is associated with the removal of the single seller status of the NZDB and the establishment of Fonterra Cooperative Group by merging two large cooperatives – the New Zealand Cooperative Dairy Company Limited and Kiwi Cooperative Dairies Limited (Evans, 2004; Conforte *et al.*, 2008).

The Fonterra Cooperative Group dominates New Zealand dairy industry, processing 96 percent of the total domestic raw milk and exporting 95 percent of the dairy products (as the world's largest exporter) (Conforte *et al.*, 2008). Apart from the Fonterra Cooperative Group, there are few dominant dairy manufacturing and exporting companies in New Zealand including Westland Cooperative Dairy Company, Tatura Cooperative Dairy Company, Open Country Cheese Company, Goodman Fielder and Synlait (Conforte *et al.*, 2008). Although the removal of single desk restriction has opened entry possibilities to other dairy firms, but the merger of the two large cooperatives into a single firm, the Fonterra Cooperative Group, has inhibited competition in the market (Evans, 2004).

Australia produces a range of dairy products including fluid milk, milk powder, buttermilk and yoghurt, whey, butter and cheese and curd. Approximately 50 percent of Australian total dairy production is exported, accounting for 10 percent of global dairy export in 2009.

Australia is the third largest exporter of dairy products in the world (PricewaterhouseCoopers

Foundation, 2011). The main Australian dairy exports are cheese (34% of Australian total dairy exports) and milk powder (33%) in 2004. The export share for other dairy products is small. The main export markets for Australian dairy products are Japan, Singapore, China, Indonesia and Malaysia (Jesse, 2005; PricewaterhouseCoopers Foundation, 2011).

During the 1980's and 1990's, individual State dairy corporations controlled milk quality, production and price for fluid milk sector in their own jurisdiction. In addition, Australian Dairy Corporation (ADC) and commercial dairy companies involved heavily in Australian dairy trade. The ADC had statutory powers to control Australian dairy exports in respect to quality, quantity, price and payment in four dairy markets including cheddar cheese in the EU quota, variety cheeses in the U.S. quota, the bulk cheese in Japan and the bulk butter and skim milk powder in Japan (Industry Commission, 1991; PricewaterhouseCoopers Foundation, 2011). Since the deregulation of the dairy industry in 2000, the statutory monopoly power in Australian domestic and exporting markets has been ended. Australian milk processing sector has since been participated by a diverse group of corporate structures such as farmer-owned cooperatives, private and multinational companies. The largest dairy processing cooperative in Australia is Murray Goulburn Cooperative which processes 35 percent of Australian total milk production. Major private and multinational companies are National Foods, Parmalat, Fonterra, Bonlac, Warrnambool Cheese and Butter and Bega Cheese (Jesse, 2005; Bartos and Davey, 2011).

Chapter 3

Regional Trade Integration Theories and Empirical Studies

This chapter reviews the relevant literatures on theories of Regional Trade Agreements (RTAs) and economic impacts of RTAs. The chapter consists of five sections. Section 3.1 provides an overview of international trade theories. Section 3.2 briefs the historical evolution of regional trade integration theories. Section 3.3 describes the static welfare analysis. Empirical studies on the economic effects of RTAs are discussed in Section 3.4. Empirical studies on trade liberalisation on dairy industries are described in Section 3.5.

3.1 An Overview of International Trade Theories

The economy of each country is linked to other countries by international trade. International trade has become an important engine for economic growth globally. According to Krugman and Obstfeld (1997), countries involve in international trade because of two main reasons. Firstly, countries trade because they differ from each other in terms of resources availability. Therefore, each country produces different products and they can gain from their differences. Secondly, countries trade in order to achieve economies of scale in production. If each country produces and exports a limited choice of products, it can produce at a larger scale and hence more efficiently than if it tries to produce everything in a smaller scale. Trade theories explain how countries trade and gain from trade. This section describes the development of international trade theories, gains from trade and trade under trade barriers.

The traditional trade theory was originated by Adam Smith (1776) in his seminal work, *The Wealth of Nations*. Smith explained that two nations gain from trade when trade between them is based on the concept of absolute advantage. A country exports a product in which the country is more efficient in the production than another country or has an absolute advantage, and imports a product in which the country is less efficient in the production than another or has an absolute disadvantage. Smith also stated that all countries will gain simultaneously if they trade freely and specialise in producing according to their absolute advantage (Salvatore, 2004)

David Ricardo (1817) argued that it is possible for a country to have absolute advantage in every product, then the concept of absolute advantage does not indicate the pattern of trade (Lawler and Seddighi, 2001). In order to remove the shortcoming of the absolute advantage principle, Ricardo presented the concept of comparative advantage in describing international

trade. A country has a comparative advantage in producing a good if the opportunity cost of producing that good in terms of other goods is lower in that country than in other countries. Trade between two countries is beneficial if each country exports the good in which it has a comparative advantage or a lower opportunity cost than another, and imports the good in which it has comparative disadvantage or a higher opportunity cost than another. In the Ricardian trade model, labour is the only factor of production, and the opportunity cost of a product in terms of another product is the ratio of unit labour requirements (the productivity of labour) in producing two different goods in two countries (Krugman and Obstfeld, 1997; Lawler and Seddighi, 2001).

According to Wreford (2006), Ricardian gains from trade can be described by a country's production possibility frontier (PPF) and indifference curve (IC) as shown in Figures 3.1 and 3.2. The PPF represents the supply side and the IC represents the demand side. In Figure 3.1, a country's equilibrium under autarky is demonstrated at point A, where the production possibility frontier (PPF), the indifference curve (IC_1) and the price ratio (P_a) are tangent to each other. Equilibrium occurs when three conditions are met: (1) the consumer's marginal rate of substitution (the slope of the indifference curve) is equal to the price ratio, which would maximize consumer's utility; (2) the producer's marginal rate of transformation (the slope of the production possibility frontier) is equal to the price ratio, which would maximize producer's profit; and (3) the quantity of each good produced is equal to the quantity of consumed. Therefore, the domestic production and consumption equilibrium of the combination of two goods, say wine and cheese occurs at point A (see Figure 3.1).

Trade allows each country to reach the specialization in producing the good in which it has a comparative advantage, then exports some of this good and imports what it does not have a comparative advantage in production. With a given amount of resources, each country's consumption is increased by trading. The increase in consumptions from trade is illustrated in Figure 3.2. Under free trade, the price line PT represents the international price ratio (the international terms of trade), showing cheese being relatively cheaper in the home market than the international market. In this case, the home country has a comparative advantage in cheese therefore it will reallocate resources from wine production to cheese production until the equilibrium move from point A to point B, where the marginal rate of transformation in production is equal to the international terms of trade. The country can export cheese and import wine in any combination along the price line PT .

The highest possible indifference curve (IC_2) is tangent to the price line PT at point C. At this point, the marginal rate of substitution in consumption is equal to the international terms of

trade, where consumers maximize utility. Thus, the movement from indifference curve (IC1) to indifference curve (IC2) shows the gains from trade.

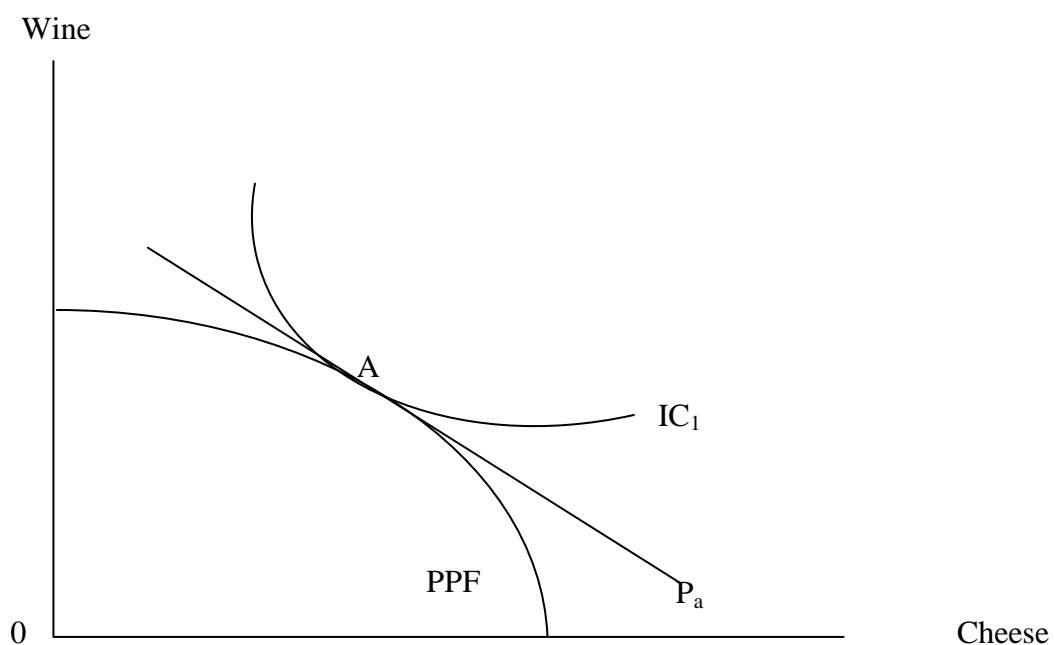


Figure 3.1 Equilibrium under autarky

Source: Wreford (2006)

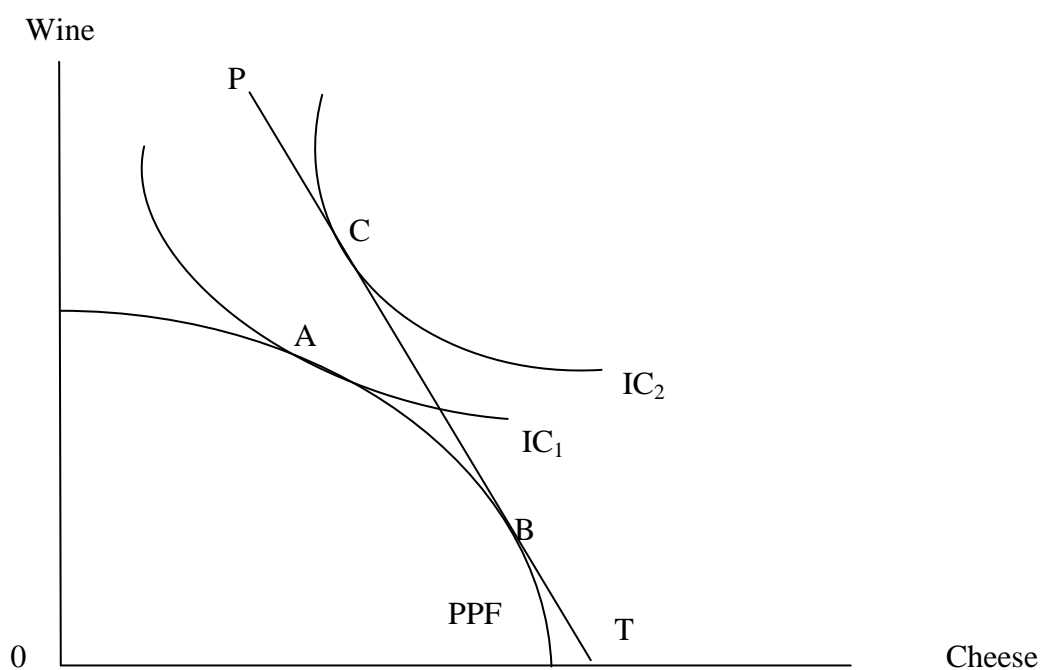


Figure 3.2 Equilibrium under free trade

Source: Wreford (2006)

The Ricardian theory has been an influential principle in the international trade theory, however, the theory fails to determine the price or the terms of trade because it focuses on only the production side. Therefore, economists have tried to refine Ricardian trade theory further. For example, Mill (1920) employed the demand concept in the international trade analysis. Mill pointed out that the trade price or the terms of trade is determined by the interaction of demands for different products of the trading partners within the production possibility frontier established by Ricardo. Besides, Mill's model is presented with an equation of international demand known as the theory of reciprocal demand. This is one of the earliest examples of general equilibrium analysis in trade theory (Wreford, 2006). Marshall (1930) improved the theory of reciprocal demand by including both the interaction between demand and supply of two countries to derive the terms of trade and offer curves. The offer curve (the Marshall's reciprocal demand) of a nation shows the locus of all points which represent the exchange quantity of the exported good of the country to obtain a given amount of the imported good, and equivalently indicates the various terms of trade at which the country is willing to trade (Gandolfo, 1994).

Heckscher (1919) and Ohlin (1933) pointed out that there are differences in countries' factors of production and factor proportion in producing different goods. The Heckscher-Ohlin (H-O) model is based on the comparative advantage concept which is influenced by the interaction between the nations' resource abundance and the factor proportions in production. The abundance of factors of production determines a country's trading pattern. For example, a country with an abundance of labours tends to produce labour-intensive products for export, while a capital-abundant country exports capital-intensive products. The H-O model is also known as the factor-proportion theory, which focuses on the initial factor endowment but ignores changes in factors of production. The H-O model has been a dominant static model in international trade theory (Krugman and Obstfeld, 1997; Zhang, 2008).

Stolper and Samuelson (1942) further explained using the H-O framework the relationship between the relative prices of output commodities and relative factor returns. An increase in the relative price of a commodity results in a rise in the real return of the factor used intensively in the production of the commodity, but leads to a decrease in the real return of the other factor. As a result, Stolper and Samuelson's explanation leads to the following theorem known as the factor-price equalization theorem, which was developed by Lerner (1952) and Samuelson (1948, 1949) (Rasin, 2006). The theorem of factor price equalization is based on the framework of H-O model but it assumed that the international factor mobility is possible. For instance, labour-abundant countries transfer their labour resources to labour-shortage

countries while capital-abundant countries export their capital to capital-scarce countries. Therefore, factor prices are equalized between the countries (Lawler and Seddighi, 2001; Salvatore, 2004).

Rybczynski (1955) emphasized that a change in a country's factor endowment directly affects the output of the final good. Rybczynski theorem displayed that if there is an increase in the factor endowment with constant relative goods prices, the output of the good which uses that factor intensively will increase, and the output of the other good will decrease (Zhang, 2008).

Traditional trade theories described above were limited and unrealistic due to the existence of trade assumptions, such as constant technology, perfect competition and constant returns to scale of production. In order to improve the explanation of international trade, trade theorists have relaxed some of the original assumptions. New trade theories have emerged since 1960 focusing on two different approaches. Firstly, trade models are influenced by neoclassical growth theory with capital accumulation introduced by MacDougall (1960), Kemp (1964) and Oniki and Uzawa (1965). These models are used to analyse the interdependence between trade pattern and economic growth. In addition, Romer (1986) and Lucas (1988) developed trade models with the new growth theory related to endogenous knowledge accumulation. Wang (1992) introduced a two-country dynamic model to investigate the relations among growth, technological changes, and international capital movements. Secondly, imperfect competition market and increasing returns to scale of production are included in new trade theories. Dixit and Stiglitz (1977) and Krugman (1989, 1990) developed trade models with the existences of the market structure of monopolistic competition and increasing returns to scale. Ethier (1979, 1982) and Francois (1994) also considered increasing returns to scale of production in international trade models (Zhang, 2008).

According to Zhang (2008), it is difficult to construct new trade theory models tractable in dynamic sense. Most of the formal dynamic models in the new trade theory omit endogenous physical capital (Zhang, 2008). The new trade theory models were developed from the H-O framework and previous empirical studies employed the Ricardian principle and the H-O model to explain international trade.

Free trade is not perfect in the real world because many countries protect their domestic industries through trade barriers, such as import tariffs, import quotas, voluntary export restraints, and export subsidy. These trade protection policies reduce the efficiency of world resources and world welfare. The General Agreement on Tariffs and Trade (GATT) or now World Trade Organization (WTO) encourages countries to reach multilateral and non-

discriminatory trade liberalisation. Regional trade integration has been widely used as free trade policies among members of the GATT/WTO. On the other hand, Okamoto (2001) argued that traditional RTAs in the 1960s, such as CUs and FTAs led to stagnation in multilateral trade liberalisation process of the GATT/WTO. This results in the breakdown of RTAs in the first period. In recent years, there has been a proliferation of FTAs among WTO members again. The analysis of the effect of FTAs is predominantly based on the economic theory of regional integration agreements.

3.2 Development of Regional Trade Integration Theories

The formation of regional trade integration (RTA) around the world leads to the controversy on its economic impacts. The evolution of regional trade integration can be described into two phases. The first RTA occurred during the 1950s and early 1960s, such as South Africa-South Rhodesia Customs Union, Central American Free Trade Area, European Economic Communities (EEC), European Free Trade Association (EFTA), and Latin American Free Trade Area (LAFTA). The first RTA involved only the reduction or elimination of trade barriers in commodities within the regional bloc (Burfisher, Robinson, and Thierfelder, 2003). They typically provide free trade among member countries while protects producers inside against outsiders. Economists questioned whether RTAs are beneficial to their members and world welfare (Bhagwati, Greenaway, and Panagariya, 1998). The theoretical analysis of RTA is developed from the theory of Customs Unions (CUs) discussed among Jacob Viner (1950), James Meade (1955), Richard Lipsey (1957), Harry Johnson (1960), Robert Mundell (1964) and Kemp and Wan (1976). These works measured economic effects of RTAs based on static analysis (Bende-Nabende, 2002; Burfisher *et al.*, 2003). However, the controversy of the economic impacts of regional integration remained unclear and unanswered. By the end of 1960s, most RTAs collapsed, except for the EEC and EFTA (Bhagwati, 1999).

Regional integration revived in the 1980s when the United States embraced RTAs as methods of reducing trade barriers to achieve the goal of multilateral free trade under the General Agreement on Tariffs and Trade (GATT). The World Trade Organization (WTO) formerly known as GATT has encouraged multilateral free trade among members through Multilateral Trade Negotiations (MTNs) under Most Favored Nation (MFN) principle. Non discriminatory RTAs are deemed to be policy methods of MTNs. As a result, there has been a proliferation of RTAs among its members, especially in terms of Free Trade Agreements (FTAs). This phase is called the second waves of RTAs, which are deeper integration, involving agreements in commodity trades, services and investment. The difference in the first and the second

regionalism lead to new controversies in the economic analysis of RTAs (Burfisher *et al.*, 2003).

Recent theoretical analysis of RTAs focused on dynamic approach in the relationship between regionalism and multilateralism. Trade economists doubted whether the proliferation of RTAs accelerates or decelerates MTNs under GATT. For example, Bhagwati (1991) questioned whether RTAs are building blocks or stumbling blocks to multilateral free trade. Baldwin (1993), Levy (1997), and Krishna (1998) also developed political-economy-theoretic models to examine the relation between RTA and multilateral time-path.

Although, the economic integration can generate long-run effects to its members including resource reallocation, specialisation, structural changes, and economic growth, but there is no formal theoretical framework to analyse these long-run effects in the previous dynamic time-path analysis (Jayasinghe, 2003). Static analytical approach may ignore many impacts associated with the new regionalism. However, it is still widely use in empirical studies of the new regionalism, focusing on trade creation, trade diversion and terms of trade effects.

3.3 Static Welfare Analysis

There are two significant analytical approaches to the static welfare analysis of RTAs. The first approach is the concepts of trade creation and trade diversion by Viner (1950), Meade (1955), Lipsey (1957), Johnson (1960) and Mundell (1964). The latter is Kemp-Wan's (1976) approach on welfare-improving customs union.

3.3.1 Trade Creation and Trade Diversion

The static welfare analysis of RTAs was pioneered by Viner in 1950. In Viner's (1950) classic book, *The Customs Union Issue*, the author introduced the concepts of trade creation and trade diversion for measuring the economic effects of CUs. Viner's model was based on a three-country, two-good partial equilibrium framework under the assumptions of infinite supply elasticity and zero demand elasticity. Viner focused on shifts in given volume of trade and production among member and non-member countries of the RTA but excluded consumption effects (Bhagwati, Krishna and Panagariya, 1999; Jayasinghe, 2003; Viner, 1950).

The essential contribution of the Viner's work demonstrates that a discriminatory RTA could be harmful for both a member country and the world welfare. The RTA produces trade creation in some products and trade diversion in others. Therefore, the welfare outcome can be welfare enhancing or reducing depending on the relative magnitudes of trade creation and

trade diversion. The Vinerian conclusion is contradictory to the pre-Vinerian approach, which shows that any form of regionalism should be welfare improving and move to worldwide free trade (Bhagwati and Panagariya, 1996; Jayasinghe, 2003; Viner, 1950).

Meade (1955) initially developed a three-good, three-country general equilibrium model with vertical supply and downward sloping demand functions. Meade measured the welfare effect of RTAs on the union and individual union members under the assumption of fixed terms of trade. Meade argued that Viner's conclusion on the magnitudes of trade creation and diversion are inadequate to capture the welfare effects. Gains of RTA in Meade's model are determined by not only the magnitude of trade creation, but also the amount of cost reduction because of trade creation. In the same way, losses come from both the magnitude of trade diversion and increasing cost due to trade diversion. Besides, the formation of RTAs may result in world welfare improvement or reduction, depending on the initial levels of tariff on the goods (Bhagwati *et al.*, 1999; Jayasinghe, 2003; Meade, 1955).

Viner's (1950) and Meade's (1955) studies on the effects of RTAs were descriptive and lacked of graphical analysis and formal models. Lipsey (1957) initially applied graphical analysis to analyse the effects of RTAs using a three-country, two-good general equilibrium model. Lipsey's graphical analysis assumed that a demand curve is downward-sloped and a supply curve is horizontal. Lipsey disputed that the exclusion of consumption effects of Viner's analysis leads to an inaccurate conclusion in welfare effects. Lipsey pointed out that after forming a union, the relative prices in the domestic markets of member countries change because of the removal of tariffs on imports among member countries. These price changes generate two important effects. First, they affect the shift in production sources from a lower-cost non-member country to a higher-cost union partner. This is called production effects of union similar to Viner's approach. Second, the consumption effects of union, where union member countries will increase their product consumption while reduce imports from non-member countries. Lipsey concluded that the gain in consumption owing to a reduction in the import price by a union member might outweigh the loss from switching production sources of imports from a lower-cost non-member country to a higher-cost union partner (Bhagwati *et al.*, 1999; Jayasinghe, 2003; Lipsey, 1957).

Johnson (1960) employed a downward sloping demand curve and constant-cost supply curve. The author agreed with Lipsey's definition of trade creation and trade diversion which consider both production and consumption effects. When a Customs Union is formed, a member country shifts its consumption from higher-cost domestic products to lower-cost imports from its partner country. This shift represents trade creation or economic gain of the

Customs Union which consists of two parallel effects: the production effect; a reduction in the real cost of goods due to the replacement of higher-cost domestic products with lower-cost partner imports, and the consumption effect; an increase in consumers' surplus from the replacement of higher-cost domestic products with lower-cost partner imports. In addition, the formation of the Customs Union results in a shift in the source of imports from lower-cost foreign to higher-cost partner countries. This shift represents trade diversion or economic loss of the Customs Union which comprises both production and consumption effects. The production effect is an increase in the real cost of goods from the substitution of higher-cost partner imports for lower-cost foreign products, and the consumption effect is a reduction in consumers' surplus from the substitution of higher-cost partner imports for lower-cost foreign products.

The net welfare effect of the Customs Union is the sum of trade creation and trade diversion effects (Johnson, 1960). The redefinition of trade creation and trade diversion by Johnson (1960) is a more direct and natural analysis of the welfare effects of the Customs Union than Viner's and Lipsey's approaches (Bhagwati *et al.*, 1999; Jayasinghe, 2003).

In addition to trade creation and trade diversion, Mundell (1964) pointed out that the welfare effects of a RTA depends on the changes in the terms of trade among members, and between the RTA members and the rest of the world. The author employed the three-goods Meade (1955) model and a neat geometric technique to examine the terms of trade effects after the formation of a RTA. The model consists of three countries and three products. Each country exports one product and imports the remaining two. Then, country 1 and country 2 form a RTA and reduce a small tariff preference for imports among them while both countries still impose tariffs on imports from country 3 as initial levels. Mundell demonstrated that a discriminatory tariff reduction granted by a member country leads to an increase in the terms of trade of the partner country with respect to both the tariff-reducing member country and the rest of the world. But the change in the terms of trade of the tariff-reducing member country with respect to the rest of the world may increase or decrease. Mundell concluded that the level of improvement in the terms of trade of the partner country is larger, the greater the member's tariff reduction. In other words, the member's gain from a RTA is larger, the higher the initial tariffs of the partner country (Bhagwati *et al.*, 1999; Mundell, 1964).

DeRosa (1998) described the basic Viner model to a more general model with downward-sloped demand and upward-sloped supply functions. The model consisted of two goods and three countries. The author concluded two important implications. First, if member countries of an RTA are the least-cost exporters, the RTA will bring trade creation and will increase

welfare certainly. Second, if one or more member countries are inefficient exporters, the net welfare effect of RTA is ambiguous depending on the magnitude of gains from trade creation and tariff revenue losses from trade diversion.

3.3.2 Making a Necessarily Welfare-Improving Customs Unions (CUs)

Kemp and Wan (1976) presented an influential discussion on effects of the formation of Customs Union (CUs) that if the trade with the rest of world remains stable as it was before the formation of a CU, the welfare of the CU partners is improved while the welfare of the rest of the world is unchanged. Therefore, the formation of the RTA leads to a Pareto improvement. In the welfare analysis after removing intra-union trade barriers, Kemp and Wan assumed that the external tariff of the CU is adjusted endogenously and the external union trade flow is given at the initial level. In contrast, Viner fixes the external tariff at the initial level and the external union trade flow is adjusted endogenously (Bhagwati *et al.*, 1999; Jayasinghe, 2003).

Kemp and Wan's (1976) implementation confronts two significant operational problems. One has to devise the common external tariff and another one has to figure out the design of lump-sum compensation among members. In practice, the Vinerian approach provides the natural framework and clear distinction between trade creation and trade diversion. Therefore, Vinerian approach is more influential in trade policy analysis than the Kemp-Wan approach. (Bhagwati *et al.*, 1999; Jayasinghe, 2003). Similarly, Burfisher *et al.* (2003) concluded that the Vinerian framework is prevalently employed to capture trade effects in the static approach because it is well established, coherent theoretical structures and comfortable to use.

3.4 Empirical Studies of the Economic Impacts of Regional Trade Agreements

There are a variety of approaches to assess the impact of RTAs on trade and welfare effects. This can be classified into two main approaches including *ex ante* and *ex post* approaches (Elliott and Ikemoto, 2004; Romalis, 2007). Both approaches have differences in study time periods and methods.

3.4.1 The *Ex Ante* Approach

The *ex ante* approach is used for predicting or simulating the impacts of free trade agreements on trade flows and welfare effects. Two prevalent techniques are employed to measure trade and welfare effects in *ex ante* studies such as the computable general equilibrium (CGE) models and partial equilibrium (PE) models. The CGE models are used for predicting the

effects of RTAs on aggregate level and do not allow analysis of specific markets (Elliott and Ikemoto, 2004; Jayasinghe and Sarker, 2004). The CGE model uses the maximization technique to analyse welfare function under constraints such as demand, supply, economic and resource limitations.

The PE models are employed to capture the impacts of RTAs on the disaggregate economy level or specific markets. The PE model of a particular commodity includes details about domestic demand, domestic supply, import demand, import supply and price linkage equations. The model can be a single market, single region, multi-market and multi-region PE models (Francois and Hall, 1997; Parham, 1998; Roy, 2001; Wijegunawardane, 2002). The PE models are suitable for measuring specific studies which require in-depth details and are applicable for decision-making in a particular commodity (Parham, 1998).

Although both models have been extensively used to measure the effects of RTAs on trade and welfare effects, they have many drawbacks including an excessive information requirement, based on older data and unrealistic baseline scenarios (McKittrick, 1998; Wall, 1999; AlBulaih, 2001; Jayasinghe and Sarker, 2004). In addition, database systems of developing countries are unreliable, so it is complicated and difficult to construct the CGE or PE model (AlBulaih, 2001).

3.4.2 The *Ex Post* Approach

The *ex post* approach focuses on the impact assessment of RTAs after implementation of the agreements. The *ex post* studies employ econometric models to capture the effects of RTAs on trade patterns and welfare effects by using pre- and post-RTAs trade data (Jayasinghe and Sarker, 2004).

The gravity model was first applied to an international trade study by Tinbergen (1962) cited in Wall (1999). The initial gravity equation expresses that the export volume between any two trading partners is directly related to their Gross Domestic Products (GDPs) and inversely related to their bilateral distance in log-linear form. It can also examine contiguity effects: cultural and historical factors, and regional integration with dummy variables in the model.

The basic gravity model excludes price variables and does not allow for measuring welfare effects (Wall, 1999; Elliott and Ikemoto, 2004). Researchers try to modify the gravity models by decreasing the limitations. For example, a study by Aitken (1973) was the first empirical analysis to capture trade creation and diversion by adding a regional dummy into the gravity model. The estimated coefficient of the dummy is taken to identify trade creation and

diversion of European Economic Community (EEC) and European Free Trade Association (EFTA). The result shows that the EEC and EFTA lead to gross trade creation on members, with the trade creation of the EEC being larger than the EFTA.

Matyas (1997, 1998) and Egger (2000) pointed out that a panel approach provides a more efficient estimation than a cross-section approach, because the panel method helps to unravel the time and the cross-section dimension effects. In addition, the parameters in the gravity models are estimated by the country-pair fixed effect method because this method can control for omitted variables, which are unobservable or difficult to measure such as cultural similarities, geographical and historical links (Wall, 1999).

Coulibaly (2004) examined trade creation and trade diversion effects of developing RTAs by using an extended gravity model. A two-stage estimation procedure is employed to analyse the export equation. The result shows that the Economic Community of West African States (ECOWAS) and the South Asian Preferential Trade Agreement (SAPTA) have net trade creations while ASEAN Free Trade Agreement (AFTA), the Andean Community (CAN), the Southern Common Market (MERCOSUR) and the South African Development Community (SADC) have net trade

Elliott and Ikemoto (2004) used a modified gravity equation to examine the effects of ASEAN Free Trade Area (AFTA) on trade flows of its member and non-member countries in the periods before and after signing of AFTA as well as the periods before and after the Asian crisis. The bilateral import value is a function of GDP, per capita GDP, distance, a complementary index between the two countries and dummy variables for land border and AFTA membership. The result shows that the coefficients of GDP, per capita GDP and complementary index are positive sign and highly significant while distance is negative sign. The dummy variables for border land and AFTA membership are significantly positive. Although, the degree of the effects of AFTA on trade flows (trade creation effects) decreases in the years immediately after the establishment of AFTA but it increases significantly in the subsequently period. In addition, the authors find that the Asian economic crisis affects region.

Most studies use the gravity model to capture the effects of FTAs on the aggregate trade level. However a few studies focus on group levels. For example, Jayasinghe and Sarker (2004) used the gravity model to capture the effects of NAFTA on bilateral trade in six major agri-food products including red meat, grains, vegetables, fruits, sugar, and oil-seeds. The authors employ pre-and post-NAFTA agri-food data, from 1985 to 2000 and estimate the gravity

equation of each product group using the pooled cross sectional time-series regression for three-year intervals. The total bilateral trade of the six products is related to GDP, per capita GDP, distance between two countries, a regional bloc dummy and an openness dummy. The result shows that the estimated coefficients of GDP for the six products are positive sign while the estimated coefficients of per capita GDP are mix sign. The distance has a negative effect on bilateral trade in the six products. Interestingly, the authors define the two dummy variables to capture trade creation and diversion of the NAFTA. After the formation of the NAFTA, agri-food product trades within NAFTA have increased while agri-food product trades with the rest of the world have decreased especially in red meat, vegetable, grain, and sugar trades. This indicates that NAFTA creates trade between its members and diverts trade from the rest of the world.

Some *ex post* studies are based on the partial equilibrium framework focusing on import demand and export supply models. For example, Romalis (2007) investigated the effects of NAFTA on trade volumes, prices and welfare. The author uses world-wide trade data at the Harmonized System 6-digit level to estimate demand and supply elasticities. The result shows that supply and demand are highly elastic to price changes. The impact of NAFTA on trade volumes is substantial while the effect on prices and welfare is insignificant.

Fukao, Okubo and Stern (2002) examined trade diversion under NAFTA using panel data of U.S. imports based on the Harmonized System 2-digit level from 1992-98. They employ the country fixed-effect model to estimate the U.S. import share equation. Explanatory variables of the model include wage rates of exporting countries, U.S. tariff rates against each exporting country, the export share of exporting countries to the U.S. and NAFTA dummy. The authors found that NAFTA leads to substantial trade diversion especially in textiles and footwear products.

Karemera and Koo (1994) investigated trade creation and diversion effects of the U.S. and Canadian Free Trade Agreement (FTA) using a SUR model. The authors estimate a dynamic import demand model of both countries, by each commodity group, based on the Standard International Trade Classification (SITC). The SUR model is used to estimate the import demand elasticities. The calculation of trade creation and trade diversion magnitude is based upon Verdoorn's method (1960). Their result shows that U.S. imports from Canada have more impact on their domestic and import prices than Canadian imports from the United States. Following the elimination of trade barriers, total U.S. imports from Canada are much greater than total Canadian imports from the United States. Considering each product group, the greatest increase of U.S. imports from Canada are from the machinery and transportation

equipment sector, while the majority of Canadian imports from the U.S. are consumer end products.

Winters and Chang (2000) estimated the effect of Spanish accession to the European Communities (EC) on the Spanish import prices of finished manufactures from main OECD suppliers. The authors employed panel data across main OECD suppliers between 1970 and 1993 and estimated the data with panel estimation. They introduced the import price ratio of non-EC member and EC member to capture the effect of the Spanish accession to the EC on non-EC member prices. The authors found that the Spanish accession to the EC decreased the prices of the non-EC member exports to Spain relative to the EC member exports.

Clausing (2001) examined the impact of the Canada-United States Free Trade Agreement (CUSFTA) on the trade growth of member and non-member countries. This study uses panel data from 1989 to 1994. The dependent variable is the percent change in U.S. imports from Canada. The explanatory variables include tariff change, market share of Canada, and year dummy. Year dummy variables are used to capture the effects of income and exchange rate changes. The author found that the CUSFTA leads to trade creating on U.S. from Canada, increasing approximately 26 percent.

Chang and Winters (2002) argued that the effect of regional trade preferences should look at trade price changes on member and non-member countries. The authors examine the effects of MERCOSUR on the export prices of non-member countries to Brazil. They pool all commodities data based on HS 6-digit level and estimate a two-step Feasible Generalised Least Squares (FGLS) estimation. Their result indicates that there are significant decreases in the export prices of non-member countries to Brazil caused by the creation of MERCOSUR. In other words, tariff reductions on Brazilian imports from its members lead to price declines of other exporters.

3.5 Empirical Studies of Trade Liberalisation on Dairy Industries

Most dairy trade studies are *ex ante* studies which use the PE models to capture impacts of trade liberalization on dairy industries. The dairy trade studies are classified into two main empirical models assessing the consequences of trade policy changes. The two models include the spatial equilibrium model and a non-spatial equilibrium model.

The spatial equilibrium model is an optimisation technique used for solving equilibrium analysis under an objective and constraint function. The model includes maximisation of a quasi-welfare function subject to demand and supply constraints (Larivière, 1999). This

technique is widely used to assess impacts of trade policy changes on dairy products. For example, Zhu, Cox and Chavas (1999) employed a similar technique to measure the effects of the Uruguay Round Agreement and full trade liberalisation on the world dairy sector. Similarly, Peng and Cox (2005) captured economic impacts of trade liberalisation on the Asian dairy market using a hedonic spatial equilibrium model, which reflected vertical and spatial linkage of dairy products.

The non-spatial equilibrium model includes a set of domestic supply and demand, net trade and price linkage equations (Parham, 1998). Multi-market and multi-region partial equilibrium frameworks are popular to capture the impacts of dairy trade liberalisation. For example, Larivière (1999) measured the effects of market access and export subsidy reforms on the world dairy markets using the AGLINK model. Similarly, Saunders, Cagatay and Moxey (2004) developed the LTEM model based on the SWOPSIM modelling framework to evaluate the economic and environmental impacts of global dairy trade liberalisation. Langley, Somwaru and Normile (2006) used the non-spatial multi-market and multi-region frameworks to estimate the impacts of trade liberalization on international dairy markets.

Some studies investigate the effects of trade liberalisation on the Thai dairy sector. For example, Pue-on (2005) examined the impacts of tariff reduction on Thai agricultural imports from New Zealand including malt extract, milk and cream, sawn wood, tuna and wool. Import demand equations are estimated by using the OLS method. The estimated price elasticities are used to calculate trade creation based on Baldwin and Murray's (1977) method. This result shows that the price elasticities of malt extract, sawn wood, tuna and wool are elastic while milk and cream are inelastic. Trade creation of all imports from New Zealand increases 4.86 percent after tariff elimination.

Khorchurklang (2005) examined factors influencing Australian dairy product exports to Thailand. The author estimates demand equations for three SITC categories of Australian dairy exports to Thailand, i.e., 022 milk powder, 023 butter and 024 cheese and curd. Demand for Australian dairy exports to Thailand is determined by prices of Australian dairy products, average dairy product export prices of competitor countries, Thailand GDP, the exchange rate of Thai baht against Australian dollar, import tariff reduction dummy and Asian financial crisis dummy. The unrestricted error correction model is used to estimate short-run and long-run elasticities of the independent variables. Khorchurklang found that tariff reduction does not influence demand for Australian dairy exports to Thailand.

The existing literature does not focus on *ex post* impact of FTAs on Thailand dairy trade. The gravity model is widely used to forecast bilateral trade flows and to capture *ex post* impact assessment of FTAs because it is a simple and robust empirical model based upon theoretical frameworks of international trade such as the Ricardian and Heckscher-Ohlin-Samuelson models (Anderson, 1979; Bergstrand, 1985; Deardorff, 1998; Wall, 1999; DeRosa and Gilbert, 2005). Moreover, Jayasinghe and Sarker (2004) introduced an augmented gravity model to examine the effects of RTAs in terms of trade creation and diversion through dummy variables. The augmented gravity model can analyse both aggregate and disaggregate trade data levels. Aggregate trade creation and diversion are inadequate to explain the welfare effects of RTAs on specific products because there are different structures across product categories. Hence, focusing on disaggregate or commodity levels may indicate more accurate effects (Jayasinghe and Sarker, 2004).

This study employs the gravity model to capture the effects of THNZCEP and TAFTA on Thai dairy products. In addition, our study also examines the adjustment in dairy import prices from non-FTA countries to Thailand. We use the import price ratio model based on Winters and Chang (2000)'s study to capture it. The analysis of the price effect is related to the pass-through theory which is explained in the next chapter.

Chapter 4

Pass-Through Theories and Empirical Studies

This chapter reviews the relevant literatures on the effects of changes in exchange rates and tariffs on trade prices. The chapter consists of three sections. Section 4.1 describes an overview of exchange rate pass-through theories. Section 4.2 discusses the basic concept of the tariff effect on import prices. Empirical studies on the exchange rate pass-through and tariff rate pass-through are discussed in Section 4.3.

4.1 Theoretical Background of Exchange Rate Pass-Through

Since the collapse of the Bretton-Woods fixed exchange rate system in the 1973, the exchange rate volatility has become an important consideration in international trade and price-setting. When the exchange rate fluctuates, it is a challenge for exporters and importers to stabilise their price level. The studies on the relationship between exchange rate movements and changes in international prices of goods have increased. This includes the pricing-to-market (PTM) and exchange rate pass-through (ERPT). Pricing-to-market is defined as the adjustment of exporter's prices or mark up in the exporter's currency with respect to a change in exchange rate. Exchange rate pass-through is referred to the response of the importer's currency prices induced by the exchange rate volatility. There is an inverse relationship between pricing-to-market and exchange rate pass-through as $PTM = 1 - ERPT$ or $ERPT = 1 - PTM$ (Pholphirul, 2007). For example, the exchange rate pass-through is relatively small if the pricing-to-market is large because exporting producers absorb the exchange rate volatility in their profit margin in order to retain their market share in importing countries. On the other hand, the exchange rate pass-through is relatively large if the pricing-to-market is small because exporters directly pass on the effects of exchange rate fluctuation to importers (Pholphirul, 2007; Miljkovic and Zhuang, 2011).

4.1.1 Basic Concept

According to King and Steel (1998), the early studies in exchange rate pass-through were based on the concept of import price elasticity. The exchange rate pass-through depends on the price elasticity of supply and demand as shown in equation 4.1:

$$\frac{\partial P}{\partial ER} = \frac{1}{1 - \left(\frac{\varepsilon_d}{\varepsilon_s} \right)} \quad (4.1)$$

where P is the importer price index (in domestic currency terms)

ER is the exchange rate

ε_d is the price elasticity of demand of import

ε_s is the price elasticity of supply of imports

If the price elasticity of supply is infinite, the exchange rate pass-through is complete. If the price elasticities of both demand and supply are finite, then exchange rate pass-through is only partial. However, this model has shortcomings. It is not applicable to dynamic analysis of the exchange rate pass-through and excludes the possible influence of factors in the analysis, such as industry structure (King and Steel, 1998).

In addition, King and Steel (1998) stated that there are a variety of factors influencing the relationship between import prices and the exchange rate changes, such as market structure, market share or market power, economic structure of the importing country, and types of exchange rate changes. In a perfectly competitive market, the degree of exchange rate pass-through relies on the price elasticities of demand and supply. In addition, Tantirigama (2006) pointed out that under perfect competition, an optimal price of an exporting firm equals to its margin revenue and marginal cost. When the exchange rate changes, an exporter do not adjust its domestic currency price, then the import price in importer's currency will change in the same proportion of the exchange rate changes. This phenomenon is called complete exchange rate pass-through into import prices.

Pholphirul (2003) also pointed that there have been an increase of imperfect competition in international trade and this drives economists to be interested in the exchange rate pass-through at the industry level. An exporter under imperfectly competitive market sets a price above marginal cost and can practice price discrimination across destination markets. If devaluation or appreciation of the importer's currency occurs, an exporter will adjust its profit or mark-up to maintain its price and the market share in the importing country. The exporter absorbs a partial effect of the exchange rate changes and passes the rest of effects to the importer. Therefore, there is an incomplete exchange rate pass-through into the importer's

currency price (King and Steel, 1998). Exchange rate pass-through at the industry level should be based on the understanding of international price setting under imperfect competition.

4.1.2 International Pricing under Imperfectly Competitive Market

The major theoretical background of pricing-to-market or exchange rate pass-through is based on the framework of a firm's profit maximisation under imperfect competition. According to Campa, Goldberg and Minguez (2005), Gagnon and Knetter (1995), the exporter pricing behaviour is the starting point for studying exchange rate pass-through into import prices. The phenomenon can be examined by a mark-up model under imperfect competition. In an imperfectly competitive market, an optimal price is mark-up over marginal cost. A firm is allowed to set different prices across destination markets by adjusting its mark-up. The ability of the firm to mark-up in the market reflects the firm's market power (Tantirigama, 2006). Krugman (1987), Knetter (1989), and Feenstra (1989) believed that the ability to adjust mark-ups across markets following exchange rate changes depends on the elasticity of demand determined by the market share and substitutability of differentiated products (see Krugman, 1987; Knetter, 1989).

Suppose that an exporter sells its product to n foreign destinations indexed by i . The demand in each importing country is shown in the following equation:

$$q_i = f_i(e_i P_i) \quad (4.2)$$

where q_i is the quantity demand in market i

P_i is the price in terms of the exporter's currency

e_i is the exchange rate defined as the importing country's currency per unit of the exporting country's currency

f_i is a residual demand schedule if the response of other suppliers is important

Then, the exporter's profit is shown as follows:

$$\pi(P_1, \dots, P_n) = \sum_{i=1}^n P_i q_i - C\left(\sum_{i=1}^n q_i\right) \quad (4.3)$$

where $C(.)$ is cost in the exporter's currency

The first-order condition for profit maximisation is given by:

$$P_i = c \frac{\varepsilon_i}{(\varepsilon_i - 1)} \quad (4.4)$$

where $c = C'(\cdot)$

$$\varepsilon_i = \left[\frac{-\partial q_i}{\partial e_i P_i} \cdot \frac{e_i P_i}{q_i} \right] \text{ which is the price elasticity of demand in the } i^{\text{th}} \text{ market}$$

Equation (4.4) implies that the exporter's currency price is a mark-up over marginal cost, which is determined by the elasticity of demand across destination markets. A change in exchange rate affects changes in the import price ($P_i e_i$) and the elasticity (ε_i), then the optimal price (P_i) is adjusted. Pass-through in imperfect market is incomplete or more-than-complete when import demand curve is convex (Knetter, 1989).

Krugman (1987) presented an analysis of pass-through under the Cournot oligopoly market. Pass-through can be incomplete even under constant elasticity of demand (a linear demand curve) if the export market is dictated by two firms being as Cournot oligopolists. Under constant elasticity, a firm will face a perceived elasticity of demand equal to ε_i / s_i . With replacement of the price elasticity of demand in equation (4.4) by the perceived elasticity of demand, the optimal price of the exporting firm will be as follows:

$$P_i = \frac{c \varepsilon_i}{(\varepsilon_i - s_i)} \quad (4.5)$$

where ε_i is the price elasticity of demand

s_i is the firm's market share

If the market share is higher, the perceived elasticity of demand becomes lower while the optimal price will be higher. When the importer's exchange rate increases, an exporting country will decrease its price in domestic currency proportionately and the exporter's market share will rise. Then, its perceived elasticity of demand will decrease. The effect shows that the exchange rate changes have not been fully pass-through into the import price. Under the Cournot oligopoly market, if market shares of both firms are equivalent, there is no pricing-to-market, then exchange rate pass-through to import price will be complete.

Feenstra (1989) developed a profit maximisation model under imperfect competition to examine the exchange rate pass-through in the US import market. The important contribution of Feenstra's study showed that the elasticity of demand and the effects of marginal cost determine exchange rate pass-through. The import demand function is given by $x(p, q, I)$ which is homogeneous of degree zero, where p is the import price denoted in US dollar, q is the price of a domestically substitute product, and I denotes income. The cost function is given by $C(x, w^*) = \phi(x)w^*$ which is homogenous of degree one in terms of factor prices expressed in the exporter's currency, where w^* is an index of foreign factor prices. Profit maximisation of an exporting firm is given as follows:

$$\max_p = \{epx(p, q, I) - \phi(x)w^*\} \quad (4.6)$$

From the first-order condition of equation (4.6), marginal cost equals marginal revenue is given by:

$$\phi'(x)(w^*/e) = p[1 - (1/\eta)] \equiv r(p, q, I) \quad (4.7)$$

where η denotes the elasticity of demand ($\eta = -x_p p/x$)

e denotes the exchange rate expressed in the exporter's currency

The optimal price equation is given by:

$$p = \pi(w, q, I) \quad (4.8)$$

where $w = w^*/e$. Total differentiation of equation (4.8) with respect to exchange rate effects in equation (4.9) yields the effect of pass-through:

$$(dp/dw)(w/p) = 1/[(\phi''x/\phi')\eta + (r_p p/r)] \quad (4.9)$$

where $(dp/dw)(w/p)$ indicates the pass-through elasticity with respect to changes in the exchange rates or foreign factor prices. From the second-order condition of equation (4.9), $r_p p/r < 1$ if $\eta_p < 0$ and $r_p p/r > 1$ if $\eta_p > 0$. $\phi''x/\phi'$ denotes the elasticity of marginal cost with respect to output. Positive/negative sign of ϕ'' implies increasing/decreasing marginal cost respectively.

Feenstra (1989) concluded three conditions determining the degree of pass-through as follows:

$$\eta_p = \phi'' = 0 \Rightarrow (dp/dw)(w/p) = 1 \quad (4.10)$$

$$\eta_p > 0, \phi'' \geq 0 \Rightarrow 0 < (dp/dw)(w/p) < 1 \quad (4.11)$$

$$\eta_p \leq 0, \phi'' < 0 \Rightarrow (dp/dw)(w/p) > 1 \quad (4.12)$$

The first case (equation 4.10) shows that if the price elasticity of demand and marginal cost are constant, then exchange rate pass-through is complete. In the second case (equation 4.11), the exchange rate pass-through into import prices is incomplete if the price elasticity is positive and marginal cost is constant or increasing in output. In the third case (equation 4.12), if the elasticity of demand is decreasing in price and marginal cost is decreasing in output, there is more complete exchange rate pass-through.

4.2 Basic Concept of the Effect of Tariff on Import Prices

Tariff is another key factor determining import prices. There are a number of studies examining the effects of tariff and non-tariff barriers on import prices known as tariff pass-through into import prices. For instance, Brander and Spencer (1984) developed a partial equilibrium model under imperfect competition to analyse the effects of a specific tariff (or subsidy) and an *ad valorem* tariff on prices.

Feenstra (1989) also examined the effects of tariff faced by a foreign monopoly firm on its optimal price and the buyer's import price. The analysis of tariff pass-through by Feenstra's (1989) is based on a price discriminating monopolist model (see section 3.5.2). When imports from a foreign firm are imposed with an *ad valorem* tariff (τ), the import price would increase by the amount of the tariff. For example, Feenstra employs the exporter's profit maximisation in equation (4.6) with tariff. The adjusted equation is shown as follows:

$$\max_p = \left\{ \frac{epx}{(1+\tau)} (p, q, I) - \phi(x)w^* \right\} \quad (4.13)$$

The optimal price with the tariff is given as:

$$p = \pi[w(1+\tau), q, I] \quad (4.14)$$

where $w = w^*/e$, (as in section 4.1.2).

The tariff pass-through into import prices can be complete, incomplete, or more complete depending on the elasticity of demand and marginal cost of the three conditions in equation 4.10, 4.11, and 4.12 in section 4.1.2. The tariff pass-through phenomenon can be described similarly as the exchange rate pass-through. For example, incomplete tariff pass-through implies that an increase in tariff leads to a partial increase in import prices because the foreign firm absorbs a partial effect of the tariff change by reducing its mark-up to stabilise the buyer's price and market share (Feenstra, 1989; Mallick and Marques, 2008).

4.3 Empirical Studies of Exchange Rate Pass-Through

Since the 1980s, there have been numerous empirical studies on exchange rate pass-through. The previous empirical studies have shown that exchange rate movements significantly affect international trading prices (Irاندoust, 1999; Miljkovic and Zhuang, 2011; Sahminan, 2002).

According to Sahminan (2002) and Pholphirul (2002), previous studies on exchange rate pass-through can be grouped into three categories. First, studies on exchange rate pass-through at the aggregate level are analysed using the open economy macroeconomics models, which focus on the relationship between three sectors such as households, firms, and the government in home and foreign countries. The study results provide important implication in the optimal monetary policy and international trade policy. Second, studies on exchange rate pass-through into Consumer Price Index (CPI) or Wholesaler Price Index (WPI) are based on the open economy macroeconomics framework as well. Third, studies on exchange rate pass-through at the industry level are based on a profit maximisation framework under an imperfectly competitive market which is known as a mark-up model. The degree of exchange rate pass-through at the specific industry level indicates international market power and price setting behaviour in each industry which can provide important policy implications for specific industry development.

Previous studies are classified into two main different models: static models, and dynamic models. Static models assume that exchange rate changes are temporary, and demand and supply factors are constant, while dynamic models are not temporary and the expected time of the exchange rate changes influences the degree of pricing-to-market and exchange rate pass-through. The dynamic models include demand and supply-side dynamics such as brand loyalty, and costs of changing price and supply (Tantirigama, 2006).

Krugman (1987) is the first to study pricing-to-market and exchange rate pass-through phenomenon. The author investigated the prices of U.S. manufactured imports during the appreciation of U.S. dollar in the 1980s. Krugman's result shows that the foreign firms

increase their export prices in response to the appreciation of U.S. dollar by 35 to 40 percent compared with prices in other markets. The foreign firms attempt to stabilise their price in U.S dollar. In turn, it indicates incomplete exchange rate pass-through into the prices of U.S. manufactured imports.

Lee and Tcha (2005) investigated the exchange rate pass-through elasticity for sheep meat exports from Australia and New Zealand using the SUR model and the Generalized Least Squares (GLS). They employ annual trade data between the two exporting countries and eight main destinations (Canada, Hong Kong, Germany, Japan, Korea, the US, the UK, and Netherlands) from 1991 to 2001. Their result shows a coexistence of complete and incomplete exchange rate pass-through in sheep meat import prices. The New Zealand sheep meat exporters have a relatively larger market share than Australian exporters, therefore they can increase their mark-up in those importing countries higher than Australian producers.

Tantirigama (2006) examined the degree of pricing-to-market of New Zealand pastoral export and the degree of exchange rate pass-through of New Zealand manufactured import between 1988Q1 and 2003Q2. The pricing-to-market in export price of New Zealand pastoral products is based on the export price equation determined by marginal cost, exchange rate, competitor price, New Zealand market share in the destination market, and promotion expenditure. The exchange rate pass-through into manufactured import prices is measured directly as the response of manufactured import price with respect to a change in New Zealand currency value. The import prices depend on marginal cost, exchange rate, competitor price, market share in New Zealand, and tariff. The author employs the error-component fixed-effects regression model to analyse the empirical models. The result showed that the extent of pricing-to-market varies across products and markets and there are significant differences in pricing-to-market between appreciation and depreciation of the New Zealand dollar. For New Zealand manufactured import, there is incomplete pass-through of exchange rate and tariff into import prices. This indicates that the New Zealand industrial import markets are not competitive.

Miljkovic and Zhuang (2011) investigated exchange rate pass-through into prices of Japanese meat imports namely beef, pork and poultry meat. The import prices of meat depend on exchange rate, the price of domestic substitutes, an increase in foreign input costs, per capita expenditure on meat, and monthly dummy variables for examining the seasonal effect. The exchange rate variable in the analysis uses the weighted exchange rate by meats imports. The authors estimate three import price equations for beef, pork, and poultry meat simultaneously by using the Iterative Seemingly Unrelated Regression (ITSUR) method. Their results showed

that the exchange rate pass-through into poultry import prices is almost complete which indicates perfect competition in Japanese poultry import market. For beef import prices, there is an incomplete exchange rate pass-through, which implies imperfectly competitive markets among Japanese beef importing firms. On the other hand, the degree of exchange rate pass-through into import prices of pork is zero. This indicates that there is a high degree of market power in the Japanese pork import market.

Mallick and Marques (2008) examined pass-through of exchange rate and tariffs into import prices across 38 industries (at two-digit-level Standard International Trade Classification) in India during the period 1990-2001. The Indian import prices depend on nominal effective exchange rates and tariffs in log-terms relationship. The model is analysed by panel data. The authors' result showed that the pass-through of exchange rate and tariffs into Indian import prices are incomplete and differ across industries, but the degree of tariff pass-through is larger than the degree of exchange rate pass through. This implies that firms exporting to India are more likely to stabilise their prices and market shares against tariffs than against exchange rate fluctuations. In addition, the differences of pass-through across industries are associated with the sector's share in total imports and the sector's effective protection rate.

Pyne and Roy (2009) investigated exchange rate pass-through into prices of Indian selected industries namely food products, beverages, animal and vegetable oil, chemicals, and machinery and transport equipments. The authors employed the reduced form equation derived from a simultaneous equation imperfect substitute model. The import price is determined by the exchange rate, exporter's domestic price (proxied by the producer price index), prices of import substitute commodities (proxied by the wholesale price index), GDP, and trade openness index. Sectoral panel data were used to analyse the import price equation. They concluded that the fixed effect estimation provided more consistent result than random effect estimation in Hausman's test. The econometric result showed that the degree of exchange rate pass-through into Indian import prices was incomplete and varied across industries.

For dynamic models, three main methods are employed to analyse long-run exchange rate pass-through including distributed lag models, Error Correction Model (ECM), and Seemingly Unrelated Regression (SUR). For example, Hooper and Mann (1989) examined pass-through into prices of U.S. manufactured imports during the period of 1973Q1-1988Q2. Their empirical model was based on a mark-up model which showed that the import price was a function of capacity utilisation and the gap between the U.S. price in foreign currency and foreign cost. The authors' result showed that over 20 percent in the short-run and 60 percent

in the long-run of the exchange rate change was passed-through into prices of manufactured imports.

Ketelsen and Kortelainen (1996) estimated exchange rate pass-through into import prices at the aggregate level for Finland, Sweden and Denmark. The authors' study model was based on the mark-up model which showed that import prices were determined by exchange rates, world export prices, producer price indices and gross domestic product. The four quarterly lags dependent variables were also included in the model. The authors used quarterly panel data during 1980Q1-1994Q3 and employed the SUR to analyse the import price equation. Their result showed that half of the changes in exchange rates and world prices were passed-through into import prices within one year and three-quarters of changes in exchange rates and world prices were passed-through into import prices in two years. In addition, there were no major differences across countries but there was the presence of a structural change in a pass-through relationship, which showed a slowdown in the pass-through due to the introduction of exchange rate regime in 1992 and an increase in competition.

King and Steel (1998) employed a mark-up model of pass-through to examine the long-run exchange rate pass-through into prices of manufactured imports in New Zealand for both the fixed and floating exchange rate regimes. In the mark-up model, the import price was determined by import-competing price, demand pressure facing foreign exporters (proxied by capacity utilisation), and the foreign production cost index. The data collected to estimate the equation was quarterly data of two time periods: 1975:Q1-1985:Q1 for fixed exchange rate regime and 1985:Q2-1995:Q4 for floating exchange rate regime. A modified version of the Engle-Granger-Yoo (EGY) three-step method was employed to estimate the equation. The authors discovered that the exchange rate pass-through was incomplete among both exchange rate regimes, but the speed of adjustment under the fixed exchange rate regime was slower than the floating exchange rate regime. In the long-run, the exchange rate pass-through into New Zealand manufactured imports became complete.

Barhoumi (2006) examined long-run exchange rate pass-through into import prices at the aggregate level in 24 developing countries using import price equations. The import price equations are determined by nominal effective exchange rates, price of the competing domestic products, exporter's costs and domestic demand conditions. Barhoumi's study used annual panel data from 1980 to 2003 and analysed by non-stationary panel estimation techniques. The author's result showed that the long-run pass-through was heterogeneity in the developing countries and the analysis of the cross-country differences of pass-through

showed that countries with fixed exchange rate and lower trade barriers tariffs have the highest degree of long-run exchange rate pass-through into import prices.

Campa, Golberg and Minguez (2005) investigated short- and long-run exchange rate pass-through into import prices across the Euro area in 9 main industries, such as food and live animals, beverages and tobacco, crude material, mineral fuel, oils, fats and waxes, chemical products, basic manufactures, machines and transport equipment, and miscellaneous manufactured goods. The import price of each industry was determined by the nominal exchange rate and the price index of products of each industry. The long-run elasticity was given by the sum of the coefficients on the contemporaneous exchange rate and four lags of exchange rate terms. The authors explored the possibility of a vector error correction model and their test result showed the absence of a cointegration relationship. They employed Ordinary Least Squares (OLS) to analyse the import price models. The OLS result showed that the exchange rate pass-through across the Euro area and industries was high but incomplete. The short-run pass-through was lower than the long-run pass-through, with an average of 0.52 for the short-run and 0.72 for the long-run. They also checked for structural break in pass-through rate caused by the introduction of the euro. In most industries, there was no statistical significance, but they found a little statistical evidence in the case of manufacturing industries. Their result showed that the introduction of the euro leads to a reduction of the degree of exchange rate pass-through into import prices.

A few studies on exchange rate pass-through were conducted in Thailand. After the 1997 Asian financial crisis, Thailand exchange rate became a floating exchange rate system. Therefore, there has been an enormous fluctuation in the Thai Baht value and the exchange rate volatility has played an important role on international price setting behaviour (Pholphirul, 2003).

Sahminan (2002) estimated exchange rate pass-through into import prices at the aggregate level in some Southeast Asian countries namely Thailand, Singapore and the Philippines. The import price equations among the three countries were determined by exchange rate, domestic competitors' price (proxied by domestic producer price index), demand pressure in foreign country (proxied by foreign industrial production index), and foreign marginal cost (proxied by foreign producer index). The author used quarterly data between 1974:Q1 and 2003:Q3 and an error correction model to analyse the import price equations. The results showed that the long-run exchange rate pass-through into import prices was incomplete for Thailand and Singapore, but complete for the Philippines. For the short-run, exchange rate did not have significant effect in Thailand and Singapore while foreign price and foreign demand were

more likely to influence import prices significantly. On the other hand, the short-run exchange rate pass-through into import prices of the Philippines was significantly negative effect.

Pholpirul (2003) examined the degree of exchange rate pass-through on Thailand import industries in short-run and long-run terms and the effect of the 1997 Asian financial crisis on the degree of pass-through. The short-run and long-run coefficients of exchange rate pass-through was analysed in nine main import industries including food, beverages and tobacco, crude materials, mineral fuels and lubricants, animal and vegetable oils and fats, chemicals, manufactured goods, machinery, and miscellaneous manufactured goods. Thailand import price model of each industry was determined by exchange rate, foreign export costs, domestic demand condition, and a dummy variable for the financial crisis. The result showed that the exchange rate pass-through coefficients of Thailand import industries were quite low between 0.104 and 0.527. The lowest degree of pass-through was in the animal and vegetable oil and fat industry while the highest degree was in the crude materials industry. The low degree of the exchange rate pass-through showed the small substitution of imports and domestic consumption. This implied that foreign exporters have market power in the Thai market and the market power generated market inefficiency or distortion. Besides, a long-run pass-through was larger than a short-run pass through which indicated that the speed of adjustment to Thailand import prices was rapid. Interestingly, the degree of exchange rate pass-through to Thailand import prices decreased after the 1997 Asian financial crisis because exporters who faced the exchange rate volatility would make a forward foreign currency contract to hedge their commodity price risk.

Ghosh and Rajan (2009) examined the long-run exchange rate pass-through into consumer and import prices at the aggregate level in Korea and Thailand over the last two decades. The authors' empirical model showed that import prices were determined by exchange rate, GDP, producer price index and consumer price index. A dynamic Ordinary Least Squares (DOLS) developed was used to estimate the empirical model. The authors' result showed that the degree of exchange rate in Thailand was higher than in Korea because Thailand was a relative small and open economy compared to Korea. During the 1997 Asia financial crisis, the degree of exchange rate pass-through increased in both Korea and Thailand.

According to Pholpirul (2003), the increase of imperfect competition and strategic trade theory has encouraged economists to study the exchange rate pass-through at the industry level. Previous empirical studies on exchange rate pass-through at the specific industry level have focused on industrial commodities. A few studies have been conducted in agricultural products. For example, Lee and Tcha (2005); Campa, Goldberg and Minguez (2005);

Tantirigama (2006); Miljkovic and Zhuang (2011); and Pyne and Roy (2009) examined the effects of exchange rate changes on import prices of agricultural products. However, many developed and developing countries are net importers in agricultural products. Therefore, the analysis of the exchange rate pass-through into the import side becomes more interesting to net importing countries (Miljkovic and Zhuang, 2011).

Thailand is one of the net importers in dairy products. Studying exchange rate pass-through and tariff rate pass-through in Thailand dairy import prices is interesting for Thailand dairy industries and dairy exporting nations. There is no empirical study on exchange rate pass-through and tariff rate pass-through in dairy import prices in Thailand. Our study fills the research gap by examining how the volatility in exchange rates and the reduction of tariff rates for FTA countries will affect Thailand import prices of dairy products. The result can indentify price behaviour of Thailand dairy imports and the market competitive status between domestic and foreign dairy producers. We employs a static and disaggregate level model based on Tantirigama (2006)'s study.

Chapter 5

Empirical Models and Research Methodology

This chapter describes the analytical frameworks and empirical models for measuring the effects of Free Trade Agreements (FTAs) on Thailand dairy import flows and prices. The chapter consists of four sections. Section 5.1 discusses the analytical framework for the static trade effects of FTAs. Section 5.2 develops the gravity model for capturing the effects of FTAs on Thailand dairy imports. Section 5.3 explains the import price model for examining the effect of FTAs on Thailand dairy import prices. Data and Methodology is described in Section 5.4.

5.1 A Conceptual Framework for the Static Trade Effects of FTAs

The static analysis of the trade effects of RTAs/FTAs is pioneered by Viner (1950). The trade effects in the Vinerian approach focus on trade creation and trade diversion. Subsequent economists such as Meade (1955), Lipsey (1957), Johnson (1960), and Mundell (1964) have developed their theoretical analysis of the trade effects based on the Vinerian framework because it is natural, rich in insights and coherent theoretical structures (Bhagwati, Krishna, and Panagariya, 1999; Jayasinghe, 2003).

The analysis of the trade effects of FTAs in this study is based on the Vinerian framework which DeRosa (1998) described as being more general with a graphical analysis. The Viner model is a partial equilibrium model which consists of three countries: a home country (H), a partner country (P) and a non-member country (N) trading in a specific good. Let us assume that the home country and the partner country form a customs union or a free trade area and the non-member country represents the rest of the world. The home country is a small and net import country which has a downward-sloped demand and upward-sloped supply curves while the partner and non-member countries have constant-cost supply curves. DeRosa analyses the static trade effects of the formation of a customs union using a graphical perspective for two cases. First, the non-member country is the most efficient producer of good X as shown in Figure 5.1. Second, the member country is the least-cost producer of good Y as shown in Figure 5.2.

In Figure 5.1, S_H^X and D_H^X represent the supply and demand curves of the home country for good X respectively. P_P^X and P_N^X represent the supply curves of the partner and non-member countries for good X respectively. The supply price of the non-member country for good X is

assumed to be the lowest price. Under a non-discriminatory specific tariff (t_H^X) on imports of good X in the home country, all of good X are imported from the non-member country at the price level $P_N^X + t_H^X$. Then, when the home country forms a customs union with the partner country, the import price of good X from the partner country decreases by t_H^X to P_P^X . Therefore, the source of good X switches from the non-member country, which is the most efficient producer to the partner country which is the less efficient producer, and imports of good X in the home country expand.

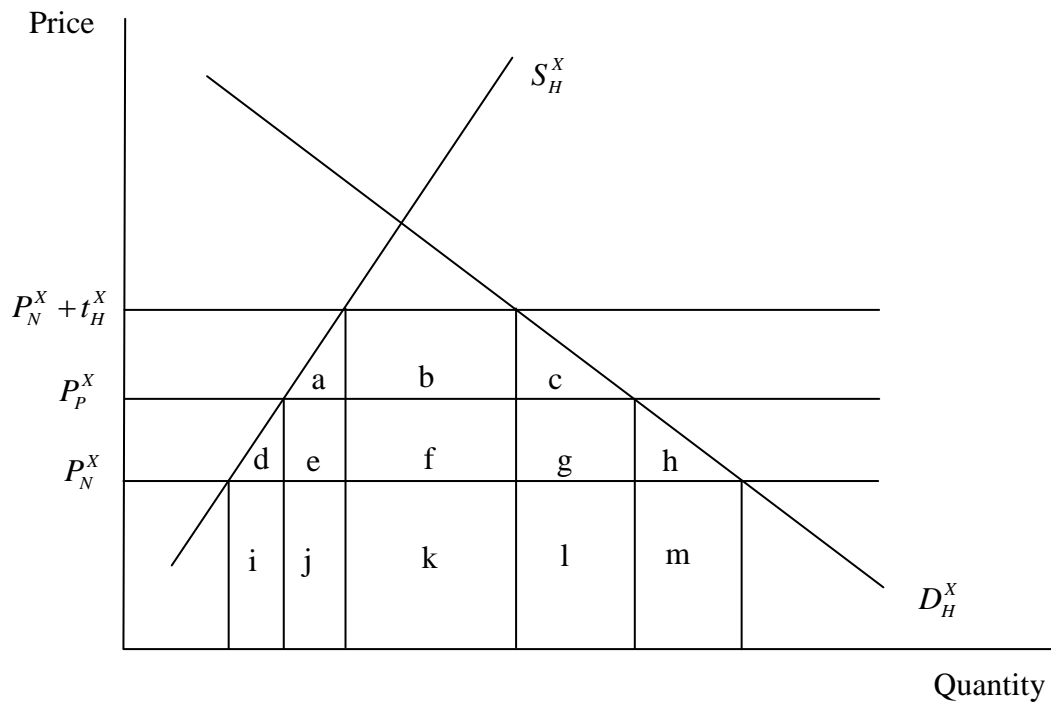


Figure 5.1 Vinerian analysis of trade effects when the non-member country is the most efficient producer

Source: DeRosa (1998, p.100)

Table 5.1 provides a summary of the trade effects of the customs union shown in Figure 5.1. The trade effects on the home country include trade diversion and creation. The replacement of imports of good X from the least-cost producer by the higher-cost producer leads to trade diversion in the home country represented by the area k. However, the expansion of the home country's imports of good X produces trade creation represented by the area (e+j+g+l). Trade creation involves two effects: a production effect (e+j) and a consumption effect (g+l). A net trade effect in the home country represented by the area (e+j+g+l-k) is ambiguous in sign depending on the magnitude of trade creation and diversion. The partner country meanwhile has a trade creation effect and no trade diversion. A net trade effect of the partner country is

positive as represented by the area $(i+j+l+m)$. Overall, a net trade effect of the customs union as a whole is ambiguous as represented by the area $(e+2j+i+g+2l+m-k)$.

Table 5.1 Summary of the trade effects of the customs union shown in Figure 5.1

| Trade Effects | Algebraic Representation | Sign |
|-----------------------------------|--------------------------|-----------|
| <u>Home Country (H)</u> | | |
| Trade creation | $(e+j)+(g+l)$ | Positive |
| Trade diversion | $-k$ | Negative |
| Net trade Effects | $(e+j)+(g+l)-k$ | Uncertain |
| <u>Partner Country (P)</u> | | |
| Trade Creation | $i+j+l+m$ | Positive |
| Trade Diversion | $-$ | $-$ |
| Net Trade Effects | $i+j+l+m$ | Positive |
| <u>Customs Union (H+P)</u> | | |
| Net Trade Effects | $(e+2j+i)+(g+2l+m)-k$ | Uncertain |

Source: DeRosa (1998, p.102)

In Figure 5.2, the partner country is assumed to be the most efficient producer of good Y . S_H^Y and D_H^Y represent supply and demand curves of the home country for good Y respectively. P_P^Y and P_N^Y represent supply curves of the partner and non-member countries for good Y respectively. With levying a non-discriminatory specific tariff, t_H^Y , on imports of good Y , the home country imports all of good Y from the partner country at the price level $P_P^Y + t_H^Y$. When the formation of a customs union between the home and partner countries occurs, the home country eliminates specific tariffs (t_H^Y) on imports of good Y from the partner country and the import price decreases to P_P^Y . Therefore, the home country's import of good Y from the partner country expands. A summary of the trade effects of the customs union in Figure 5.2 is shown in Table 5.2. There is a positive trade creation and no trade diversion because the partner country is the most efficient producer of good Y . Net trade creation of the home and partner countries is similar to the area $(i+j+l+m)$ and net trade creation of the customs union is $2(i+j+l+m)$.

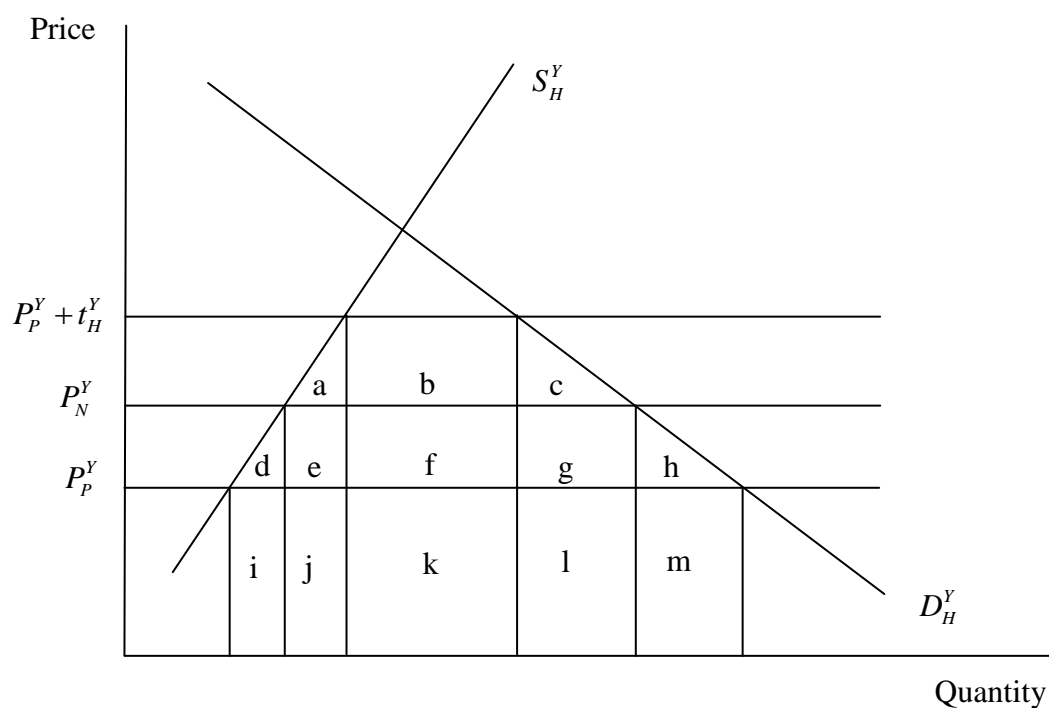


Figure 5.2 Vinerian analysis of trade effects when the partner country is the most efficient producer

Source: DeRosa (1998, p.101)

Table 5.2 Summary of the trade effects of the customs union shown in Figure 5.2

| Trade Effects | Algebraic Representation | Sign |
|-----------------------------------|--------------------------|----------|
| <u>Home Country (H)</u> | | |
| Trade creation | $i+j+l+m$ | Positive |
| Trade diversion | - | - |
| Net trade Effects | $i+j+l+m$ | Positive |
| <u>Partner Country (P)</u> | | |
| Trade Creation | $i+j+l+m$ | Positive |
| Trade Diversion | - | - |
| Net Trade Effects | $i+j+l+m$ | Positive |
| <u>Customs Union (H+P)</u> | | |
| Net Trade Effects | $2(i+j+l+m)$ | Positive |

Source: DeRosa (1998, p.103)

In practice, there are two prevalent quantitative analysis approaches for measuring the trade and welfare effects of RTAs/FTAs. The first is the analytical approach using the computable general equilibrium (CGE) model to capture the effects of RTAs/FTAs. The CGE model is mostly used in *ex ante* studies. The CGE model provides coherent theoretical structures and captures intersectoral and macroeconomic effects. However, there are computational and data limitations such as computing under unrealistic baseline scenarios and requiring numerous data (Elliott and Ikemoto, 2004; Jayasinghe and Sarker, 2004; Romalis, 2007). The second is the empirical approach involving *ex post* analysis with econometric models. The gravity model is a predominantly econometric model used in measuring the trade effects of RTAs/FTAs through dummy variables. The gravity equation is a robust and transparent empirical model derived from a general equilibrium framework of international goods. In addition, the gravity model plays an important role in the estimation of trade pattern in aggregated and disaggregated levels (see Anderson, 1979; Bergstrand, 1985; Deardorff, 1998; Cheng and Wall, 1999; Jayasinghe and Sarker, 2004; DeRosa and Gilbert, 2005). We employ the gravity model to measure the effects of FTAs on Thailand dairy imports.

5.2 The Assessment of the Trade Effects of FTAs with the Gravity Model

The gravity equation is developed from Newton's Law of Universal Gravitation. The gravitation law illustrates that the gravitation force between two objects is directly related to their masses and inversely related to the distance between them (Frankel, 1997; Kang, 2003; Kisu, 2006). This is expressed as the following equation:

$$F_{ij} = g \frac{M_i M_j}{D_{ij}} \quad (5.1)$$

where, F_{ij} is the gravitation force between objects i and j , M_i is the mass or size of the object i , M_j is the mass or size of the object j , D_{ij} is the distance between the objects i and j , and g is a gravitational constant.

An analogy of the gravitation law was initially employed to study the relationship between human behaviour and distance. Following this, the gravity model has been widely used in the field of social science for predicting the movements or flows of people, information and commodities between two places (Cheng and Wall, 1999; Rosenberg, 2004; Thanyakhan, 2008). Tinbergen (1962) and Pöynönen (1963) initially applied the analogy of the gravitation law for empirical works in international trade. Their basic gravity model for trade shows that

trade flows or exports between two countries are directly related to their economic mass represented by Gross National Product (GNP) and indirectly related to distance between them. The distance indicates a transportation cost which is an important natural factor dominating bilateral trade flows (Tinbergen, 1962; Pöynönen, 1963; Frankel, 1997; Krugman, 1991). The basic gravity equation for trade is given as follows:

$$PX_{ij} = \beta_0 (Y_i)^{\beta_1} (Y_j)^{\beta_2} (D_{ij})^{\beta_3} (A_{ij})^{\beta_4} \mu_{ij} \quad (5.2)$$

where, PX_{ij} is the value of exports or trade flows from countries i to country j , Y_i is the GNP of the country i , Y_j is the GNP of the country j , D_{ij} is the distance between the countries i and j , A_{ij} is another explanatory variable inducing or resisting trade between the countries i and j , and μ_{ij} is a log-normally distributed error term.

Linnemann (1966) improved an economic theoretical justification for the basic gravity model with a Walrasian general equilibrium system of export supply and import demand equations. The gravity equation by Linnemann (1966) included population size as a measure of market size as well, which is expressed as follows:

$$PX_{ij} = \gamma_0 (Y_i)^{\gamma_1} (Y_j)^{\gamma_2} (N_i)^{\gamma_3} (N_j)^{\gamma_4} (D_{ij})^{\gamma_5} (A_{ij})^{\gamma_6} U_{ij} \quad (5.3)$$

where, PX_{ij} is the value of trade flows or exports from countries i to j , Y_i is the GNP of the country i , Y_j is the GNP of the country j , N_i is the population of the country i , N_j is the population of the country j , D_{ij} is the distance between the countries i and j which is a proxy of transportation cost between the two countries, A_{ij} is another explanatory variable inducing or resisting trade between the countries i and j , U_{ij} is a log-normally distributed error term.

Atiken (1973) also employed Linnemann's model to estimate the effects of the European Economic Community (EEC) and European Free Trade Association (EFTA) on European members' trade. The author's study contributed to the empirical success in using the gravity model to explain members' trade flows and to capture the impacts of regional trade agreements. The author was the first to measure trade creation and trade diversion through a regional dummy in a Vinerian sense.

However, the omission of price variables in the basic gravity model leads to a lack of confidence in its theoretical foundation (Anderson, 1979; Bergstrand, 1985, 1989; Helpman and Krugman, 1985; Wall, 1999; Deardroff, 1998; Elliott and Ikemoto, 2004). Anderson

(1979) was the first to explain a strong theoretical foundation for the gravity model. The author derived the gravity model from the properties of expenditure systems with the assumptions of Cobb-Douglas preferences, and product differentiation across countries known as the Armington assumption. The author concluded that the gravity model is coherent with the generalized trade-share expenditure system model, and illustrates that the import flow between two countries is a function of national income, population, and bilateral distance of the two countries similar to Linnemann's model.

Helpman and Krugman (1985) proved that the gravity model is consistent with new trade theories such as the monopolistic competition model and the Heckscher-Ohlin model. Their derivation of the gravity equation shows that the bilateral trade flow is a function of Gross Domestic Products (GDPs) without distance. Under the assumption of a product differentiation with increasing return to scale, the gravity model is likely to fit the trade pattern better.

Bergstrand (1985) argued that distance plays an important role in the foundation of the full gravity model and demonstrated that the basic gravity model should include national incomes and bilateral distance as key explanatory variables. The gravity model may incorporate more explanatory variables in some cases depending on the assumptions in the theoretical derivation for the gravity model. The Bergstrand (1985) gravity model is a reduced form of a partial equilibrium subsystem of a general equilibrium model of international trade with a constant elasticity of substitution (CES) utility function and a constant elasticity of transformation (CET) joint production function. The author demonstrated the gravity equation in six cases. The author concluded that price terms are included in the gravity equations under two cases: when the importing market is small relative to other markets, and when parameters of the identical utility and production functions are constant across all country pairings similar to the H-O model of inter-and intra-industry trade. The last four cases include perfect substitutability of goods internationally in production and consumption, perfect commodity arbitrage, zero tariffs, and zero transportation costs, and the gravity equations are similar to the basic equation (5.2).

Bergstrand (1989) improved the theoretical foundation of the gravity model for a specific commodity with relative factor-endowment differences and non-homothetic tastes. The author incorporated per capita incomes of importing and exporting countries into the gravity model. The Bergstrand (1989) gravity equation is known as the "generalized" gravity equation which is a reduced form of a general equilibrium model of world trade with two differentiated-

product industries and two factors. The “generalized” gravity equation is expressed as follows:

$$\begin{aligned}
PX_{Aij} = & \delta^{(\gamma^A+1)/(\gamma^A+\sigma^A)} \times (Y_i^K)^{(\sigma^A-1)/(\gamma^A+\sigma^A)} \times (\beta_{KA}\beta_{LB} - \beta_{KB}\beta_{LA})^{-1} \\
& \times \left[\beta_{LB} - \beta_{KB} (K_i^* / L_i^*)^{-1} \right]^{(\sigma^A-1)/(\gamma^A+\sigma^A)} \times (Y_j)^{(\gamma^A+1)/(\gamma^A+\sigma^A)} \times (1 - y_j^{-1})^{(\gamma^A+1)/(\gamma^A+\sigma^A)} \\
& \times C_{Aij}^{-(\sigma^A-1)(1+\gamma^A)/(\gamma^A+\sigma^A)} \times T_{Aij}^{-\sigma^A(\gamma^A+1)/(\gamma^A+\sigma^A)} \times E_{ij}^{\sigma^A(\gamma^A+1)/(\gamma^A+\sigma^A)} \\
& \times \left\{ \left[\sum_n (P_{Ain} / C_{Ain})^{1+\gamma^A} \right]^{1/(1+\gamma^A)} \right\}^{-\gamma^A(\sigma^A-1)/(\gamma^A+\sigma^A)} \\
& \times \left\{ \left[\sum_n (P_{Anj} T_{Anj}) / E_{nj} \right]^{1-\sigma^A} \right\}^{-(\gamma^A+1)/(\gamma^A+\sigma^A)} \quad (5.4)
\end{aligned}$$

Equation (5.4) demonstrates that the value of the trade flow from country i to country j in industry A (PX_{Aij}) is determined by the GDPs of countries i and j (Y_i^K and Y_j), the capital-labour endowment ratio of country i (K_i^* / L_i^*), the per capita GDP of country j (y_j), the c.i.f./f.o.b. factor to ship output in industry A from country i to country j (C_{Aij}), the tariff rate of country j on industry A (T_{Aij}), the exchange rate between countries i and j (E_{ij}), the f.o.b. price of the output of industry A exported from country i (P_{Ain} / C_{Ain}) and the c.i.f. price of the output of industry A imported to country j ($P_{Anj} T_{Anj} / E_{nj}$). The author proved that the “generalized” gravity equation is consistent with new trade theories such as the Heckscher-Ohlin model of inter-industry trade and the Helpman-Krugman-Markusen models of intra-industry trade.

In terms of empirical analysis of the generalized gravity equation, the empirical gravity model is given as follows:

$$PX_{ij} = \psi_0 (Y_i)^{\psi_1} (Y_i / N_i)^{\psi_2} (Y_j)^{\psi_3} (Y_j / N_j)^{\psi_4} (D_{ij})^{\psi_5} (A_{ij})^{\psi_6} e_{ij} \quad (5.5)$$

The model is written in a double log-linear form as follows:

$$\begin{aligned}
\ln PX_{ij} = & \ln \psi_0 + \psi_1 \ln Y_i + \psi_2 \ln(Y_i / N_i) + \psi_3 \ln Y_j + \psi_4 \ln(Y_j / N_j) \\
& + \psi_5 \ln D_{ij} + \psi_6 \ln A_{ij} + \ln e_{ij} \quad (5.6)
\end{aligned}$$

where, PX_{ij} is the value of trade flows or exports from country i to country j , Y_i is the GDP of the country i , Y_i / N_i is the per capita GDP of the country i which is a proxy of country i 's capital-labour endowment ratio, Y_j is the GDP of the country j , Y_j / N_j is the per capita GDP of the country j , D_{ij} is the distance between the countries i and j which is a proxy of the c.i.f./f.o.b. factor, A_{ij} is any other explanatory variables inducing or resisting trade between countries i and j , and e_{ij} is a log-normally distributed error term. Examples of other explanatory variables frequently included in the gravity model are the dummy for adjacency, the dummy for common membership in preference trade agreements or free trade agreements, the bilateral exchange rate, the exporter wholesale price index, and the importer wholesale price index.

The gravity equation (5.6) represents a reduced form of a general equilibrium model of trade for a specific commodity, which is not only a transparent and robust theoretical model, but also a successful empirical model in terms of explanatory power and robustness. In addition, the gravity model for bilateral trade in specific goods or disaggregated level provides an interpretation in microeconomic terms. The coefficient of the per capita GDP of the exporting country indicates whether the considered commodity is labour or capital intensive production. The coefficient of the per capita GDP of the importing country indicates whether the considered commodity is a luxury or necessity (Bergstrand, 1989).

Subsequently, the Bergstrand (1989) gravity equation, known as the modified gravity model, has been empirically used for predicting the bilateral trade flows in specific goods. For example, studies by Koo, Karemere, and Taylor (1994), Dascal, Mattas, and Tzouvelekas (2002), Jayasinghe and Sarker (2004), and Grant and Lambert (2005) concluded that the modified gravity model provided an adequate statistical description of the bilateral trade flows for single commodities and the estimated coefficients are consistent with theoretical literatures.

In addition, the modified gravity model performs well empirically and is useful for the assessment of the trade effects of regional trade agreements or free trade agreements in both aggregated and disaggregated trade flows. For example, Frankel and Wei (1998) employed the modified gravity model to capture the trade effects of regional blocs on aggregated bilateral trade flows focusing on trade creation and trade diversion as in Viner (1950)'s framework. Their model showed that the bilateral export flows depend on GNPs and per capita GNPs of the importing and exporting countries, the bilateral geographic distance

between them, the exporter's average distance from its trading partners called the exporter's remoteness, the importer's average distance from its trading partners called the importer's remoteness, and dummies for adjacency, language linkage, membership of trade blocs and openness of trade blocs. The coefficient of the dummy for membership of trade blocs indicates the trade creation effect of the trade blocs, while the coefficient of the dummy for the openness of the trade blocs indicates the trade diversion of the trade blocs.

Recently, Grant and Lambert (2005) also employed the modified gravity model to measure the effects of regional trade agreements (RTAs) on agrifood product trades. The authors adopted the analytical concept of trade creation and diversion from Frankel and Wei (1998), but they applied it to study bilateral trades in specific goods. The modified gravity equation by Grant and Lambert (2005) is expressed in log terms as follows:

$$\begin{aligned} \ln V_{ijt} = & \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln(GDP_{it} / N_{it}) + \beta_4 \ln(GDP_{jt} / N_{jt}) \\ & + \beta_5 \ln D_{ij} + \beta_6 Cont_{ij} + \beta_7 CommLang_{ij} + \beta_8 LandLck_{ij} + \sum_{h=1}^8 \alpha_h TradeC_{ijht} \\ & + \sum_{l=1}^8 \gamma_l TradeD_{ijlt} + TimeDummies + FixedEffects + \varepsilon_{ijt} \end{aligned} \quad (5.7)$$

where, V_{ijt} is the value of the bilateral trades between country i and country j in year t , GDP_{it} and GDP_{jt} are the GDPs of country i and country j in year t , respectively, GDP_{it} / N_{it} and GDP_{jt} / N_{jt} are the per capita GDPs of country i and country j in year t , respectively, D_{ij} is the geographical distance between country i and country j , $Cont_{ij}$, $CommLang_{ij}$, and $LandLck_{ij}$ are dummy variables which equal one if exporter (i) and importer (j) share a land border, speak a similar language, and are landlocked countries, respectively, and equal zero otherwise, $\sum_{h=1}^8 \alpha_h TradeC_{ijht}$ is a dummy variable for capturing trade creation for eight RTAs ($h=1 \dots 8$) which equals one if exporter (i) and importer (j) are members of RTAs, and equals zero otherwise, $\sum_{l=1}^8 \gamma_l TradeD_{ijlt}$ is a dummy variable for capturing trade diversion for eight RTAs ($l=1 \dots 8$) which equals one if members of RTAs import from non-members, and equals zero otherwise, and ε_{ijt} is a log-normally distributed error term.

From the discussion above, it is evidenced that the gravity model is supported by a variety of leading theories of international trade of aggregated and disaggregated products. Moreover,

the gravity model has been empirically successful in predicting bilateral trade flow and measuring the *ex post* effects of preferential trade agreements on bilateral trade on both aggregated and disaggregated levels (Frankel, Stein, and Wei, 1995; Frankel and Wei, 1998; Jayasinghe and Sarker, 2004) Similarly, Eichengreen and Irwin (1998) pointed out that the gravity model is the workhorse empirical model in examining patterns of bilateral trade flows.

In order to predict import flows between country pairs and to measure the effects of FTAs on Thailand dairy imports, the modified gravity model for a specific commodity as in Bergstrand (1989) and Grant and Lambert (2005) is employed for this study. The specification of dummies for capturing trade creation and trade diversion is based on the studies of Frankel and Wei (1998), and Grant and Lambert (2005). The following sections describe the variables used and the expected signs, the empirical gravity model used in our study and data and estimation technique.

5.2.1 Summary of Variables Used in the Gravity Model

Table 5.3 shows the dependent and independent variables used in the modified or augmented gravity models from previous empirical studies, and their hypothesised signs. The most common explanatory variables are Gross National Incomes (GNPs) or Gross Domestic Products (GDPs), per capita GNPs or GDPs, bilateral distance, adjacency, and trade bloc membership. However, more explanatory variables are added into the model such as differences of per capita GDPs of the exporting and importing countries, population, remoteness, exchange rate, common language, price index, production index, complementarity index, extra-bloc trade openness, etc. The dependent variables include the values of export flows, import flows or total trade flows (exports plus imports).

The GNPs or GDPs of exporting and importing countries are included in the gravity model as an explanation of the economic size of the countries. The coefficients of exporter and importer GNPs or GDPs are hypothesised to be positive. A high level of exporter income results in an increase in production investment, which increases the availability of goods for export. A high level of income in the importing country leads to higher imports. Larger exporting and importing countries tend to trade more (Bergstrand, 1989; Frankel and Wei, 1998; Krueger, 1999; Endoh, 2000; Elliott and Ikemoto, 2004; Jayasinghe and Sarker, 2004; Liu, 2004; Grant and Lambert, 2005; Kisu, 2006; Ram and Prasad, 2007).

Table 5.3 Variables used in the gravity equation for bilateral trade flows and the hypothesised signs

| Variables | Types of variables | Expected signs | Estimated signs by previous studies | | | | | |
|---|--------------------|----------------|-------------------------------------|------------------------|-------------------|-------------------|-----------------------------|--------|
| | | | Bergstrand (1989) | Frankel and Wei (1998) | Krueger (1999) | Endoh (2000) | Dascal <i>et al.</i> (2002) | |
| Dependent Variable | Continuous | | Disaggregated Export | Aggregated Export | Aggregated Export | Aggregated Export | Disaggregated | |
| Explanatory Variables | | | | | | | Export | Import |
| - GDP of the exporting country | Continuous | (+) | (+) | (+) | (+) | (+) | | |
| - GDP of the importing country | Continuous | (+) | (+) | (+) | (+) | (+) | | |
| - Per capita GDP of the exporting country | Continuous | (+)/(-) | (+)/(-) | (+) | (+) | | (+) | (+) |
| - Per capita GDP of the importing country | Continuous | (+)/(-) | (+)/(-) | (+) | (+) | | (+) | (+) |
| - Differences of per capita GDP | Continuous | (+)/(-) | | | | | | |
| - Population of the exporting country | Continuous | (+)/(-) | | | | (-) | | |
| - Population of the importing country | Continuous | (+)/(-) | | | | (-) | | |
| - Bilateral geographical distance | Continuous | (-) | (-) | (-) | (-) | (-) | | |
| - Remoteness of the exporting country | Continuous | (+) | | (+) | (+) | | (+) | |
| - Remoteness of the importing country | Continuous | (+) | | (-) | (+) | | | (-) |
| - Adjacency | Dummy | (+) | (+)/(-) | (+) | (+) | (+) | | |
| - Landlockedness | Dummy | (-) | | | | | | |
| - Bilateral exchange rate | Continuous | (+)/(-) | (+)/(-) | | | | (+) | (-) |
| - Common language | Dummy | (+) | | (+) | (+) | (+) | | |
| - Exporter wholesale price index | Continuous | (+) | (+)/(-) | | | | (-) | |
| - Importer wholesale price index | Continuous | (-) | (+)/(-) | | | | | (-) |
| - Production index (production capacity) | Continuous | (+)/(-) | | | | | (+) | (-) |
| - Complementarity index | Continuous | (+) | | | | | | |
| - Intra-RTA/FTA trade bias | Dummy | (+) | (+)/(-) | (+)/(-) | (+)/(-) | (+)/(-) | (+) | (+) |
| - Extra-RTA/FTA import openness | Dummy | (-) | | (+)/(-) | (+)/(-) | (+)/(-) | | |
| - Extra-RTA/FTA export openness | Dummy | (-) | | | | (+)/(-) | | |

Table 5.3 Variables used in the gravity equation for bilateral trade flows and the hypothesised signs (continued)

| Variables | Types of variables | Expected signs | Estimated signs by previous studies | | | | | |
|---|--------------------|----------------|-------------------------------------|------------------------------|-------------------|--------------------------|------------------------|------------------------|
| | | | Elliott and Ikemoto (2004) | Jayasinghe and Sarker (2004) | Liu (2004) | Grant and Lambert (2005) | Kisu (2006) | Ram and Prasad (2007) |
| Dependent Variable | Continuous | | Aggregated Import | Disaggregated Total Trade | Aggregated Import | Disaggregated Import | Aggregated Total Trade | Aggregated Total Trade |
| Explanatory Variables | | | | | | | | |
| - GDP of the exporting country | Continuous | (+) | (+) | (+) | (+) | (+) | (+) | (+) |
| - GDP of the importing country | Continuous | (+) | (+) | (+) | (+) | (+)/(-) | (+) | (+) |
| - Per capita GDP of the exporting country | Continuous | (+)/(-) | (+) | (+)/(-) | | (+)/(-) | | (+) |
| - Per capita GDP of the importing country | Continuous | (+)/(-) | (+) | (+)/(-) | | (+)/(-) | | (+) |
| - Differences of per capita GDP | Continuous | (+)/(-) | (+)/(-) | | | | | |
| - Population of the exporting country | Continuous | (+)/(-) | | | (+) | | | |
| - Population of the importing country | Continuous | (+)/(-) | | | (+) | | | |
| - Bilateral geographical distance | Continuous | (-) | (-) | (-) | (-) | (+)/(-) | (-) | (-) |
| - Remoteness of the exporting country | Continuous | (+) | | | | | | |
| - Remoteness of the importing country | Continuous | (+) | | | | | | |
| - Adjacency | Dummy | (+) | (+) | | (+) | (+) | (+) | (+) |
| - Landlockedness | Dummy | (-) | | | | (+)/(-) | | (-) |
| - Bilateral exchange rate | Continuous | (+)/(-) | | | (-) | | (-) | |
| - Common language | Dummy | (+) | | | (+) | (+) | | (+) |
| - Exporter wholesale price index | Continuous | (+) | | | | | | |
| - Importer wholesale price index | Continuous | (-) | | | | | | |
| - Production index (production capacity) | Continuous | (+)/(-) | | | | | | |
| - Complementarity index | Continuous | (+) | (+) | | | | | |
| - Intra-RTA/FTA trade bias | Dummy | (+) | (+) | (+)/(-) | (+)/(-) | (+)/(-) | (+) | (+) |
| - Extra-RTA/FTA import openness | Dummy | (-) | (+)/(-) | (+)/(-) | (+)/(-) | (+)/(-) | | |
| - Extra-RTA/FTA export openness | Dummy | (-) | (+)/(-) | | (+)/(-) | | | |

The per capita GDPs of exporting and importing countries in the aggregated gravity model also explain the economic size of the countries. The coefficients of per capita GDPs are positive (Frankel and Wei, 1998; Krueger, 1999; Elliott and Ikemoto, 2004; Ram and Prasad, 2007). But in the disaggregated gravity model, the coefficients of per capita GDPs of exporting and importing countries can be interpreted in terms of microeconomic theory. The coefficients of per capita GDPs of exporting and importing countries would have both positive and negative signs. A positive coefficient for an exporter per capita GDP indicates that the considered product tends to be capital intensive in production, and a negative coefficient for an exporter per capita GDP indicates that the considered product tends to be labour intensive in production. In cases of an importer per capita GDP, a positive coefficient indicates that the considered product is normal goods, and a negative coefficient for an importer per capita GDP indicates that the considered product is inferior goods (Jayasinghe and Sarker, 2004; Grant and Lambert, 2005).

Differences in per capita GDPs of exporting and importing countries are included in the aggregated gravity model to test the Linder and Heckscher-Ohlin hypotheses. A negative coefficient of differences in per capita GDPs would support the Linder hypothesis: two countries with similar income tend to increase trade between them. A positive coefficient of differences in per capita GDPs would support the Heckscher-Ohlin hypothesis: two countries with differences in income tend to increase trade between them (Elliott and Ikemoto, 2004; Ram and Prasad, 2007).

Population is a measurement of country size. The population of exporting and importing countries would have negative effects on bilateral trade flows. A larger population in an exporting country implies a larger domestic market which results in a reduction in exports. However, a larger population in an importing country leads to more varieties of domestic output and less dependence on imports (Endoh, 2000). While Liu (2004) found that the exporter and importer population have a significantly positive impact on aggregated bilateral import.

Bilateral geographical distance is used as a proxy for transportation cost which would have a negative effect on bilateral trade flows. A greater distance leads to a higher transportation cost and a reduction in trade (Bergstrand, 1989; Frankel and Wei, 1998; Krueger, 1999; Endoh, 2000; Elliott and Ikemoto, 2004; Jayasinghe and Sarker, 2004; Liu, 2004; Grant and Lambert, 2005; Kisu, 2006; Ram and Prasad, 2007). In addition, the remoteness of the exporting and importing countries is added into the gravity model as a measurement of how far an exporting or importing country is from other countries. An exporter's and importer's remoteness would

have positive effects on bilateral trade flows. Both remote countries tend to trade more with each other (Frankel and Wei, 1998).

Adjacency and common language are dummy variables which are equal to one when a pair of trading countries shares a land border or common language. The coefficients of the dummies would be positive. If two countries are neighbouring countries, the transportation cost between them will decrease and they will trade more with each other (see Bergstrand, 1989; Frankel and Wei, 1998; Krueger, 1999; Endoh, 2000; Elliott and Ikemoto, 2004; Liu, 2004; Grant and Lambert, 2005; Kisu, 2006; Ram and Prasad, 2007). Similarly, if a pair of countries communicates the same language, communication and transaction costs will decrease and trade between them will increase (see Frankel and Wei, 1998; Krueger, 1999; Endoh, 2000; Liu, 2004; Grant and Lambert, 2005; Ram and Prasad, 2007). On the other hand, the dummy variable for landlocked has a negative effect on bilateral trade flows. If a pair of trading countries is landlocked and does not have any ocean port, their transportation costs will increase and their trade will decrease (Grant and Lambert, 2005; Ram and Prasad, 2007).

Exchange rate is expected to have both positive and negative effects on bilateral trade flows depending on the exporter or importer views. The appreciation of the real exchange rate of the exporting country tends to reduce its exports while the appreciation of the real exchange rate of the importing country tends to increase its imports (Bergstrand, 1989; Dascal *et al.*, 2002; Liu, 2004; Kisu, 2006).

Wholesale price index (WPI) is a proxy of the price of goods. The coefficient of the exporter wholesale price index is expected to have a positive effect on bilateral trade flows while the coefficient of the importer wholesale price index is expected to have a negative effect on bilateral trade flows. For example, if there is an increase in the price of a specific product in the exporting country, the exporter tends to produce and export more. If a product price in the importing country increases, import demand for the product will decrease (Bergstrand, 1989; Dascal *et al.*, 2002).

A dummy for intra-RTA/FTA trade bias is included in the gravity model to capture trade creation of RTA/FTA. Dummies for extra-RTA/FTA import openness, and extra-RTA/FTA export openness are added to examine trade diversion. The coefficient of intra-RTA/FTA trade bias is expected to be positive which indicates trade creation of RTA/FTA. The presence of RTA or FTA should increase trade flows among member countries. However, the coefficients of extra-RTA/FTA import openness, and extra-RTA/FTA export openness are expected to be negative which indicates trade creation of RTA/FTA. Members of RTA/FTA

tend to trade less with non-members (see Frankel and Wei, 1998; Krueger, 1999; Endoh, 2000; Elliott and Ikemoto, 2004; Jayasinghe and Sarker, 2004; Liu, 2004; Grant and Lambert, 2005). Some studies capture only trade creation with a dummy for intra-RTA/FTA trade bias while some studies capture both trade creation and trade diversion effects which add two or three dummies into the gravity model.

5.2.2 Gravity Model for Thailand Dairy Imports

The modified gravity model is employed to study the determinants of Thailand dairy import flows from its main trading partners. The most common variables used from previous studies are considered in this study including the population of exporting and importing countries, per capita GDPs of exporting and importing countries, bilateral geographical distance, and dummy variables for intra-FTA trade bias and extra-FTA trade openness. In order to examine the effects of the Thailand-New Zealand Closer Economic Partnership (THNZCEP) and the Thailand-Australia Free Trade Agreement (TAFTA) on Thailand dairy import flows, the dummies for intra-FTA trade bias and extra-FTA trade openness of both agreements are added into the modified gravity equation together, similar to Grant and Lambert (2005)'s work. The specification of the modified gravity model can be expressed as follows:

$$\begin{aligned} \ln V_{ijkt} = & \beta_0 + \beta_1 \ln POP_{it} + \beta_2 \ln POP_{jt} + \beta_3 \ln (GDP_{it}/N_{it}) + \beta_4 \ln (GDP_{jt}/N_{jt}) \\ & + \beta_5 \ln D_{ij} + \alpha_1 THNZCEP_{ijt} + \alpha_2 THNZCEPO_{ijt} + \alpha_3 TAFTA_{ijt} \\ & + \alpha_4 TAFTAO_{ijt} + \varepsilon_{ijkt} \end{aligned} \quad (5.8)$$

$$i = 1 \dots n; \quad j = \text{Thailand}; \quad k = 1 \dots m; \quad \text{and } t = 1, \dots, T$$

where

V_{ijkt} = the value of Thailand dairy import k from country i in year t in millions of U.S. dollars;

POP_{it} and POP_{jt} = the population of country i and Thailand in year t in thousand persons;

GDP_{it}/N_{it} and GDP_{jt}/N_{jt} = the per capita GDPs of country i and Thailand in year t in U.S. dollars;

D_{ij} = the geographical distance in kilometers between the capital of country i and Thailand;

| | |
|----------------------|---|
| $THNZCEP_{ijt}$ | = the dummy for intra-FTA trade bias of the THNZCEP where $THNZCEP_{ijt}$ equals 1 if country i is a member (New Zealand) in year t , and $THNZCEP_{ijt}$ equals 0 otherwise; |
| $THNZCEPO_{ijt}$ | = the dummy for extra-FTA trade openness of the THNZCEP where $THNZCEPO_{ijt}$ equals 1 if the country i is a non-member in year t , and $THNZCEPO_{ijt}$ equals 0 otherwise; |
| $TAFTA_{ijt}$ | = the dummy for intra-FTA trade bias of the TAFTA where $TAFTA_{ijt}$ equals 1 if country i is a member (Australia) in year t , and $TAFTA_{ijt}$ equals 0 otherwise; |
| $TAFTAO_{ijt}$ | = the dummy for extra-FTA trade openness of the TAFTA where $TAFTAO_{ijt}$ equals 1 if country i is a non-member in year t , and $TAFTAO_{ijt}$ equals 0 otherwise; |
| β_0 | = individual effects or country specific effects for Thailand dairy import k |
| ε_{ijkt} | = a log-normally distributed error term. |

The impacts of FTAs can be measured in terms of the relative magnitudes of trade creation (TC) and trade diversion (TD) effects. This method is based on Viner's framework (1950) (Karemera and Koo, 1994; Bhagwati *et al.*, 1999; Clausing, 2001).

Frankel and Wei (1998), Krueger (1999) and Jayasinghe and Sarker (2004) use the gravity model with relevant dummy variables to capture the trade impacts of FTAs. Trade creation and diversion show how a FTA helps or hinders global free trade. In other words, a FTA either enhances or reduces the welfare of member and non-member countries. According to DeRosa (2003) "*The change in consumer surplus corresponds to the change in national welfare occasioned mainly by trade creation and the in producer surplus corresponds to the change in national welfare occasioned mainly by trade diversion*" (DeRosa, 2003, pp. 6). This implies that the trade creation and trade diversion of a FTA lead to changes in consumer and producer surplus respectively which results in national welfare effects. Grant and Lambert (2005) also state that comparing the magnitudes of trade creation and trade diversion within each FTA can indicate a rough welfare estimate.

In equation 5.8, $THNZCEP_{ij}$ and $TAFTA_{ij}$ represent intra-FTA trade bias. The coefficients of $THNZCEP_{ij}$ and $TAFTA_{ij}$ (α_1 and α_3) indicate the trade creation effect of both FTAs. If α_1 and α_3 are positive, it implies that the presence of both FTAs increases intra-FTA trade or produces the trade creation. If they are negative, it implies that the presence of both FTAs decreases intra-FTA trade, which shows there is no occurrence of trade creation by both FTAs. The percentage of the trade creation effect is calculated by subtracting one from the exponent of the regression coefficient and then multiplying the result by 100, for example, $[(\exp(\alpha_1) - 1) \times 100]$ or $[(\exp(\alpha_3) - 1) \times 100]$.

The dummy coefficients for extra-FTA trade openness ($THNZCEPO_{ij}$ and $TAFTAO_{ij}$) stands for FTA member's net imports from the rest of the world, which captures the trade diversion effect. If α_2 and α_4 are negative, it means that a FTA member country reduces its imports from non-member countries or produces the trade diversion. If α_2 and α_4 are positive, it means that there is no occurrence of trade diversion by both FTAs. The percentage of the trade diversion effects of both THNZCEP and TAFTA equal $[(\exp(\alpha_2) - 1) \times 100]$ or $[(\exp(\alpha_4) - 1) \times 100]$, respectively.

5.3 The Assessment of the Import Price Effects of Free Trade Agreements (FTAs)

5.3.1 The Price Effects on Imports from FTA Member Countries

Following the implementation of a free trade agreement, member countries will reduce or eliminate tariffs for imports between them. This may, or may not, result in an equivalent decrease in their import prices. Under perfect competition, a reduction in tariff is completely passed through to the import price. But in cases of monopolistic competition, only part of the tariff reduction is passed through to consumers in the importing country, the rest is absorbed by a member's exporters in terms of higher export prices. This phenomenon is known as an incomplete tariff rate pass-through to import prices (Kreinin, 1961; Brander and Spencer, 1984; Feenstra, 1989; Tantirigama, 2006). Feenstra (1989) and Winkelmann and Winkelmann (1997) also pointed out that in the case of the incomplete tariff rate pass-through to import price, an increase (decrease) in the tariff rate results in a decrease (increase) in producer price and a welfare gain (loss) to the importing country.

Thailand is a small participant as a net importer in the dairy product trade. Its dairy import market faces imperfect competition which is dominated by New Zealand, Australia and the

European Union (EU), similar to other Asian countries' dairy markets (see Peng, 2006) and the world dairy market (see Blank, 1986). New Zealand and Australia have been the main suppliers of Thailand dairy imports with more than 50 percent of Thai dairy import market share. While Thailand-New Zealand Closer Economic Partnership (THNZCEP) and Thailand-Australia Free Trade Agreement (TAFTA) are implemented, both countries have the market power to influence import price changes in the Thai dairy market. It is important to study how the prices of Thailand dairy imports from New Zealand and Australia adjust following their tariff changes.

In addition, the exchange rate is an important factor affecting international price changes. Under the floating exchange rate system, export and import prices are determined by exchange rate movements. What will happen to the trade prices when the exporter's or importer's currency depreciates or appreciates is an interesting empirical question. In the imperfect competitive market theory, exporters who have market power in their destination markets to practise pricing-to-market (PTM) by adjusting their mark-ups from their domestic currency price (so-called producer currency price, PCP) according to an exchange rate variation. Therefore, the import price in the importing country's currency (so-called local currency price, LCP) is partially changed in response to the exchange rate movement. This phenomenon is known as incomplete exchange rate pass-through. On the other hand, exporters in the perfect competitive market practise complete exchange rate pass-through. They do not adjust their mark ups following the exchange rate movement, therefore the import price in the importing country's currency will change proportionately to the exchange rate change (Lee and Tcha, 2005).

Studying tariff and exchange rate pass-through in Thailand import prices of dairy products reinforces the understanding of the main dairy exporter's pricing behaviour in the Thai dairy market. The conceptual framework used in our study is based on the exporter profit maximization under imperfect competition. The import demand is determined by the import price. The import price is the foreign export price denoted in the importer currency which is expressed as the following equation:

$$p_m = pe(1+t) \quad (5.9)$$

where p_m is the price in the importer currency, p is the price in the exporter currency, e is the exchange rate in terms of the importer currency per unit of the exporter currency, and t is the import tariff. This framework is similar to Tantirigama (2006), and Mallick and Marques (2008) studies.

Suppose that an exporter from New Zealand or Australia exports its dairy product to Thailand and Thailand demand for the dairy product is shown in the following equation:

$$q = q(p_m) = q[pe(1+t)] \quad (5.10)$$

where q is the quantity demand for the dairy product in the Thailand market, p_m is the price of the dairy product in Thailand currency, p is the price of the dairy product in New Zealand or Australian currency, e is the exchange rate which is denoted as Thailand currency per unit of New Zealand or Australian currency and t is an *ad valorem* tariff on Thailand dairy imports. In addition, the import demand function in equation (5.10) is implicitly determined by the price of substitute goods, the exporter market share, income and promotion expenditure (Feenstra, 1989; Tantirigama, 2006).

Then, the exporter profit function in its own currency for the dairy product is:

$$\pi = pq[pe(1+t)] - c(q) \quad (5.11)$$

where $c(q)$ is the exporter cost function in its own currency for the dairy product. The exporter cost is not only determined by the import demand but also by the cost of inputs. The first-order condition for profit maximization of equation (5.11) gives equality of marginal cost with marginal revenue as follows:

$$p + q \cdot \frac{dp}{dq} = c', \text{ or } \quad p \left(1 - \frac{1}{E} \right) = c', \text{ or } \quad p = c' \left(\frac{E}{E-1} \right) \quad (5.12)$$

In an imperfectly competitive market, the optimal export price (p) in equation (5.12) is a mark-up over marginal cost (c'). The exporter can practise price discrimination across different markets by adjusting its mark-up. The ability to adjust its mark-up across markets following changes in tariff and exchange rates depends on the elasticity of import demand (E). The elasticity of import demand is defined as the elasticity with respect to an import price, holding all other factors constant, which is given as follows:

$$E = \frac{\partial q}{\partial pe(1+t)} \cdot \frac{pe(1+t)}{q} = - \frac{q'}{q} \cdot pe(1+t) \quad (5.13)$$

The elasticity of import demand is not only a function of $pe(1+t)$, but is also implicitly influenced by other import demand determinants such as competitor price, exporter market share, income, and promotional expenditure. Therefore, the exporter price is determined by the cost of inputs, the import tariff rate, the exchange rate, the competitor price, the exporter

market share, income and the exporter promotional expenditure (Feenstra, 1989; Tantirigama, 2006).

The effects of tariff and exchange rate changes on the export price can be derived by taking the derivative of equation (5.12) with respect to tariff (t) and exchange rate (e) respectively, assuming c' as constant. The effect of tariff changes on export price is given as follows:

$$\frac{\partial p}{\partial t} = -c' \cdot \frac{1}{(E-1)^2} E' \left(\frac{\partial p_m}{\partial t} \right) \quad (5.14)$$

$$\frac{\partial p}{\partial t} = \frac{-E'c'}{(E-1)^2} \cdot \frac{\partial [pe(1+t)]}{\partial t} \quad (5.15)$$

$$\frac{\partial p}{\partial t} = \frac{-E'c'pe}{(E-1)^2 + E'c'e(1+t)}, \text{ where } E' = \frac{\partial E}{\partial p_m} = \frac{\partial E}{\partial pe(1+t)} \quad (5.16)$$

Hence, the tariff elasticity of export price is given by:

$$\frac{\partial p}{\partial t} \cdot \frac{t}{p} = \frac{-E'c'et}{(E-1)^2 + E'c'e(1+t)} \quad (5.17)$$

Analogically, if the exchange rate changes and c' is held constant, the effect on the export price can be derived as follows:

$$\frac{\partial p}{\partial e} = -c' \cdot \frac{1}{(E-1)^2} E' \left(\frac{\partial p_m}{\partial e} \right) \quad (5.18)$$

$$\frac{\partial p}{\partial e} = \frac{-E'c'}{(E-1)^2} \cdot \frac{\partial [pe(1+t)]}{\partial e} \quad (5.19)$$

$$\frac{\partial p}{\partial e} = \frac{-E'c'p(1+t)}{(E-1)^2 + E'c'e(1+t)}, \text{ where } E' = \frac{\partial E}{\partial p_m} = \frac{\partial E}{\partial pe(1+t)} \quad (5.20)$$

Hence, the exchange rate elasticity of the export price is given by:

$$\frac{\partial p}{\partial e} \cdot \frac{e}{p} = \frac{-E'c'e(1+t)}{(E-1)^2 + E'c'e(1+t)} \quad (5.21)$$

The tariff and exchange rate elasticities in equations (5.17) and (5.21) indicate the degree of pricing-to-market into export prices. The degree of pricing-to-market is defined as the adjustment of the exporter price or mark-up in the exporter currency with respect to changes in tariff or exchange rates. If we consider in terms of import prices (prices in the importer currency), the tariff and exchange rate elasticities indicate tariff rate pass-through and

exchange rate pass-through into import prices which are defined as the response of the importer currency prices induced by changes in tariff and exchange rates respectively. Both the pricing-to-market and pass-through describe the same thing but different aspects. However, there is an inverse relationship between them. For example, the relationship between pricing-to-market (PTM) and exchange rate pass-through (ERPT) is expressed as $PTM = 1 - ERPT$ or $ERPT = 1 - PTM$ (Pholphirul, 2007).

According to Brander and Spencer (1984), Feenstra (1989), Tantirigama (2006), and Mallick and Marques (2008), the tariff and exchange rate pass-through at the product level can be empirically examined by including them as explanatory variables in the import price equation (5.9) of the product. By the relationship $p_m = pe(1+t)$, the factors influencing the import price are similar to the determinant of the export price.

5.3.1.1 Summary of Variables Used in the Import Price Model for FTA Members

The import price equation can be analysed both at the aggregated and disaggregated levels. The most common dependent variable is the import price denoted as a unit value index of imports in the importing country's currency. The unit value index is prevalently used for a proxy of real prices because the real prices data are inaccessible (King and Steel, 1998). According to Tantirigama (2006), key factors affecting changes in import prices of products are tariff and exchange rates. In addition, import demand shifters such as prices of substitute products, production costs, consumer income, industrial productivity index and capacity utilization, market share, and trade openness determine import price movement (see Table 5.4).

The import tariff is included in the import price model for capturing an effect of a change in tariff rate on prices of imports known as tariff rate pass-through (TRPT). The coefficient of the import tariff is expected to be positive which indicates the percentage increase in the import price for a 1% increase in the tariff rate. Feenstra (1989) and Nicita (2009) found that the estimated coefficient of the import tariff is positive and statistically significant while Tantirigama (2006) and Mallick and Marques (2008) found that the coefficient sign of the import tariff varies across commodities.

The exchange rate is added in the import price model for examining an effect of exchange rate changes on import prices known as exchange rate pass-through (ERPT). The coefficient sign of the exchange rate is hypothesised to be positive. An increase in the exchange rate (a depreciation of domestic currency) results in an increase in the import price (see Feenstra,

Table 5.4 Variables used in the import price equation and the hypothesised signs

| Variables | Types of variables | Expected signs | Estimated signs by previous studies | | | | | |
|---|--------------------|----------------|--|-------------------------|-------------------------|-------------------------|--|--|
| | | | Feenstra (1989) | Hooper and Mann (1989) | King and Steel (1998) | Sahminan (2002) | Pholphirul (2003) | Lee and Tcha (2005) |
| Dependent Variable | Continuous | | Import prices for selected commodities | Aggregated import price | Aggregated import price | Aggregated import price | Import prices for selected commodities | Import prices for selected commodities |
| Explanatory Variables | | | | | | | | |
| - Import tariff rate | Continuous | (+) | (+) | | | | | |
| - Exchange rate | Continuous | (+) | (+) | (+) | (+) | (+) | (+)/(-) | (+)/(-) |
| - Domestic price in the importing country | Continuous | (+) | (+) | (+) | (+)/(-) | (+)/(-) | | |
| - Competitor price | Continuous | (+) | (+) | | | | | (+)/(-) |
| - World price | Continuous | (+) | | | | | | |
| - Domestic price in the exporting country | Continuous | (-) | | | | | | |
| - Exporter cost/producer price index (PPI) | Continuous | (+) | | (+) | (+) | (+)/(-) | (+) | |
| - Trade cost (measured by tariff*distance) | Continuous | (+) | | | | | | |
| - Importer income/expenditure/ productivity index/industrial production index | Continuous | (+) | (+)/(-) | | | | (+)/(-) | |
| - Exporter capacity utilization rate | Continuous | (+) | | (+)/(-) | (+)/(-) | (+)/(-) | | |
| - Exporter market share in the importing country | Continuous | (+)/(-) | | | | | | (+)/(-) |
| - Importer trade openness index (TOI) | Continuous | (+) | | | | | | |
| - Monthly dummy | Dummy | (+)/(-) | | | | | | |
| - Dummy for disease ban | Dummy | (+)/(-) | | | | | | |
| - Dummy for financial crisis | Dummy | (-) | | | | | (+)/(-) | |

Table 5.4 Variables used in the import price equation and the hypothesised signs (continued)

| Variables | Types of variables | Expected signs | Estimated signs by previous studies | | | | | |
|---|--------------------|----------------|--|--|--|-------------------------|---------------------------|--|
| | | | Tantirigama (2006) | Miljkovic and Zhuang (2011) | Mallick and Marques (2008) | Ghosh and Rajan (2009) | Nicita (2009) | Pyne and Roy (2009) |
| Dependent Variable | Continuous | | Import prices for selected commodities | Import prices for selected commodities | Change in import prices for selected commodities | Aggregated import price | Aggregated consumer price | Aggregated and disaggregated import price in exporter currency |
| Explanatory Variables | | | | | | | | |
| - Import tariff rate | Continuous | (+) | (+)/(-) | | (+)/(-) | | (+) | |
| - Exchange rate | Continuous | (+) | (+)/(-) | (+) | (+)/(-) | (+) | | (-) |
| - Domestic price in the importing country | Continuous | (+) | | (+) | | | (+) | (+) |
| - Competitor price | Continuous | (+) | (+)/(-) | | | | | |
| - World price | Continuous | (+) | | | | | (+)/(-) | |
| - Domestic price in the exporting country | Continuous | (-) | | | | | | (-) |
| - Exporter cost/producer price index (PPI) | Continuous | (+) | (+)/(-) | (+) | | (+)/(-) | | |
| - Trade cost (measured by tariff*distance) | Continuous | (+) | | | | | (+)/(-) | |
| - Importer income/expenditure/ productivity index/industrial production index | Continuous | (+) | | (+) | | (+)/(-) | | (+) |
| - Exporter capacity utilization rate | Continuous | (+) | | | | | | |
| - Exporter market share in the importing country | Continuous | (+)/(-) | (+)/(-) | | | | | |
| - Importer trade openness index (TOI) | Continuous | (+) | | | | | | (+) |
| - Monthly dummy | Dummy | (+)/(-) | | (+)/(-) | | | | |
| - Dummy for disease ban | Dummy | (+)/(-) | | (+)/(-) | | | | |
| - Dummy for financial crisis | Dummy | (-) | | | | | | |

1989; Hooper and Mann, 1989; King and Steel, 1998; Sahminan, 2002; Pholpirul, 2003; Lee and Tcha, 2005; Tantirigama, 2006; Miljkovic and Zhuang, 2011; Mallick and Marques, 2008; Ghosh and Rajan, 2009; Pyne and Roy, 2009). Most previous studies discovered that the exchange rate has a significantly positive effect on the import price.

The prices of substitute products would have a positive effect on the import price. A rise in the prices of substitute products would increase the import demand and the import price. Some studies used a local producer price as a proxy for the price of substitute products (see Hooper and Mann, 1989; King and Steel, 1998; Sahminan, 2002; Miljkovic and Zhuang, 2011; Nicita, 2009; Pyne and Roy, 2009) while a foreign competitor price is used by Lee and Tcha (2005), Tantirigama (2006) and Nicita (2009). Feenstra (1989) examined the effects of both local and foreign competitor prices on the import prices for selected products. The domestic product price in the exporting country is expected to have a negative effect on the price of imports in the importing country. When the exporter domestic price for a product increases, the exporter excess supply for the product will increase and result in a decrease in the price of imports in the importing country. However, Pyne and Roy (2009) found that this variable has the correct sign but is statistically insignificant.

The exporter production and trade costs are expected to have positive effects on the import price. The exporter production cost can be proxied by the wholesale price index (Feenstra, 1989), a unit labour cost or input cost (Hooper and Mann, 1989; King and Steel, 1998; Miljkovic and Zhuang, 2011), or the producer price index (Sahminan, 2002; Tantirigama, 2006; Ghosh and Rajan, 2009). Trade cost is measured by an interaction term between tariff rate and distance (Nicita, 2009).

The importer income represents the import demand pressure in the importing country. The expected sign for the consumer income is positive. An increase in the consumer income would result in an increase in the import demand and the import price. Generally, income is proxied by GDP (Feenstra, 1989; Ghosh and Rajan, 2009). But some studies at the disaggregated level employed other proxies of income such as consumer expenditure (see Miljkovic and Zhuang, 2011) and the industrial production index (see Pholpirul, 2003; Pyne and Roy, 2009).

Exporter capacity utilization rate represents the domestic demand pressure in the exporting country which has a positive effect on the import price. If the exporter domestic demand for a product increases, its production is close to full capacity. Then, the exporter may increase the

product price (Hooper and Mann, 1989; King and Steel, 1998; Sahminan, 2002). If the exporter capacity utilization rate is inaccessible, King and Steel (1998) and Sahminan (2002) suggested using the exporter industrial production index as a proxy.

The market share would have a negative or positive effect on the import price. The relationship between the import price and market share in the importing country indicates how the exporter charges its price in the importing country market according to market share. The coefficient sign for the market share can imply the exporter competitive status in the importing country market. A negative sign of the market share coefficient indicates that the exporter with a relatively large market share reduces its mark-up which results in a decrease in the import price to compete with other foreign exporters. This occurs in the perfectly competitive market. On the other hand, a positive coefficient of the market share implies that there is monopolistic competition in the importing country market. The exporter with a relatively large market share can increase its mark-up and price in the importing country owing to its market power (Lee and Tcha, 2005). Similar to Tantirigama (2006), exporters in imperfectly competitive market can set different prices across their export markets depending on their market power.

The trade openness index (TOI) is a share of the importing country's trade volumes on its GDP. The expected sign of the importer TOI on the import price would be positive. Pyne and Roy (2009) used the share of import orientation ratio (IOR) as a proxy of the TOI which is calculated as a percentage of the importing country's import on its GDP. An increase in the IOR indicates a growth in the import demand which leads to an increase in the import price (Pyne and Roy, 2009).

Dummy variables used in previous studies include monthly, disease ban and financial crisis. The monthly dummy is added to capture seasonal effects on the import price which can be either positive or negative. The dummy for a disease ban is included in the import price model for agricultural products. It has a negative effect on the import price for the considered product, but a positive effect on the import price for the substituted product (Miljkovic and Zhuang, 2011). The dummy for the Asian financial crisis is expected to exhibit a negative effect on the import price (Pholphirul, 2003).

5.3.1.2 Empirical Equation for Thailand Dairy Import Prices from FTA Members

The response of a product's import price to trade policy and exchange rate changes can be empirically measured by including them as explanatory variables in the import price equation (Brander and Spencer, 1984; Feenstra, 1989; Tantirigama, 2006; Mallick and Marques, 2008).

Apart from the two variables, the product's import price derived from the exporter profit maximization under imperfect competition is determined by export supply and import demand shifters such as the exporter production costs or input costs, the competitor prices, the exporter market share, income, promotional expenditure and dummy variables for monthly, disease ban and financial crisis (Feenstra, 1989; Tantirigama, 2006).

The price effect of the Thailand-New Zealand Closer Economic Partnership (THNZCEP) and the Thailand-Australia Free Trade Agreement (TAFTA) on Thailand dairy imports from New Zealand and Australia (FTA member countries) employs the import price equation based on the theoretical framework described in section 5.3.1. The prices of Thailand dairy imports from the two countries are determined by exchange rates, import tariff rates, competitor prices, exporter market shares in Thailand and dummy variable for drought in exporting countries. This relationship is expressed as a double log-linear form in equation (5.22) which is estimated by regressing separately for each exporting country and dairy product.

$$\ln pm_{ikt} = \alpha_{ik} + \beta_{1ik} \ln e_{it} + \beta_{2ik} \ln tar_{ikt} + \beta_{3ik} \ln cp_{ikt} + \beta_{4ik} \ln z_{ikt} + \beta_{5ik} D_{it} + v_{ikt} \quad (5.22)$$

i = New Zealand or Australia; $k = 1 \dots m$; and $t = 1, \dots, T$

where

- $\ln pm_{ikt}$ is the log import price (unit value) of dairy product k from exporter i (New Zealand and Australia) denoted in Thailand currency (Thai Baht);
- $\ln e_{it}$ is the log exchange rate defined as Thailand currency per exporter i 's currency;
- $\ln tar_{ikt}$ is the log average import tariff rate for Thailand dairy import k from exporter i ;
- $\ln cp_{ikt}$ is the log competitor price of exporter i for dairy product k (unit value denoted in Thai Baht);
- $\ln z_{ikt}$ is log exporter i 's market share for dairy product k in Thailand;
- D_{it} is the dummy variable for drought in exporting countries where D_{it} equals 1 if country i encounters with drought in year t , and where D_{it} equals 0 otherwise;
- α_{ik} is constant terms among source country i for dairy import k ;

$\beta_{1ik}, \beta_{2ik}, \beta_{3ik}, \beta_{4ik}, \beta_{5ik}$ are elasticities of the import price of dairy product k from exporter i with respect to exchange rate, tariff rate, competitor price, exporter market share and the dummy variable for drought in exporting countries, respectively;

V_{ikt} is the disturbance term.

β_{1ik} is the degree of exchange rate pass-through of dairy products from different source countries which explains how the prices of dairy imports denoted in Thailand currency change with respect to the exchange rate movement. Besides, the degree of exchange rate pass-through can indirectly reflect the degree of pricing-to-market which explains how a dairy exporter adjusts its price in the domestic currency according to exchange rate fluctuations or the degree of pricing-to-market and indicates the market competition status in Thailand dairy import markets (Tantirigama, 2006).

If $\beta_{1ik} = 0$, there is no exchange rate pass-through. This explains that the import price expressed in Thai Baht is unchanged with respect to an increase in the exchange rate (Thailand currency devaluation) because an exporter fully reduces its mark up to stabilise the price in Thailand. If $\beta_{1ik} = 1$, there is a complete exchange rate pass-through into the price of Thailand dairy imports. When the Thai Baht moves higher against the exporter currency, the exporter does not adjust its domestic currency mark-up or price (non-pricing-to-market). Therefore, the import price expressed in Thai Baht increases proportionally with Thailand currency devaluation. This implies that Thailand dairy import market is perfect competition. If $\beta_{1ik} < 1$, it implies that there is a less than complete exchange rate pass-through into the import price known as an incomplete exchange rate pass-through. When Thailand currency devaluation (the exporter currency appreciation) occurs, the exporter reduces the mark-up partially to maintain its market share, hence the import price expressed in Thai Baht increases incompletely with Thailand currency devaluation. If $\beta_{1ik} > 1$, it implies that there is a more than complete exchange rate pass-through into the import price. The exporter increases the mark-up partially according to Thailand currency devaluation, then the import price expressed in Thai Baht increases more than the exchange rate change (see Table 5.5). The last two cases both imply that the Thailand dairy import market is imperfect competition.

Table 5.5 Relationship of the exchange rate pass-through and pricing-to-market

| Types of exchange rate pass-through | Exchange rate (THB/NZD) | Export price (NZD) | Import price (THB) | Types of pricing-to-market |
|--|-----------------------------|-----------------------------|------------------------|-------------------------------------|
| No exchange rate pass-through ($\beta_{1ik}=0$) | Increased 1% (Depreciation) | Reduced mark up 1% | Unchanged import price | Negative complete pricing-to-market |
| Complete exchange rate pass-through ($\beta_{1ik}=1$) | Increased 1% (Depreciation) | Unchanged mark up | Increased 1% | No pricing-to-market |
| Less than complete (incomplete) exchange rate pass-through ($\beta_{1ik}<1$) | Increased 1% (Depreciation) | Partially reduced mark up | Increased less than 1% | Negative partial pricing-to-market |
| More than complete exchange rate pass-through ($\beta_{1ik}>1$) | Increased 1% (Depreciation) | Partially increased mark up | Increased more than 1% | Positive partial pricing-to-market |

Source: Tantirigama (2006)

There is an inverse relationship between the degree of pricing-to-market and the degree of exchange rate pass-through in which $PTM = 1 - ERPT$. If the degree of exchange rate pass-through is low, the degree of pricing-to-market is high (Pholphirul, 2007). If we know the coefficient of exchange rate pass-through (β_{1ik}), we can approximately measure the absolute value of the degree of pricing-to-market by $1 - \beta_{1ik}$ (Tantirigama, 2006). Therefore, this study also reveals the pricing behaviour of New Zealand and Australian dairy exporters in the Thailand dairy market.

The elasticity of the import price with respect to the tariff (β_{2ik}) is expected to be positive which indicates tariff rate pass-through into the import price. The interpretation of the tariff rate pass-through is similar to the exchange rate pass-through. If $\beta_{2ik}=0$, there is no tariff rate pass-through. When Thailand tariff rate for New Zealand and Australian dairy products reduces, exporters from both countries increase their mark-up or price in proportion to the tariff reduction, hence the import price in Thai Baht is constant. If $\beta_{2ik}=1$, there is a complete tariff rate pass-through. The import price of dairy products in Thai Baht decreases proportionally with the tariff reduction because the exporters keep their mark-ups stable. If $\beta_{2ik}<1$, there is an incomplete tariff rate pass-through. The import price of dairy products in Thai Baht decreases partially with the tariff reduction because the exporter partially increases its mark-up or price in the local currency. If $\beta_{2ik}>1$, there is a more than complete tariff rate

pass-through. The exporter partially decreases its mark-up or price of dairy products in the local currency with respect to the tariff reduction, and then the import price in Thai Baht decreases more than the tariff reduction (Tantirigama, 2006; Nicita, 2009).

β_{3ik} is the elasticity of import price with respect to the competitor price. A positive effect of the competitor price on the import price indicates the co-movement in the pricing strategy between the exporter and its competitor (Lee and Tcha, 2005; Tantirigama, 2006). β_{4ik} is the elasticity of import price with respect to the exporter market share which would be negative or positive. β_{5ik} is the coefficient of the dummy variable of drought in the exporting countries which would be positive.

The tests for the import price equation in this study include three hypotheses as follows:

1) The hypothesis of complete exchange rate pass-through ($H_0 : \beta_{1ik} = 1$, all i and k).

The rejection of the null hypothesis indicates that there is a less or more than complete exchange rate pass-through into the price of Thailand dairy imports.

2) The hypothesis of complete tariff rate pass-through ($H_0 : \beta_{2ik} = 1$, all i and k).

The rejection of the null hypothesis indicates that there is a less or more than complete tariff rate pass-through into the price of Thailand dairy imports.

3) The hypothesis of symmetric pass-through of exchange rate and tariff ($H_0 : \beta_{1ik} = \beta_{2ik}$, all i and k).

In theory, there is no difference between exchange rate and tariff pass-through. The rejection of the null hypothesis indicates an asymmetric pass-through of exchange rate and tariff.

These three hypotheses impose the restrictions in regression analysis which are tested with Wald statistics.

5.3.2 Import Price Effects on Non-Members of Free Trade Agreements (FTAs)

Trade liberalization policies such as regional and free trade agreements not only affect changes in the export and import prices of their member countries, but also their non-member country prices. When there is a preferential tariff reduction for an exporter from a FTA member country, its price in the importer's market is cheaper than other non-FTA member countries. If the exporter from the FTA member country practises incomplete tariff rate pass-through into import prices, a fall in its post-tariff price is less than the tariff reduction because

the exporter is likely to increase its pre-tariff price partially, while other exporters from non-FTA member countries tend to reduce their pre-tariff prices in compensation (Winters and Chang, 1997). The analysis of the effect of preferential tariff reduction for FTA member countries on non-FTA member countries' prices is based on the framework of tariff rate pass-through initially introduced by Winters and Chang (1997). They derived the empirical model for measuring the price effect of the European Union (EU) on its non-member in Spanish market from the profit maximization of the two exporting firms, an EU member (which received the tariff preference) and a non-EU member country. The two exporting firms are assumed to perform a Bertrand game in Spanish market and to maximize profits from Spanish sales.

The effects of the THNZCEP and TAFTA on dairy product prices of non-FTA member countries in Thailand market are investigated by applying Winters and Chang (1997)'s theoretical framework and empirical model. Following the implementation of the THNZCEP and TAFTA, Thailand reduced or eliminated tariffs for dairy imports from New Zealand and Australia while it still imposes the original tariff on non-FTA member countries. If New Zealand and Australian dairy exporters manipulate the Thailand dairy import market, they generally practise incomplete tariff rate pass-through into import prices in the Thailand market. The import prices (post-tariff prices) for dairy products from New Zealand and Australia in Thailand market will decrease partially with respect to the tariff reduction because New Zealand and Australian exporters raise their mark-ups or pre-tariff prices partially. On the other hand, other dairy exporters from non-FTA member countries who lose their competitive advantage will reduce their pre-tariff prices partially in compensation in the Thailand dairy import market.

A simple model to generate the price effects of the THNZCEP and TAFTA on Thailand dairy imports is based on the profit maximization of two dairy exporting firms, a FTA member and a non-FTA member, in Thailand dairy import market. The price effects of the THNZCEP and TAFTA are analysed separately in each model. For example, in the case of the model for the price effects of the THNZCEP, it is assumed that Thailand imports dairy products from two sources; a FTA member dairy exporting firm (a New Zealand dairy exporter) and a non-FTA member dairy exporting firm. The New Zealand dairy exporter obtains a preferential tariff reduction. Both dairy exporting firms behave in a Bertrand fashion and maximize profits in terms of their own currency in Thailand dairy import market. The objective functions of the two dairy exporting firms, the New Zealand exporter (denoted by *) and the non-member dairy exporter are given by:

$$Max_p \left\{ \frac{e}{\tau} pq(p, p^*, P, Y - c(q)w) \right\} \quad (5.23a)$$

$$Max_{p^*} \left\{ \frac{e^*}{\tau^*} p^* q^*(p, p^*, P, Y - c^*(q^*)w^*) \right\} \quad (5.23b)$$

where e is the exchange rate in terms of the exporter currency units per Thailand currency, p is the dairy product price including tariffs in Thailand currency, τ is the *ad valorem* tariff factor $(1+t)$, where t is Thailand tariff rate on this dairy product, $q(p, p^*, P, Y)$ and $q^*(p, p^*, P, Y)$ are Thailand import demand functions for the dairy product from the non-FTA member country and the FTA member country (New Zealand) respectively, P and Y are Thailand aggregated price level and total income; $c(q)$ is the number of composite factor units required to transfer one unit of the dairy product to Thailand, and w is the unit cost of the composite factor.

The first-order conditions for the firms' profit maximization of equations (5.23a) and (5.23b) give the following export price equations:

$$p = \pi \left(\frac{w\tau}{e}, p^*, P, Y \right) \quad (5.24a)$$

$$p^* = \pi^* \left(\frac{w^*\tau^*}{e^*}, p, P, Y \right) \quad (5.24b)$$

The optimal prices for the dairy product of the non-FTA member country and New Zealand exporters as in equations (5.24a) and (5.24b) respectively are determined by the exporter cost with tariff denoted in the exporter currency, Thailand tariff for the dairy import, the competitor price, Thailand aggregated price level and total income.

However, the empirical estimation of equations (5.24a) and (5.24b) directly cannot examine the effect of the tariff reduction under the THNZCEP on the non-FTA member country's dairy product price in Thailand market. Winters and Chang (1997) initiated the use of a simple equation of the ratio of non-member to member product prices to capture the price effect of a regional integration on its non-member countries. The relative price is determined by the relative exporter cost, the relative tariff and the relative capacity utilization index. The main interest of Winters and Chang (1997)'s model is to illustrate how the relative tariff affects the relative price. This does not explain the effect on the non-member price with respect to the member's tariff reduction directly.

The use of a simple equation of the price ratio is adopted in recent studies such as Winters and Chang (2000) and Özden and Sharma (2006) because the equation of the relative price is a robust econometric method which involves the relationship between the member and non-member prices and reduces the spurious correlation problem in regression analysis. Winters and Chang (2000)'s method is more practical to capture the effect of the FTA member's tariff reduction on its non-member prices. They explain that the relative price of non-member to member countries is determined by export supply and import demand determinants as in equations (5.24a) and (5.24b) such as exporter cost with tariff, the importer aggregated price index and total income but excluding the competitor price effect. The tariff effect on the relative price is primarily interesting, so it can be examined by splitting the tariff from the exporter cost as new explanatory variables.

$$\frac{p}{p^*} = \sigma \left(\frac{w}{e}, \frac{w^*}{e^*}, \tau, \tau^*, P, Y \right) \quad (5.25)$$

The effect of the THNZCEP on the non-FTA member country's dairy product price is empirically estimated by a single equation of the price ratio between the non-FTA member country and New Zealand dairy products in Thailand dairy import market as in equation (5.25). The estimated coefficient of τ^* explains that how the tariff preference change under the THNZCEP affects non-member import prices. The model for the price effects of the TAFTA can be derived in the same way as an Australian dairy exporter represents a TAFTA member exporter.

The model described above has only one non-FTA member country, but in fact, there are more non-FTA member countries which supply dairy products to Thailand. Three non-FTA member countries of Thailand top trading partners for dairy imports are included in the empirical analysis.

5.3.2.1 Summary of Variables Used in the Ratio of Non-Member to Member Product Prices Equation

There are not many *ex-post* studies examining the price effect of regional or free trade agreements on their non-member countries. Most previous studies focus on the effect on trade volumes rather than prices because the trade price effect is smaller and more complicated to measure than the trade flow effect. However, in an imperfectly competitive market such as an oligopolistic or monopolistic market, the effect of a FTA on trade price exhibits significant impact (Winters and Chang, 1997).

From previous studies, the dependent variable can be both the ratio of non-member to member import prices (Winters and Chang, 1997, 2000) and the ratio of member to non-member export prices (Özden and Sharma, 2006). The prices are shown as unit value indices. For the import price ratio equation, explanatory variables are import demand and export supply determinants such as exporter costs, import tariffs, exporter capacity utilization, importer incomes, importer aggregated price indices, export quantities and import quantities (see Table 5.6).

The relative exporter costs, the relative capacity utilization terms and the relative tariffs between member and non-member countries are hypothesized to have positive effects on the relative import prices. An increase in the relative exporter costs, the relative capacity utilization terms and the relative tariffs lead to an increase in the relative import prices. Winters and Chang (1997) found that the estimated coefficients of the relative exporter costs are positive and statistically significant while the estimated coefficient of the relative capacity utilization terms are both positive and negative signs and mildly significant. The effect of the relative tariffs is statistically insignificant.

Winters and Chang's (2000) study did not consider independent variables in terms of the ratio because of the difficulty in interpreting the result. They examined the effects of import tariffs, exporter costs, capacity utilization of member and non-member countries separately. The non-member import tariffs, exporter costs and capacity utilization are expected to have positive effects on the ratio of non-member to member product prices while the member import tariffs, exporter costs and capacity utilization would have negative effects. Another two explanatory variables are included in the Winters and Chang (2000) model such as the importing country's income and aggregated price index. The coefficient signs of both variables are hypothesized to be positive. From their result, the estimated coefficients for non-member tariffs, member tariffs, non-member export costs, member export costs, and the importing country's aggregated price index are correct in signs only.

For the export price ratio model of Özden and Sharma (2006), the explanatory variables include the difference in tariffs between non-member and member countries, the member total export volume and the importing country's total import volume. The three explanatory variables are hypothesized to have positive effects on the ratio of member to non-member export prices. The most interesting variable is the tariff difference. When the difference between member and non-member tariffs increases due to the member tariff reduction, the member exporter raises its export price while the non-member exporter reduces its export price in compensation. Therefore, the ratio of member to non-member export prices increases.

The results of Özden and Sharma (2006) show that the estimated coefficients for the tariff difference, member total export volume and importing country's total import volume are statistically significant with the expected signs.

Table 5.6 Variables used in of the ratio of non-member to member product prices equations and hypothesized signs

| Variables | Types of variables | Expected signs | Estimated signs by previous studies | | |
|--|--------------------|----------------|---|---|---|
| | | | Winters and Chang (1997) | Winters and Chang (2000) | Özden and Sharma (2006) |
| Dependent Variable | Continuous | | The ratio of non-member to member import prices | The ratio of non-member to member import prices | The ratio of member to non-member export prices |
| Explanatory Variables | | | | | |
| - The ratio of non-member to member exporter costs | Continuous | (+) | (+) | | |
| - The ratio of non-member to member tariffs | Continuous | (+) | (+)/(-) | | |
| - The ratio of non-member to member capacity utilization indices | Continuous | (+) | (+)/(-) | | |
| - Import tariff rate for a non-member product | Continuous | (+) | | (+) | |
| - Import tariff rate for a member product | Continuous | (-) | | (-) | |
| - Non-member exporter cost | Continuous | (+) | | (+) | |
| - Member exporter cost | Continuous | (-) | | (-) | |
| - Non-member capacity utilization index | Continuous | (+) | | (-) | |
| - Member capacity utilization index | Continuous | (-) | | (+) | |
| - The importing country's income | Continuous | (+) | | (-) | |
| - The importing country's aggregated price index | Continuous | (+) | | (+) | |
| - The difference between non-member and member tariffs | Continuous | (+) | | | (+) |
| - Member total export volume | Continuous | (+) | | | (+) |
| - Importing country's total import volume | Continuous | (-) | | | (-) |

5.3.2.2 *Empirical Equation for the Price Ratio of Thailand Dairy Imports from a Non-FTA Member and a FTA Member.*

The effects of the THNZCEP or TAFTA on the dairy product prices of non-FTA member countries in Thailand dairy import market are empirically estimated by the price ratio of a non-FTA member dairy product to a FTA member dairy product equation. Each equation is estimated separately by each FTA member countries (New Zealand and Australia) and dairy products.

According to the theoretical framework discussed in section 5.3.2, the model for the price effects of the THNZCEP shows that the relative price of a dairy product from the non-THNZCEP member and the THNZCEP member (New Zealand) is influenced by Thailand import tariff for a non-THNZCEP member dairy products, Thailand import tariff for New Zealand dairy products, a non-THNZCEP member's production cost represented by the average raw milk price, New Zealand production cost represented by the average raw milk price. The raw milk price is a proxy for exporter's production cost because raw milk is a main input for processing dairy products. According to Doucouliagos and Hone (2000), variable cost of Australian dairy processing industry was significantly influenced by the unit price of raw milk and other inputs. The relative price equation for each of Thailand dairy imports under the THNZCEP or TAFTA in a double log-linear form is given as follows:

$$\ln \frac{p_{ikt}}{p_{jkt}} = \alpha_{ijk} + \beta_{1ijk} \ln \tau_{ikt} + \beta_{1ijk}^* \ln \tau_{jkt}^* + \beta_{2ijk} \ln Z_{it} + \beta_{2ijk}^* \ln Z_{jt}^* + \varepsilon_{ijk} \quad (5.26)$$

$$i = 1 \dots n; \quad j = \text{New Zealand or Australia}; \quad k = 1 \dots m; \quad \text{and } t = 1, \dots, T$$

where

$\ln \frac{p_{ikt}}{p_{jkt}}$ is the log of the ratio of non-FTA member i 's price to the New Zealand price in the case of the THNZCEP (or Australian price in the case of the TAFTA) for dairy product k in Thailand market;

$\ln \tau_{ikt}$ is the log of Thailand import tariff for dairy product k from non-FTA member i ;

$\ln \tau_{jkt}^*$ is the log of Thailand import tariff for dairy product k from New Zealand in the case of the THNZCEP (or Australia in the case of the TAFTA);

$\ln Z_{it}$ is the log of non-FTA member i 's average production cost represented by the average raw milk price;

$\ln Z_{jt}^*$ is the log of New Zealand average production cost represented by the average raw milk price in the case of the THNZCEP (or the Australian average raw milk price in the case of the TAFTA);

α_{ijk} is constant terms;

$\beta_{1ijk}, \beta_{1ijk}^*, \beta_{2ijk}, \beta_{2ijk}^*$ are elasticities of the relative import price for Thailand dairy product k with respect to the tariff for non-FTA member i 's dairy product, the tariff for New Zealand or Australian dairy products, non-FTA member i 's exporter costs, New Zealand or Australian exporter costs, respectively;

ε_{ijkt} is disturbance term.

The coefficient of main interest here is β_{1ijk}^* which indicates the effect of tariffs for the FTA member dairy products on the relative price of the non-FTA member and the FTA member dairy products. The sign of β_{1ijk}^* is hypothesized to be negative ($\beta_{1ijk}^* < 0$). A tariff reduction for the FTA member dairy product leads to an increase in the dairy product price ratio of the non-FTA member country to the FTA member country in Thailand market (p_{ikt} / p_{jkt}^*). This shows that the price for the dairy product from the non-FTA member country is more expensive than the FTA member country in Thailand market because of the existence of high tariffs on non-FTA member dairy products.

The signs of β_{1ijk} and β_{2ijk} are hypothesized to be positive and β_{2ijk}^* are hypothesized to be negative.

5.4 Data and Methodology

5.4.1 Data Collection

5.4.1.1 Data Collection for the Gravity Model

The modified gravity model in equation (5.8) uses quarterly pooled cross-sectional and time-series data from 1991:Q1 to 2009:Q4 which covers pre- and post-FTA periods for Thailand top five trading partners in seven categories of dairy product import flows following the Harmonized System (HS) 4-digit level as:

- HS0401: milk and cream, not concentrated, nor containing added sugar or other sweetening matter. Thailand top five trading partners for this product are Australia, New Zealand, France, the United Kingdom and Malaysia.

- HS0402: milk and cream, concentrated, or containing added sugar or other sweetening matter. Thailand top five trading partners for this product are New Zealand, Australia, the Czech Republic and Slovak, the Netherlands and the United State of America.

- HS0403: buttermilk, curdled milk and cream, yogurt, kephir and other fermented or acidified milk and cream. Thailand top five trading partners for this product are New Zealand, Australia, Ireland, the Netherlands and Germany.

- HS0404: whey. Thailand top five trading partners for this product are the United State of America, France, the Netherlands, Australia and New Zealand.

- HS0405: butter and other fats and oils derived from milk; dairy spreads. Thailand top five trading partners for this product are Australia, New Zealand, Belgium, the Netherlands and France.

- HS0406: cheese and curd. Thailand top five trading partners for this product are Australia, New Zealand, Denmark, the Netherlands and France.

- Total dairy products (HS0401-HS0406). Thailand top five trading partners for the total dairy imports are New Zealand, Australia, the Netherlands, the United State of America and the Czech Republic and Slovak.

The details and sources of data used to analyse the modified gravity model are as follows:

- The value of Thailand imports from its top five trading partner countries in seven dairy product categories including the independent variables are obtained from the Information and Communication Technology Centre Team, Office of the Permanent Secretary, Ministry of Commerce, Thailand.

- The population of Thailand are obtained from the Office of the National Economic and Social Development Board, Thailand. The population of Thailand top five trading partner countries are obtained from the OECD and the International Monetary Fund (IMF).

- The GDP and per capita GDP of Thailand are obtained from the Bank of Thailand. GDPs and the per capita GDPs of Thailand top five trading partner countries are obtained from OECD and the International Monetary Fund (IMF)

- The geographical distance and adjacency between Thailand and its top five trading partner countries are obtained from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII).

5.4.1.2 Data Collection for the Thailand Import Price Equations for Dairy Products

Thailand import price regression model in equation (5.22) for New Zealand and Australian dairy products employs quarterly time-series data from 1991:Q1 to 2009:Q4 which covers pre- and post-FTA periods. There are six dairy product categories considered in the equation such as concentrated milk and cream (HS0402), buttermilk and yogurt (HS0403), whey (HS0404), butter (HS0405), cheese and curd (HS0406) and the total dairy products. Non-concentrated milk and cream (HS0401) is not included in this analysis due to missing data in the import price during the study period.

The regression model of Thailand dairy import price ratio in equation (5.26) uses yearly pooled cross-sectional and time-series data from 1991 to 2009 for three main non-FTA member countries in six dairy product categories. The Czech Republic and Slovak, the Netherlands and the United State of America are three main non-FTA member exporters for concentrated milk and cream (HS0402). Ireland, the Netherlands and Germany are three main non-FTA member exporters for buttermilk and yogurt (HS0403). The United State of America, France and the Netherlands are three main non-FTA member exporters for whey (HS0404). Belgium, the Netherlands and France are three main non-FTA member exporters for butter (HS0405). Denmark, the Netherlands and France are three main non-FTA member exporters for cheese and curd (HS0406). For the total dairy products, the Netherlands, the United State of America and the Czech Republic and Slovak are three main non-FTA member exporters.

The details and sources of data to analyse the Thailand import price equations for dairy products are as follows:

- Import prices (unit values denoted in Thai baht), competitor prices (unit value denoted in Thai baht) and market shares for dairy products from New Zealand, Australia and main non-FTA member countries are obtained from the Information and Communication Technology Centre Team, Office of the Permanent Secretary, Ministry of Commerce, Thailand.
- Import tariff rates for dairy products from New Zealand, Australia and main non-FTA member countries are obtained from the Customs Department of Thailand.
- Exchange rates for New Zealand, Australian and main non-FTA member countries' currencies defined as Thai baht per exporter's currency are obtained from the Bank of Thailand.

- Average raw milk price for New Zealand, Australia and main non-FTA member countries are obtained from Statistics New Zealand, the Australian Bureau of Statistics and the OECD and FAO agricultural outlook data set, respectively.

5.4.2 Methodology

5.4.2.1 Estimation Techniques for the Modified Gravity Model and the Import Price Ratio Equation for Thailand Dairy Imports

The modified gravity model in equation (5.8) and the equation of the Thailand dairy import price ratio in equation (5.26) are estimated using pooled cross-sectional and time-series data and panel data estimation. There are two advantages in using panel data estimation over cross-section analysis. First, panel data estimation allows us to capture the relevant relationship among variables over time. Second, panel data estimation can monitor the possible unobserved trading-pair individual effects or country specific effects. When the country effects are correlated with the regressors but omitted, OLS estimation will be biased (Kang, 2003; Kisu, 2006). There are 4 panel data estimation techniques used for analysing the gravity model such as pooled OLS, fixed effect model (FEM), random effect model (REM) and time series and cross sections (TSCS) procedure.

The TSCS procedure is a form of panel estimation in which the data are observed for a relatively large number of periods and for a relatively small number of cross sectional units while the FEM and REM fit the data set which are observed for a relatively small number of periods and for a relatively large number of cross sectional units (Greene, 2002). The panel data set for each dairy product model includes 76 quarters and 5 countries generating a total of 380 samples. The panel data set for the import price ratio equation in each dairy product includes 19 years and 3 countries generating a total of 57 samples. Therefore, TSCS is a suitable method for analysing the modified gravity model and the import price ratio equation in our study.

The TSCS procedure by NLOGIT Version 4.0 is estimated by two step FGLS or iterated FGLS which produces a maximum likelihood estimator. The TSCS model formulation provides three forms of the heteroscedasticity regression and three forms of the autocorrelation models.

The three forms of the heteroscedasticity regression are:

- S0 = homoscedastic and uncorrelated across group
- S1 = groupwise heteroscedasticity

- S2 = groupwise heteroscedasticity and correlated across group

The three forms of the autocorrelation models are:

- R0 = no autocorrelation
- R1 = common autocorrelation
- R2 = group specific autocorrelation

When all three heteroscedasticity specifications are crossed with the three autocorrelation specifications, the TSCS estimation can formulate nine models as follows:

| | |
|-----------------|--|
| Model 1: S0, R0 | = homoscedastic and uncorrelated across group without autocorrelation |
| Model 2: S1, R0 | = groupwise heteroscedasticity without autocorrelation |
| Model 3: S2, R0 | = groupwise heteroscedasticity and correlated across group without autocorrelation |
| Model 4: S0, R1 | = homoscedastic and uncorrelated across group with common autocorrelation |
| Model 5: S1, R1 | = groupwise heteroscedasticity with common autocorrelation |
| Model 6: S2, R1 | = groupwise heteroscedasticity and correlated across group with common autocorrelation |
| Model 7: S0, R2 | = homoscedastic and uncorrelated across group with group specific autocorrelation |
| Model 8: S1, R2 | = groupwise heteroscedasticity with group specific autocorrelation |
| Model 9: S2, R2 | = groupwise heteroscedasticity and correlated across group with group specific autocorrelation |

The TSCS procedure by NLOGIT Version 4.0 provides Lagrange Multiplier (LM) statistics for testing homoscedasticity as a restriction on S1 and Likelihood Ratio (LR) statistics for testing groupwise heteroscedasticity as a restriction on S2. However, there is no specific test given for the autocorrelation model selection (Greene, 2002). Fujiki and Kitamura (2001) introduced the Likelihood Ratio test for selecting the autocorrelation model.

The LR test is used for comparing the fit of two models. The null model is a restricted model while the alternative model is an unrestricted model. The LR test is based on the difference in the log-likelihood function of the two models. The formula for the LR test is given as follows:

$$\begin{aligned} LR &= -2\ln(\text{Likelihood for the null model}) + 2\ln(\text{Likelihood for the alternative model}) \\ &= 2 [\ln(\text{Likelihood for the alternative model}) - \ln(\text{Likelihood for the null model})] \end{aligned}$$

The difference in the log-likelihood function of the two models or the LR test is compared to a Chi-square distribution, with degrees of freedom equal to the difference in the number of parameters between the two models. If the difference in the log-likelihood function of the two models (the LR test) is greater than a critical value of the Chi-square, the alternative model is statistically significant and fits better than the null model (Wikipedia, 2011).

Therefore, the model specification for TSCS estimation in our study is based on heteroscedasticity test by LM and LR statistics as suggested by Greene (2002) and the autocorrelation test by the log-likelihood function as suggested by Fujiki and Kitamura (2001).

5.4.2.2 *Estimation Techniques for the Import Price Equation for Thailand Dairy Imports from FTA Member Countries*

The equations for Thailand dairy import price from FTA member countries (New Zealand and Australia) for six dairy product categories (concentrated milk and cream, buttermilk and yogurt, whey, butter, cheese and curd and the total dairy products) in equation (5.22) are analysed by the seemingly unrelated regression estimation (SURE). Zellner (1962) stated that the SURE model is an efficient technique to analyse a system of multiple equations with cross-equation parameter restrictions and correlated error terms (Greene, 2002). The SURE based on Generalized Least Squares (GLS) method uses the correlations of the errors among different equations to improve the efficiency of parameter estimates which are better than running equations separately by the OLS method (Alaba, Olubusoye and Ojo, 2010). There are two methods for the SURE estimation: GLS and GLS with a first-order autoregressive AR(1). If serial correlation is present in the model, the GLS AR(1) method can deal with the serial correlation which provides more efficient estimates than the GLS method (Greene, 2002; Tantirigama, 2006).

In addition, the hypothesis testing of complete exchange rate pass-through, complete tariff rate pass-through and symmetric pass-through of exchange rate and tariff are imposed the restrictions in regression analysis and are tested with Wald statistics.

Chapter 6

Research Results and Findings

This chapter presents the results of the empirical models and discusses the findings. The chapter is divided into three sections. Section 6.1 discusses the estimated results of the gravity models of Thailand dairy imports and the impacts of the implementation of Thailand-New Zealand Closer Economic Partnership (THNZCEP) and Thailand-Australia Free Trade Agreement (TAFTA) on Thailand dairy imports. Section 6.2 presents the estimated results of the import price models of Thailand dairy imports from FTA member countries. Section 6.3 discusses the estimated results of the relative import price models of Thailand dairy imports between FTA member and non-FTA member countries.

6.1 Empirical Results of the Gravity Models for Thailand Dairy Imports

The modified gravity model for each dairy product is estimated by pooling the data from 1991:Q1-2009:Q4 across the top 5 Thailand trading partners using panel data estimation techniques. There are 4 panel data estimation techniques used for analysing the models such as pooled OLS, FEM, REM and TSCS procedure. The estimated results from the 4 techniques are documented in Appendix A. The estimation technique used for describing the determinants of Thailand dairy imports is the TSCS estimation. The results from TSCS models show that most of the estimated coefficients have the expected signs and are statistically significant. Further, the estimated results of the dummies for FTA implementation from the TSCS estimation are reliable and consistent while the estimated results from the FEM and REM are ambiguous.

6.1.1 Estimated Results of the Determinants of Thailand Dairy Imports

This section presents the results of the estimated coefficients of the determinants of Thailand dairy imports. The estimated results using Equation (5.8) are presented in Tables 6.1. There are 7 estimated gravity models for Thailand imports of non-concentrated milk and cream (HS0401), concentrated milk and cream (HS0402), buttermilk and yogurt (HS0403), whey (HS0404), butter (HS0405), cheese and curd (HS0406) and total dairy products. The gravity models are estimated in double-logarithmic equation including 9 explanatory variables: log of exporter population ($LPOP_i$), log of Thailand population ($LPOP_j$), log of exporter per capita GDP ($LGDP_i$), log of Thailand per capita GDP ($LGDP_j$), log of bilateral distance ($LDIS_{ij}$), a dummy variable for intra THNZCEP trade bias ($THNZCEP_{ij}$), a dummy variable

for extra THNZCEP trade openness ($THNZCEPO_{ij}$), a dummy variable for intra TAFTA trade bias ($TAFTA_{ij}$) and a dummy variable for extra TAFTA trade openness ($TAFTAO_{ij}$). These 9 explanatory variables are selected based on previous literatures. The correlation coefficients of the explanatory variables included in the model are below 0.80. This indicates there is no multicollinearity in the model (Hair, 2006).

The best fit models for Thailand import flows in non-concentrated milk and cream (HS0401), concentrated milk and cream (HS0402), buttermilk and yogurt (HS0403), whey (HS0404), butter (HS0405), cheese and curd (HS0406) and total dairy products are S1R2, S2R1, S2R1, S2R1, S1R1, S1R2, and S2R2, respectively. The likelihood ratio tests for all models are compared with the critical Chi-squared statistic with 9 degrees of freedom at the 5 percent level of significance which show the rejection of the null hypothesis of no explanatory power at the 5 percent level of significance. Therefore, the explanatory power for all models is satisfactory and the models can be used to explain the determinants of Thailand dairy imports in these seven categories.

Exporter population ($LPOP_i$)

The estimated exporter population coefficient is negative and statistically significant at the 1% level of significance in concentrated milk and cream (HS0402), buttermilk and yogurt (HS0403), whey (HS0404), butter (HS0405), cheese and curd (HS0406) and total dairy products. A larger population in the dairy exporting country implies a larger domestic demand which results in a reduction of export supplies for concentrated milk and cream, buttermilk and yogurt, whey, butter, cheese and curd and total dairy products to Thailand. The findings are consistent with the study of Endoh (2000) who found that when population in the exporting countries increases, their aggregated domestic demand increases while their aggregated export flows to Asian and Pacific countries decreases.

Similarly, the estimated exporter population coefficient for non-concentrated milk and cream (HS0401) is positive and statistically significant at the 1% level of significance. An increase in population of the dairy exporting countries leads to an increase in Thailand imports for non-concentrated milk and cream. Although, this finding is contrary to the expected relationship, but it is analogous to the finding of Liu (2004) who shows that the exporter population has a significantly positive impact on aggregated bilateral import in China and Australia.

Table 6.1 Estimated results of the gravity models of Thailand dairy imports with TSCS estimation by selected dairy products

| Dairy product | Non-concentrated milk and cream (HS0401) | Concentrated milk and cream (HS0402) | Buttermilk and yogurt (HS0403) | Whey (HS0404) | Butter (HS0405) | Cheese and curd (HS0406) | Total dairy products |
|---|--|--------------------------------------|--------------------------------|-------------------|----------------------|-------------------------------|------------------------------|
| Model | TSCS: S1,R2 | TSCS: S2,R1 | TSCS: S2,R1 | TSCS: S2,R1 | TSCS: S1,R1 | TSCS: S1,R2 | TSCS: S2,R2 |
| Explanatory variable | Estimated coefficients | | | | | | |
| Constant | -136.24* (-1.75) | 72.08** (2.45) | -288.09*** (-5.02) | -78.32 (-1.46) | 115.51*** (2.64) | -27.76 (-1.52) | 1.84 (0.14) |
| Log of exporter population (LPOP _i) | 0.81*** (2.60) | -1.24*** (-7.47) | -2.20*** (-7.21) | 0.14 (0.32) | -1.34*** (-4.93) | -0.57*** (-8.89) | -0.69*** (-9.45) |
| Log of Thailand population (LPOP _j) | 9.50 (1.33) | -0.09 (-0.04) | 33.08*** (6.88) | 8.71** (2.06) | 3.02 (0.74) | 9.73*** (5.79) | 1.86 (1.61) |
| Log of exporter per capita GDP (LGDP _{Pi}) | 1.26** (1.97) | 0.62*** (4.69) | -2.78*** (-2.92) | 0.88 (1.18) | -1.17 (-1.28) | -1.16*** (-4.18) | 0.41*** (3.44) |
| Log of Thailand per capita GDP (LGDP _{Pj}) | 3.02** (2.44) | 0.27 (0.66) | 2.56*** (2.93) | -0.15 (-0.30) | 1.76** (2.35) | 1.64*** (5.44) | 0.56*** (2.58) |
| Log of bilateral distance (LDIS _{ij}) | -0.51 (-0.93) | -5.58*** (-5.47) | -4.11 (-1.28) | -1.45 (-0.65) | -13.63*** (-9.47) | -6.87*** (-13.15) | -0.78* (-1.68) |
| Dummy for intra THNZCEP trade bias (THNZCEP _{ij}) | 5.72*** (3.71) | 0.67* (1.95) | 0.41 (0.58) | -0.61 (-0.27) | 0.98 (1.30) | 0.39 (1.13) | 0.59*** (2.69) |
| Dummy for extra THNZCEP trade openness(THNZCEPO _{ij}) | -0.20 (-0.20) | -0.13 (-0.40) | -0.26 (-0.23) | 0.03 (0.13) | -1.10* (-1.83) | 0.16 (0.70) | -0.35* (-1.69) |
| Dummy for intra TAFTA trade bias (TAFTA _{ij}) | 6.03*** (4.82) | -0.38 (-1.07) | 1.88 (1.26) | 0.36 (0.73) | 0.40 (0.64) | 0.32 (1.25) | 0.30 (1.01) |
| Dummy for extra TAFTA trade openness(TAFTAO _{ij}) | -2.22** (-2.17) | -0.63** (-1.99) | -0.69 (-1.02) | 0.13 (0.33) | -0.10 (-0.15) | 0.29 (1.16) | -0.33* (-1.66) |
| No. Of observations | 380 | 380 | 380 | 380 | 380 | 380 | 380 |
| Mean | 2.57 | 14.95 | 10.13 | 12.15 | 11.92 | 12.16 | 15.78 |
| Standard deviation | 4.30 | 2.90 | 5.42 | 3.41 | 4.11 | 1.62 | 1.01 |
| Wald Statistics | 141.58 | | | | 161,635.43 | 8,501.74 | |
| Lagrange multiplier statistic | 12.68 | | | | 9.51 | 12.79 | |
| Likelihood ratio statistic | 61.49 | 26.59 | 42.16 | 24.97 | 468.83 | 408.38 | 41.24 |
| Log-likelihood function | -896.01 | -459.85 | -972.07 | -563.77 | -748.76 | -376.89 | -259.47 |
| Parameter | 20 | 26 | 26 | 26 | 16 | 20 | 30 |
| Autocorrelation coefficient | 0.15, 0.50, 0.41, 0.71, 0.45 | 0.60 | 0.30 | 0.80 | 0.35 | 0.51, 0.56, 0.61, -0.08, 0.19 | 0.29, 0.63, 0.19, 0.73, 0.63 |

Note: t statistics are in parentheses, and ***, ** and * are significance at 1%, 5%, 10% level respectively.

Thailand population (LPOP_j)

Population is a measurement of country size. The population of the importing country would have a negative effect on bilateral trade flow in which a larger population in the importing country leads to more varieties of domestic output and less dependence on imports (Endoh, 2000) but the estimated coefficients of Thailand population for most cases are positive in our study. The estimated coefficients are significantly positive in 3 dairy product categories: buttermilk and yogurt (HS0403), whey (HS0404) and cheese and curd (HS0406). The results indicate that Thailand import flows for buttermilk and yogurt, whey and cheese and curd increase proportionately more than the increase in Thailand population. Although, the estimated results contradict the expected relationship, but are in line with the finding of Liu (2004) who shows that the importer population has a significantly positive impact on aggregated bilateral import in China and Australia.

Dairy consumption in Thailand is highly dependence on imports because Thailand dairy production is insufficient to meet domestic demand and dairy products produced in the country are fewer in varieties due to low technology in dairy production (Rabobank, 2004). These reasons can describe the positive impact of Thailand population on its import flows for dairy products.

Exporters GDP per capita (LGDPP_i)

Exporter GDP per capita is a proxy for income of the exporting country. The exporter GDP per capita coefficient measures the income elasticity for trade flow of the exporting country. The exporter GDP per capita shows mixed signs and magnitudes for selected dairy import categories of Thailand. For non-concentrated milk and cream (HS0401), concentrated milk and cream (HS0402) and total dairy products, the estimated coefficients are positive and statistically significant. These results indicate that a higher level of exporter income leads to a higher level of production and a larger level of export supplies for non-concentrated milk and cream, concentrated milk and cream and total dairy products to Thailand. This is consistent with other studies such as Frankel and Wei (1998); Anderson and Wincoop (2003). They found that the income elasticities of aggregated trade flows for the exporting countries are positive and highly significant ranging from 0.70 to 1.20. The exporter GDP per capita coefficient is close to those found in the literatures. Recently, Grant and Lambert (2005) studied World agricultural trade with the gravity model and they found that the exporter GDP per capita coefficient for the total dairy products amounts to 0.30. This magnitude is close to the total dairy products in our study which is 0.41.

On the other hand, the estimated coefficients for buttermilk and yogurt (HS0403) and cheese and curd (HS0406) are negative and statistically significant at the 1 percent level. Although, the estimated results contradict the expected relationship, they are compatible with Bergstrand (1989), Jayasinghe and Sarker (2004), and Grant and Lambert (2005) studies. The authors explained that the relationship between the exporter per capita GDP and selected product trade flow can be positive and negative. A negative coefficient for the exporter per capita GDP indicates that the product tends to be labour intensive in production while a positive coefficient for the exporter per capita GDP indicates that the product tends to be capital intensive in production (Bergstrand, 1989; Jayasinghe and Sarker, 2004; Grant and Lambert, 2005). Thus we can conclude that buttermilk and yogurt and cheese and curd are labour-intensive production in the exporting countries while the non-concentrated milk and cream, concentrated milk and cream and total dairy products are capital-intensive production in the exporting countries.

Thailand GDP per capita (LGDP_i)

The estimated income elasticities of Thailand import demand are positive and statistically significant such as non-concentrated milk and cream (HS0401), buttermilk and yogurt (HS0403), butter (HS0405), cheese and curd (HS0406) and total dairy products. These results indicate that Thailand imports for non-concentrated milk and cream, buttermilk and yogurt, butter, cheese and curd and total dairy products increase when Thailand GDP per capita rises. Overall, the estimated income elasticities for dairy import demands in Thailand are quite high compared to the estimated income elasticities of aggregated trade flows in previous literatures (see Frankel and Wei, 1998; Anderson and Wincoop, 2003). The large effect of Thailand GDP per capita on dairy import demands in Thailand may be caused by the high dependence of Thailand on dairy import.

A positive coefficient of the importer per capita GDP indicates that the product is a normal good while a negative coefficient indicates that the product is an inferior good (Jayasinghe and Sarker, 2004; Grant and Lambert, 2005). We can conclude that non-concentrated milk and cream, concentrated milk and cream, buttermilk and yogurt, butter, cheese and curd and total dairy products are normal goods whereas whey is inferior goods in Thailand. The negative coefficient for whey indicates that when Thailand per capita GDP increases, Thailand import for whey decreases. Thailand imports low quality whey to use in UHT milk and food processing. If Thai customer's income increases, they will decrease the demand for whey and switch to consume higher quality dairy products such as concentrated milk and cream or whole milk powder.

Bilateral distance ($LDIS_{ij}$)

Distance between Thailand and the exporting countries is a proxy for transportation cost. Therefore, the bilateral distance would have a negative effect on trade flows. The result shows the bilateral distance has a negative effect on Thailand imports for all dairy product categories and significance in some dairy product categories. The bilateral distance coefficient is negative and statistically significant at 1 percent level in concentrated milk and cream (HS0402), butter (HS0405) and cheese and curd (HS0406), and is negative and significant at 10 percent level in the total dairy product. The results are consistent with the expected relationship and Bergstrand (1989); Frankel and Wei (1998); Krueger (1999); Endoh (2000); Elliott and Ikemoto (2004); Jayasinghe and Sarker (2004); Liu (2004); Grant and Lambert (2005); Kisu (2006); Ram and Prasad (2007) studies. The negative sign of the bilateral distance parameter indicates that Thailand imports for dairy products decrease when the distance between Thailand and the exporting country increases.

Dummy variable for intra-THNZCEP trade bias ($THNZCEP_{ij}$)

The THNZCEP has a significant effect on dairy product trade between the two countries. The dummy variable for intra-THNZCEP trade bias is included into the gravity models to capture the trade creation of the THNZCEP. The estimated coefficients of the dummy for intra-THNZCEP trade bias are positive in most cases except for whey (HS0404). Interestingly, only 3 dairy product categories: non-concentrated milk and cream (HS0401), concentrated milk and cream (HS0402) and total dairy product are positive and statistically significant. These results indicate that the implementation of the THNZCEP leads to an increase or trade creation in Thailand imports for non-concentrated milk and cream, concentrated milk and cream and total dairy products from New Zealand.

Dummy variable for extra-THNZCEP trade openness ($THNZCEPO_{ij}$)

The dummy variable for extra-THNZCEP trade openness is included into the gravity models to capture trade diversion of the THNZCEP. Most of the estimated coefficients of the dummy variable for extra-THNZCEP trade openness are negative but are statistically significant in only 2 dairy product categories: butter (HS0405) and total dairy products. These results show that Thailand imports for the butter and total dairy products from non-THNZCEP members decrease after the implementation of the THNZCEP. It indicates that the THNZCEP produces trade diversion in Thailand imports for butter and total dairy products.

Dummy variable for intra-TAFTA trade bias (TAFTA_{ij})

The TAFTA significantly affects the dairy product trade between the two countries. The dummy variable for intra-TAFTA trade bias is included into the gravity models to capture trade creation of the TAFTA which have a positive effect. The estimated coefficients of the dummy variable for intra-TAFTA trade bias have the correct signs as expected in most dairy product categories except in concentrated milk and cream (HS0402). However, only the non-concentrated milk and cream (HS0401) coefficient is positive and statistically significant at the 1 percent level. The finding shows that there is an increase or trade creation in Thailand imports for non-concentrated milk and cream from Australia after the implementation of the TAFTA.

Dummy variable for extra-TAFTA trade openness (TAFTAO_{ij})

The dummy variable for extra-TAFTA trade openness is used to measure the trade diversion of the TAFTA on Thailand dairy imports. Most of the estimated coefficients of the dummy variable for extra-TAFTA trade openness are negative except in whey (HS0404) and cheese and curd (HS0406). The estimated coefficients are negative and statistically significant in non-concentrated milk and cream (HS0401), concentrated milk and cream (HS0402) and total dairy products. These findings indicate that the implementation of the TAFTA leads to a decrease or trade diversion in Thailand imports for non-concentrated milk and cream, concentrated milk and cream and the total dairy products from non-TAFTA members.

However, the estimated coefficients of the dummy variables for intra-THNZCEP trade bias (THNZCEP_{ij}), extra-THNZCEP trade openness (THNZCEPO_{ij}), intra-TAFTA trade bias (TAFTA_{ij}) and extra-TAFTA trade openness (TAFTAO_{ij}) show mixed signs in different dairy product categories. These findings are compatible with as Frankel and Wei (1998); Krueger (1999); Endoh (2000); Jayasinghe and Sarker (2004); Liu (2004); Grant and Lambert (2005) studies. The authors found that the sign and magnitude of the estimated coefficients of the dummy variables for intra-RTA/FTA trade bias and extra-RTA/FTA trade openness always vary by products and RTAs/FTAs.

Grant and Lambert (2005) investigated regionalism World agricultural trade with the gravity model. Their results in the dairy products shows that the estimated coefficients of the dummy variable for intra-RTA/FTA trade bias are positive in Southern Common Market (Mercosur), Closer Economic Relations (CER), European Union (EU), Asian-Pacific Economic Cooperation (APEC) and Africa. North American Free Trade Agreement (NAFTA), Association of South East Asian Nations Free Trade Agreement (AFTA), and Andean

Community of Nations (Andean Pact) show negative and insignificant coefficients. They concluded that there is no occurrence of trade creation and trade diversion of NAFTA, AFTA, and ANDEAN PACT because member countries of NAFTA, AFTA, and ANDEAN PACT usually trade dairy products with non-member countries more than member countries. Therefore, The FTA will produce trade creation or trade diversion depending on the production and trade structure of member countries' commodities. For example, AFTA will produce trade creation in other agricultural products but not in dairy products because most of South East Asian countries are high-cost producers in dairy production, and are net importers of dairy products from non-AFTA member countries such as European countries, New Zealand and Australia.

The calculated magnitudes of trade creation and trade diversion of the THNZCEP and TAFTA on Thailand dairy imports are discussed in the next section.

6.1.2 The Impacts of THNZCEP and TAFTA on Thailand Dairy Imports

The impacts of FTAs are measured in terms of the relative magnitudes of trade creation (TC) and trade diversion (TD) effects based on Viner's framework (1950). In this study, a trade creation effect of FTAs on Thailand dairy products implies a shift in Thailand dairy consumption and production from a higher cost producer in Thailand to a lower-cost member producer which is considered to be welfare improving for FTA-members. While, a trade diversion effect of FTAs on Thailand dairy products implies a shift in Thailand dairy consumption and production from a lower cost non-member producer to a higher cost member producer which is considered to be welfare reducing for FTA-members.

The dummy coefficients for intra-THNZCEP trade bias ($THNZCEP_{ij}$) and extra-THNZCEP trade openness ($THNZCEPO_{ij}$) are α_1 and α_2 in Equation 5.8 which indicate the trade creation and trade diversion effects of the THNZCEP on Thailand dairy imports respectively. The percentage of trade creation and trade diversion effects of the THNZCEP on Thailand dairy are calculated by $[(\exp(\alpha_1) - 1) \times 100]$ and $[(\exp(\alpha_2) - 1) \times 100]$.

Similarly, the estimated coefficients of the dummy variables for intra-TAFTA trade bias ($TAFTA_{ij}$) and extra-TAFTA trade openness ($THNZCEPO_{ij}$) are α_3 and α_4 in Equation 5.8 which indicate the trade creation and trade diversion effects of the TAFTA on Thailand dairy imports, respectively. The percentage of trade creation and trade diversion effects of the TAFTA on Thailand dairy imports equal $[(\exp(\alpha_3) - 1) \times 100]$ and $[(\exp(\alpha_4) - 1) \times 100]$, respectively.

Comparing the magnitudes of trade creation and trade diversion effects of each FTA can reveal the total effects of the FTA on welfare of FTA-members.

6.1.2.1 Trade Creation and Trade Diversion Effects of THNZCEP

Table 6.2 shows the calculated magnitudes of trade creation and trade diversion effects of the THNZCEP and TAFTA by selected dairy product categories. The trade creation effects of the THNZCEP are positive in most cases ranging from 48.37% to 30,516.68%. Interestingly, the THNZCEP is positive and significant only in three dairy product categories: non-concentrated milk and cream (HS0401), concentrated milk and cream (HS0402) and total dairy product. These results show that after the implementation of THNZCEP, Thailand imports for non-concentrated milk and cream, concentrated milk and cream and total dairy products from New Zealand increase significantly by 30,516.68%, 95.11% and 79.75%, respectively. On the other hand, whey (HS0404) has a negative trade creation of -45.45% which means Thailand import of whey decreases by 45.45% after the implementation of the THNZCEP.

Table 6.2 Calculated percentage change of trade creation and trade diversion of THNZCEP and TAFTA by selected dairy product categories

| Dairy product category | Trade effects of THNZCEP | | Trade effects of TAFTA | |
|--|--------------------------|---------------------|------------------------|---------------------|
| | Trade creation (%) | Trade diversion (%) | Trade creation (%) | Trade diversion (%) |
| Non-concentrated milk and cream (HS0401) | 30,516.68*** | -18.13 | 41,580.98*** | -89.14** |
| Concentrated milk and cream (HS0402) | 95.11* | -12.15 | -31.66 | -46.48** |
| Buttermilk and yogurt (HS0403) | 51.34 | -22.65 | 557.85 | -50.09 |
| Whey (HS0404) | -45.45 | 3.43 | 43.62 | 13.33 |
| Butter (HS0405) | 167.12 | -66.55* | 49.81 | -9.92 |
| Cheese and curd (HS0406) | 48.37 | 17.62 | 37.60 | 33.90 |
| Total dairy products | 79.75*** | -29.23* | 35.44 | -27.97* |

Note: ***, ** and * are significance at 1%, 5%, 10% level respectively.

These estimated results are consistent with Thailand import trends for these dairy product categories during 1991-2009 as shown in Figures 6.1-6.7. It can be seen that after the implementation of the THNZCEP, Thailand imports for most dairy product categories from New Zealand have increased significantly and New Zealand has become the most important source of Thailand dairy imports, except in whey. The market share of New Zealand for whey imports in Thailand is very small (5.28% in 2009) compared to others suppliers. France and the USA (non-THNZCEP member countries) have been the main sources of Thailand imports

for whey due to lower product prices. Therefore, this can cause negative trade creation of the THNZCEP in whey. In non-concentrated milk and cream, the magnitude of trade creation is considerably large. Before the implementation of the THNZCEP, Thailand did not import non-concentrated milk and cream from New Zealand, but after the implementation of the THNZCEP, Thailand has switched to import from New Zealand and Australia instead of France and the United Kingdom (see Figure 6.1).

Trade diversion effects of the THNZCEP are negative in most cases, excluding whey and cheese and curd. The largest and statistically trade diversion effects are found in butter and total dairy products with -66.55% and -29.23% respectively. These results imply that Thailand imports for butter and total dairy products from non-THNZCEP members decrease by 66.55% and 29.23% respectively after the implementation of the THNZCEP. The findings are consistent with the diminishing trend of Thailand dairy import from non-THNZCEP member countries (see Figures 6.5 and 6.7). In contrast, trade diversion effects in whey and cheese and curd are positive and insignificant.

In summary, the net welfare effect of the THNZCEP is positive in most dairy product categories (non-concentrated milk and cream, concentrated milk and cream, buttermilk and yogurt, butter, cheese and curd and total dairy products). These results indicate that the implementation of the THNZCEP leads to welfare improving among THNZCEP members in the six categories. The net welfare effect of the THNZCEP is negative in whey. This implies that the implementation of the THNZCEP reduces its member welfare in whey. New Zealand market share for whey in Thailand is very small (5.28%). Most whey is imported from non-FTA member countries because their price of whey is cheaper than New Zealand price.

Interestingly, the implementation of the THNZCEP boosts Thailand imports in cheese and curd from both New Zealand (a THNZCEP member) and THNZCEP non-members. This is because the demand for cheese and curd in Thailand has increased considerably which has been dominated by Thai tourism sector such as hotels, Western restaurants and bakery shops (Murphy and Tisdell, 1996). As a result, there is a growth in Thailand import demand for cheese and curd from main dairy exporting countries in the World.

Overall, the implementation of the THNZCEP enhances its member welfare significantly in total dairy product. We can conclude that the implementation of the THNZCEP is an important tool to enhance trade liberalization in dairy product trade between Thailand and New Zealand.

6.1.2.2 Trade Creation and Trade Diversion Effects of TAFTA

Trade creation effects of the TAFTA are positive in most cases, excluding concentrated milk and cream (HS0402). Interestingly, only in the case of non-concentrated milk and cream (HS0401), the trade creation effect is positive and statistically significant accounting for 41,580.98%. This indicates that Thailand imports for non-concentrated milk and cream from Australia increase significantly by 41,580.98% after the implementation of TAFTA.

The trade creation of the TAFTA in concentrated milk and cream (HS0402) is negative but insignificant. This shows that Thailand import of concentrated milk and cream from Australia decreases after the implementation of TAFTA. This is because Thailand switches to import more from New Zealand instead of Australia (see Figure 6.2).

The pattern of trade diversion effects of the TAFTA is similar to the THNZCEP. The trade diversion effects of the TAFTA are negative in most cases, excluding whey and cheese and curd. The largest and statistically trade diversion effects are found in non-concentrated milk and cream, concentrated milk and cream and total dairy products. The results imply that Thailand imports for these three dairy categories from non-TAFTA members decrease significantly after the implementation of the TAFTA. The findings are consistent with a declining trend in Thailand dairy imports for these three dairy categories from non-TAFTA member countries (see Figures 6.1, 6.2 and 6.7).

In summary, the net welfare effect of the TAFTA is positive in most dairy product categories (non-concentrated milk and cream, buttermilk and yogurt, whey, butter and total dairy products). The implementation of the TAFTA results in welfare improvement among TAFTA members in the six categories. Surprisingly, Thailand post-TAFTA trade pattern differs from other dairy products in concentrated milk and cream. The net welfare effect of the TAFTA is negative which implies that the implementation of the TAFTA leads to welfare reduction among its member in concentrated milk and cream. This is because Thailand switch to import from lower cost (price) concentrated milk and cream from other countries.

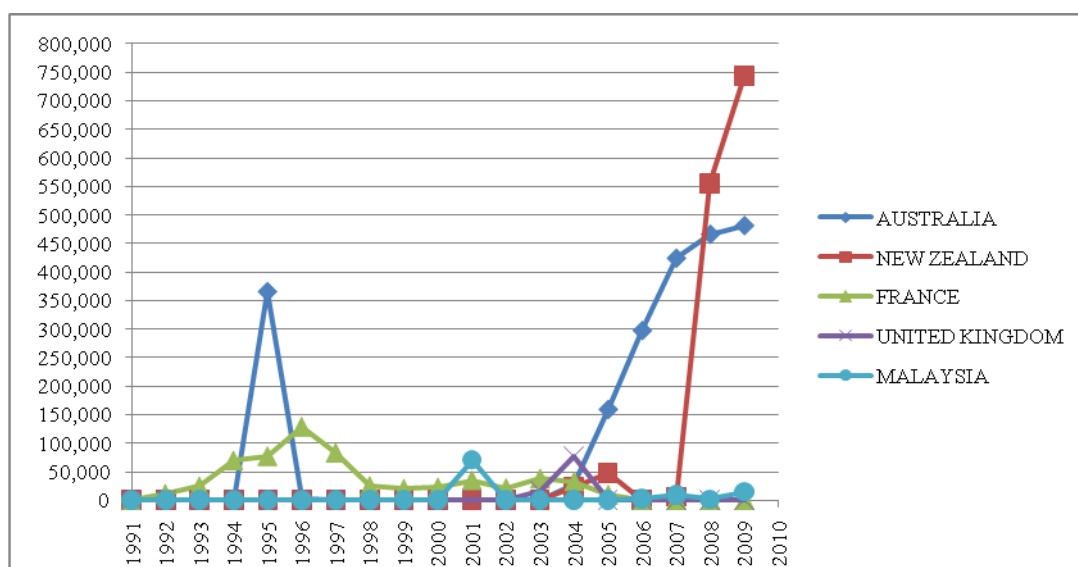


Figure 6.1 Thailand import value in US Dollar for non-concentrated milk and cream (HS0401) from top 5 exporting countries between 1991 and 2009

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

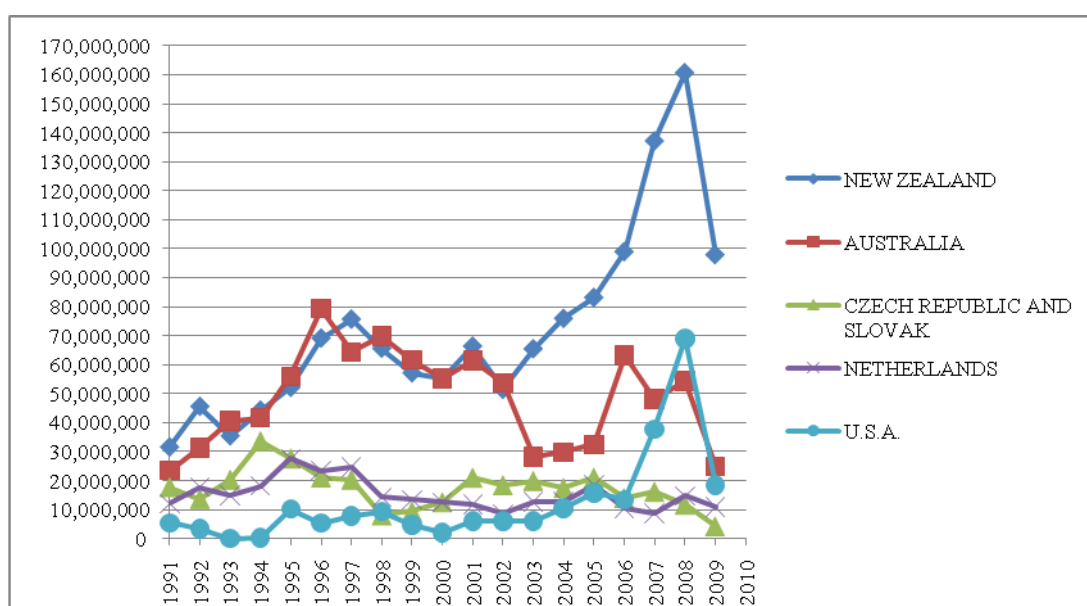


Figure 6.2 Thailand import value in US Dollar for concentrated milk and cream (HS0402) from top 5 exporting countries between 1991 and 2009

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

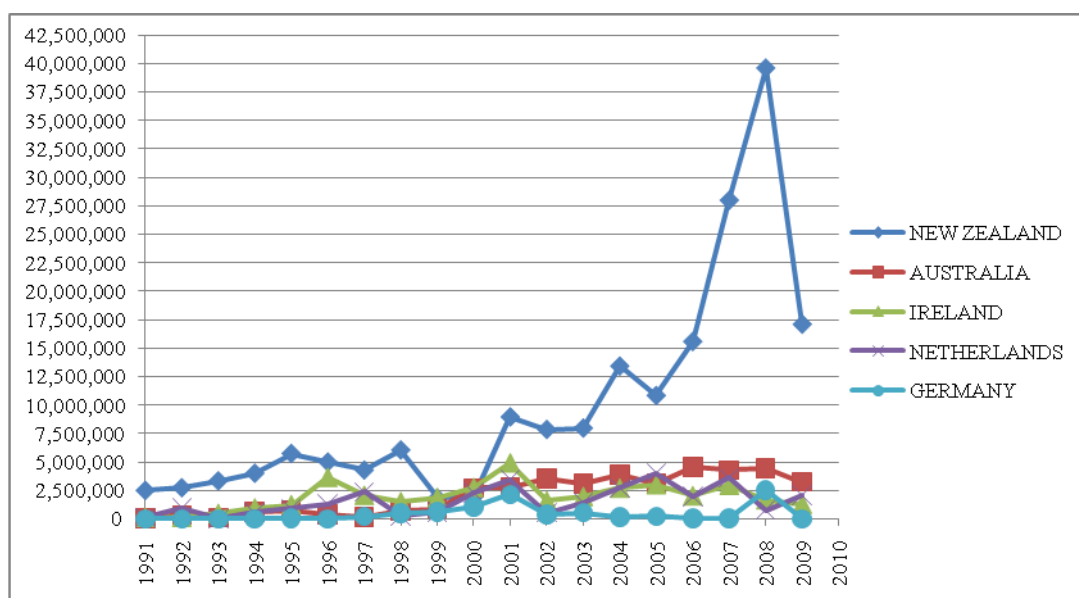


Figure 6.3 Thailand import value in US Dollar for buttermilk and yogurt (HS0403) from top 5 exporting countries between 1991 and 2009

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

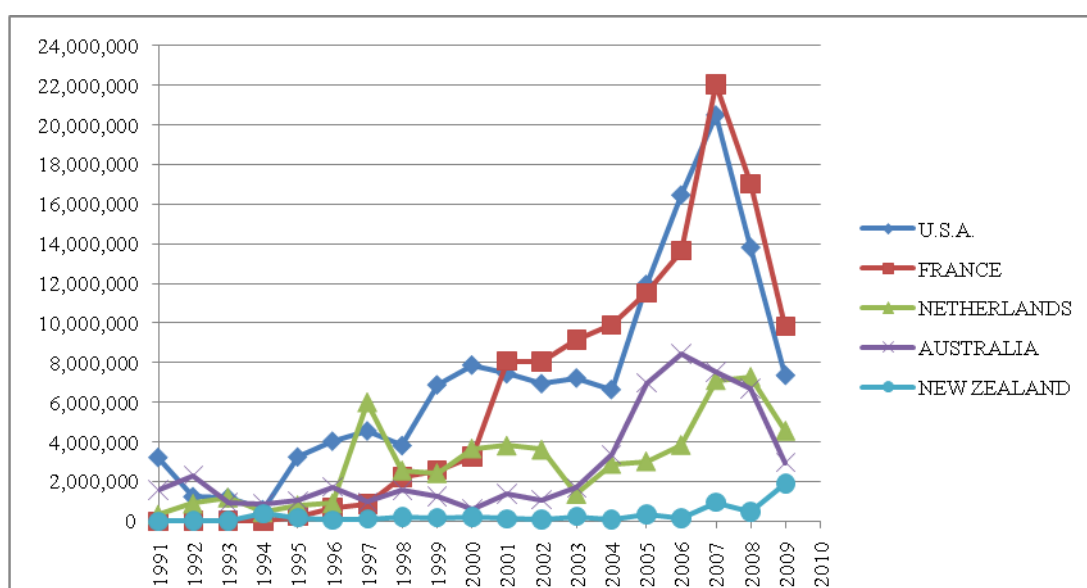


Figure 6.4 Thailand import value in US Dollar for whey (HS0404) from top 5 exporting countries between 1991 and 2009

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

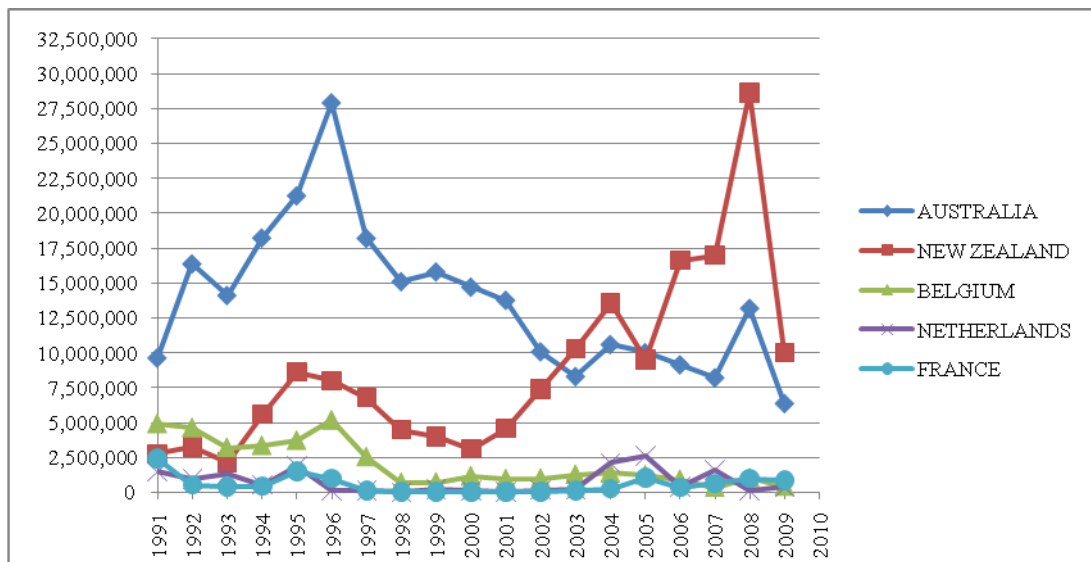


Figure 6.5 Thailand import value in US Dollar for butter (HS0405) from top 5 exporting countries between 1991 and 2009

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

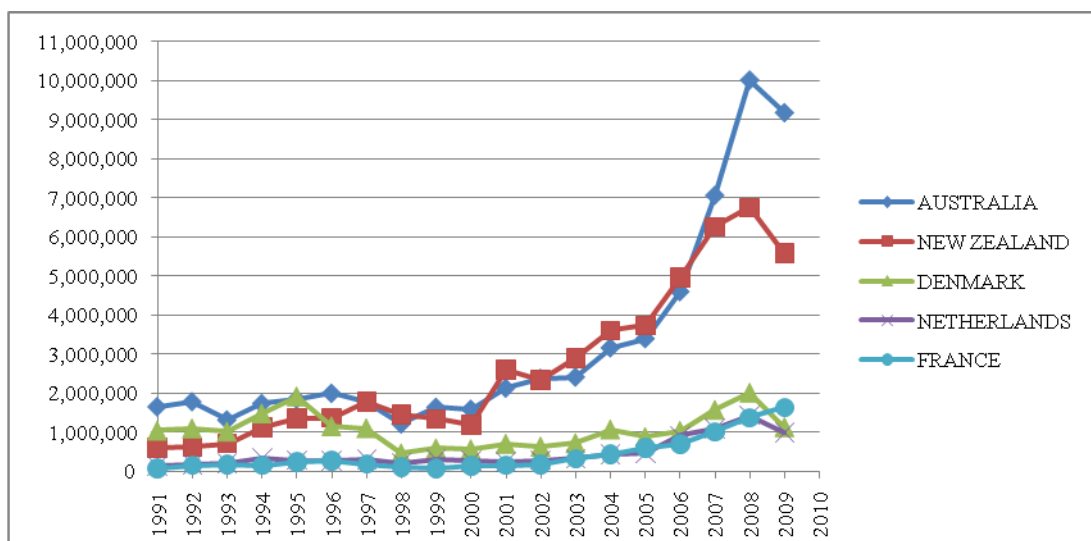


Figure 6.6 Thailand import value in US Dollar for cheese and curd (HS0406) from top 5 exporting countries between 1991 and 2009

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

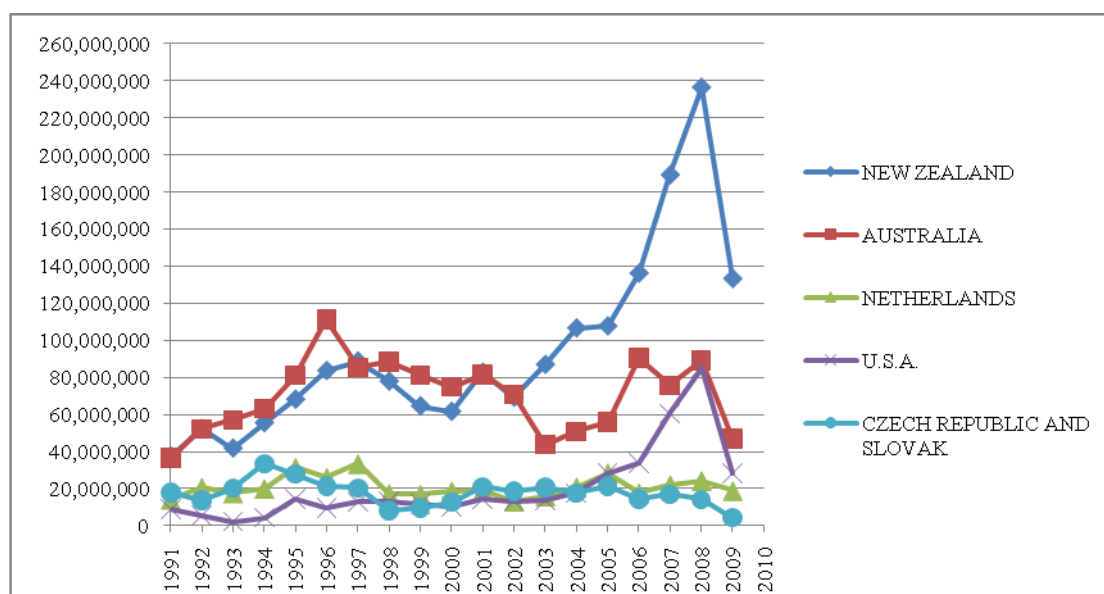


Figure 6.7 Thailand import value in US Dollar for total dairy products from top 5 exporting countries between 1991 and 2009

Source: Information and Communication Technology Centre, Thailand Ministry of Commerce (Various years)

6.2 Empirical Results of Import Price Models for Thailand Dairy Imports from FTA-Member Countries

This section presents the results of the estimated coefficients of import price models for Thailand dairy imports from FTA-member countries. New Zealand is considered to be an FTA-member country in the THNZCEP and Australia is considered to be an FTA-member country in the TAFTA. The import price models for Thailand dairy imports from New Zealand and Australia are estimated using data from 1991:Q1-2009:Q4 for six dairy product categories: concentrated milk and cream (HS0402), buttermilk and yogurt (HS0403), whey (HS0404), butter (HS0405), cheese and curd (HS0406) and total dairy products. Non-concentrated milk and cream (HS0401) is not included in this analysis due to missing data in the import price during the study period. Key factors affecting changes in Thailand import prices of dairy products from New Zealand and Australia from the literatures include exchange rate, import tariff rate, competitor prices, production costs, consumer income, industrial productivity index, market share and a dummy variable for drought. The results show that dairy production costs, consumer income and industrial productivity index are highly correlated to other independent variables with correlation coefficients of over 0.80 in each dairy product categories. To avoid the multicollinearity problem in the regression analysis, these three variables are excluded from Thailand import price model for dairy products.

New Zealand and Australian price models are analysed separately. In each country model, six price equations for six Thailand dairy import categories are estimated simultaneously. It is assumed that there is a presence of contemporaneous correlation of error terms across the import price equations because the prices of various dairy products tend to move together. Seemingly Unrelated Regression Equation (SURE) estimation by Zellner (1962) is employed in our study. There are two methods for the SURE estimation: Generalized Least Squares (GLS) and Generalized Least Squares (GLS) with a first-order autoregressive AR (1). If serial correlation is present in the model, the GLS AR (1) method can address the serial correlation which provides more efficient estimates than the GLS method (Greene, 2002; Tantirigama, 2006).

The estimated results by the GLS method in all regressions show that the presence of the positive serial correlation among cross-section regressions. The Durbin-Watson statistics in New Zealand and Australian regression models are below 2 (see Appendix B and C, respectively). To correct for the positive serial correlation, the GLS AR (1) method is employed to re-estimate all regressions. It can be clearly seen that all estimated results by the GLS AR (1) method show higher adjusted R^2 and lower residuals sum of squares than the GLS method. In addition, the Durbin-Watson statistics from the GLS AR (1) method in all regressions increase and are closer to 2 which indicate no serial correlation. These evidences suggest that the GLS AR (1) method provides more efficient and reliable results than the GLS method. Therefore, the estimated results from the GLS AR (1) method are used to identify the determinants of the import price models for Thailand dairy imports from New Zealand and Australia (see Tables 6.3-6.6).

6.2.1 Import Price Models for Thailand Dairy Imports from New Zealand

The import price models for six Thailand dairy imports from New Zealand are estimated in two models. Model A consists of four explanatory variables: exchange rate (LE_i), import tariff ($LTAR_i$), competitor price (LCP_i) and exporter market share (LZ_i) (see Table 6.3). Model B includes five explanatory variables including a dummy variable for drought (DDROU) (see Table 6.4). The signs of the estimated coefficients for exchange rate (LE_i), import tariff ($LTAR_i$), competitor price (LCP_i) and exporter market share (LZ_i) between Model A and Model B are similar in all dairy products while the magnitudes of the estimated coefficients are slightly different. Overall, the explanatory powers (adjusted R^2) and F-statistics of all regressions in Model B are higher than Model A while the residuals sum of squares of all regressions in Model B are lower than in Model A. The specification F-statistics are

statistically significant at the 1% level. These evidences suggest that the regression results in Model B are more efficient and reliable than in Model A.

Table 6.3 Estimated import price models (Model A) for Thailand dairy imports from New Zealand by GLS AR (1) method

| Dairy product | Concentrated milk and cream (HS0402) | Buttermilk and yogurt (HS0403) | Whey (HS0404) | Butter (HS0405) | Cheese and curd (HS0406) | Total dairy products |
|--|--------------------------------------|--------------------------------|------------------|--------------------|--------------------------|----------------------|
| Explanatory variable | Estimated coefficients | | | | | |
| Constant | 1.43** (2.44) | 1.82*** (3.26) | 2.59 (1.43) | 1.10*** (3.44) | 3.22*** (2.96) | 1.48** (2.55) |
| Log of exchange rate (LE) | 0.74*** (4.77) | 0.46*** (2.99) | -0.06 (-0.13) | 0.06 (0.72) | 0.46** (2.56) | 0.74*** (4.96) |
| Log of import tariff (LTAR) | 0.03 (0.38) | -0.18*** (-3.04) | -0.10 (-0.36) | -0.10** (-2.52) | -0.23* (-1.95) | -0.002 (-0.03) |
| Log of competitor price (LCP) | 0.13*** (3.62) | 0.38*** (6.59) | 0.52** (2.57) | 0.79*** (17.82) | 0.18 (1.33) | 0.14*** (4.24) |
| Log of market share (LZ) | -0.08** (-2.49) | 0.06*** (2.69) | -0.03 (-1.07) | 0.03* (1.77) | 0.002 (0.05) | -0.05* (-1.68) |
| No. Of observations | 60 | 60 | 60 | 60 | 60 | 60 |
| Degrees of freedom | 55 | 55 | 55 | 55 | 55 | 55 |
| Mean | 4.38 | 4.17 | 3.84 | 4.25 | 4.63 | 4.36 |
| Standard deviation | 0.26 | 0.38 | 0.43 | 0.33 | 0.27 | 0.27 |
| Residuals sum of squares | 1.20 | 1.37 | 4.46 | 0.40 | 1.00 | 1.08 |
| R ² | 0.6604 | 0.8210 | 0.5499 | 0.9332 | 0.7460 | 0.7170 |
| Adjusted R ² | 0.6357 | 0.8080 | 0.5172 | 0.9283 | 0.7275 | 0.6964 |
| F-Statistics | 26.70*** | 63.10*** | 16.80*** | 192.10*** | 40.40*** | 34.80*** |
| Durbin-Watson | 1.29 | 0.76 | 1.89 | 1.24 | 1.58 | 1.06 |
| Autocorrelation coefficient | 0.35 | 0.62 | 0.06 | 0.38 | 0.21 | 0.47 |
| RHO used for AR(1) | 0.40 | 0.27 | 0.66 | 0.08 | 0.37 | 0.39 |
| Hypothesis testing | Wald Statistics | | | | | |
| H ₀ : b _{1i} = 1, all i | 2.76* | 12.60*** | 5.03** | 122.48*** | 9.19*** | 3.05* |
| H ₀ : b _{2i} = 1, all i | 151.64*** | 414.67*** | 15.06*** | 802.72*** | 108.58*** | 209.73*** |
| H ₀ : b _{1i} = b _{2i} , all i | 24.34*** | 20.48*** | 0.01 | 3.54* | 15.47*** | 30.77*** |

Note: 1) t statistics are in parentheses

2) ***, ** and * are significance at 1%, 5%, 10% level respectively.

Table 6.4 Estimated import price models (Model B) for Thailand dairy imports from New Zealand by GLS AR (1) method

| Dairy product | Concentrated milk and cream (HS0402) | Buttermilk and yogurt (HS0403) | Whey (HS0404) | Butter (HS0405) | Cheese and curd (HS0406) | Total dairy products |
|---|--------------------------------------|--------------------------------|------------------|--------------------|--------------------------|----------------------|
| Explanatory variable | Estimated coefficients | | | | | |
| Constant | 2.24*** (4.33) | 2.25*** (4.04) | 3.51** (1.98) | 1.16*** (3.76) | 3.34*** (3.08) | 2.18*** (4.13) |
| Log of exchange rate (LE) | 0.52*** (3.80) | 0.32** (2.18) | -0.23 (-0.51) | 0.01 (0.07) | 0.25 (1.54) | 0.54*** (3.99) |
| Log of import tariff (LTAR) | -0.03 (-0.37) | -0.20*** (-3.40) | -0.16 (-0.60) | -0.09** (-2.52) | -0.23** (-2.03) | -0.04 (-0.63) |
| Log of competitor price (LCP) | 0.12*** (3.15) | 0.38*** (5.95) | 0.43* (1.93) | 0.81*** (18.03) | 0.29** (2.02) | 0.14*** (3.79) |
| Log of market share (LZ) | -0.07** (-2.42) | 0.05** (2.25) | -0.03 (-1.15) | 0.03** (2.10) | 0.01 (0.35) | -0.05* (-1.66) |
| Dummy variable for drought (DDROU) | 0.19*** (4.34) | 0.15*** (2.94) | 0.19 (1.52) | 0.04 (1.63) | 0.12*** (2.84) | 0.18*** (4.38) |
| No. Of observations | 60 | 60 | 60 | 60 | 60 | 60 |
| Degrees of freedom | 54 | 54 | 54 | 54 | 54 | 54 |
| Mean | 4.38 | 4.17 | 3.84 | 4.25 | 4.63 | 4.36 |
| Standard deviation | 0.26 | 0.38 | 0.43 | 0.33 | 0.27 | 0.27 |
| Residuals sum of squares | 0.94 | 1.09 | 4.37 | 0.36 | 0.89 | 0.82 |
| R ² | 0.7290 | 0.8545 | 0.5507 | 0.9391 | 0.7684 | 0.7800 |
| Adjusted R ² | 0.7039 | 0.8411 | 0.5090 | 0.9335 | 0.7470 | 0.7597 |
| F-Statistics | 29.10*** | 63.40*** | 13.20*** | 166.60*** | 35.80*** | 38.30*** |
| Durbin-Watson | 1.71 | 1.00 | 1.77 | 1.39 | 1.77 | 1.52 |
| Autocorrelation coefficient | 0.15 | 0.50 | 0.11 | 0.31 | 0.12 | 0.24 |
| RHO used for AR(1) | 0.39 | 0.31 | 0.61 | 0.07 | 0.26 | 0.42 |
| Hypothesis testing | Wald Statistics | | | | | |
| 1) H ₀ : b _{1i} = 1, all i | 11.83*** | 21.79*** | 7.43*** | 156.50*** | 22.48*** | 11.39*** |
| 2) H ₀ : b _{2i} = 1, all i | 200.24*** | 430.33*** | 18.80*** | 861.51*** | 120.24*** | 248.28*** |
| 3) H ₀ : b _{1i} = b _{2i} , all i | 18.15*** | 14.91*** | 0.02 | 1.54 | 8.65*** | 22.35*** |

Note: 1) t statistics are in parentheses

2) ***, ** and * are significance at 1%, 5%, 10% level respectively.

Exchange rate

The estimated coefficients of Thailand import prices for dairy products from New Zealand with respect to exchange rate movement are positive and statistically significantly in three dairy product categories: concentrated milk and cream, buttermilk and yogurt and total dairy products. These results show that when the Thai baht depreciates against the New Zealand dollar by one percent, import prices for New Zealand concentrated milk and cream, buttermilk and yogurt and total dairy products (denoted in Thai Baht) increase by 0.52, 0.32 and 0.54 percent, respectively. The estimated coefficients of exchange rate in whey, butter, and cheese and curd are not significantly different from zero which suggest that there is no exchange rate pass-through into import prices of New Zealand whey, butter, and cheese and curd.

For the cases of concentrated milk and cream, buttermilk and yogurt and total dairy products, the null hypothesis of complete exchange rate pass-through to dairy import prices from New Zealand are rejected at the 1% level of significance. The rejection indicates incomplete exchange rate pass-through in Thailand import prices for New Zealand concentrated milk and cream, buttermilk and yogurt and total dairy products. When Thailand currency depreciates (New Zealand currency appreciation), New Zealand dairy exporters reduce their mark-up partially to maintain their market shares in Thailand, hence the import price expressed in Thai baht increase partially. These results are consistent with the exchange rate pass-through theory and are similar to previous literatures. For example, Pholpirul (2003) found that incomplete exchange rate pass-through in the prices of Thailand import in nine industries ranging between -0.08 and 0.53. The degree of exchange rate pass-through in buttermilk and yogurt from New Zealand equals 0.32 which is close to the exchange rate pass-through coefficients in the food industry from Pholpirul (2003)'s study which is 0.40.

Import tariff rate

After the implementation of THNZCEP, Thailand has reduced import tariff rates for New Zealand dairy products. Thailand import tariffs are included in the import price models to measure the effects of import tariff changes on Thailand import prices of dairy products from New Zealand. The effects of tariff changes on import prices are known as the degree of the tariff rate pass-through into import prices. The estimated coefficients of exchange rate in concentrated milk and cream, whey, and total dairy products are not significantly different from zero which suggest that there is no tariff rate pass-through into import prices of New Zealand concentrated milk and cream, whey, and total dairy products.

While the estimated elasticities of Thailand import prices for dairy products from New Zealand with respect to the import tariff are negative and significance in only three dairy product categories: buttermilk and yogurt, butter and cheese and curd. The results show that when Thailand import tariffs for these three dairy products decrease by one percent, Thailand import prices of these three dairy products from New Zealand increase by 0.20, 0.09 and 0.23 percent for buttermilk and yogurt, butter and cheese and curd, respectively. The null hypothesis of complete tariff rate pass-through to dairy import prices from New Zealand are rejected at the 1% level of significance in these three dairy product categories. The result indicates that there is an incomplete tariff rate pass-through in import prices in these three dairy product categories from New Zealand. This also implies that New Zealand dairy exporters increase their domestic currency price more than proportionately to a decrease in Thailand import tariff. As a result, Thailand import prices for New Zealand buttermilk and yogurt, butter and cheese and curd increase. The implementation of THNZCEP does not decrease the prices of New Zealand dairy products in Thailand because New Zealand production costs of dairy products have significantly increased over the study period.

Previous literature documented positive effects of tariffs on import prices (see Feenstra, 1989; Mallick and Marques, 2008; Nicita, 2009). The signs of the estimated coefficients of import tariffs in this study are not similar to the hypothesized sign but the findings are similar to Tantirigama (2006)'s study which showed that import tariffs has a small negative impact on New Zealand import prices of motorcars from Australia, France, Italy and the US. The negative sign indicates that car exporters practise a more than proportionate decrease (increase) in their domestic currency prices with respect to an increase (decrease) in tariffs. Mallick and Marques (2008) described the negative tariff rate pass-through in Indian import prices of beverages and fibres are caused by an inelastic demand in these two sectors. Although, the tariffs for beverages and fibres have reduced but foreign exporters in these two sectors can take advantage to increase their foreign currency prices more than proportionately to the tariff reduction.

In addition, the null hypothesis of the symmetry of the exchange rate and tariff rate pass-through is rejected in all dairy product categories at the 1% level of significance. This indicates that there is a difference between exchange rate pass-through and tariff rate pass-through in all dairy product categories. Therefore, the response of import prices to exchange rate movements cannot be used to predict the effect of change in tariffs in all cases.

Competitor price

Australian dairy product prices are used as competitor prices of New Zealand in Thailand. The estimated coefficients of Australian prices are positive and statistically significant in all dairy product categories. These results mean that the prices of Thailand dairy imports from New Zealand rise when the prices of Australian dairy products increase. This indicates that there is a positive co-movement of New Zealand pricing strategy with its competitor (Australia) in Thailand dairy import market.

The finding is consistent with previous literatures. For example, Tantirigama (2006) found positive responses of New Zealand exporters to their competitor (Australia) prices on milk and cream in Thailand with an elasticity of 0.04 while the elasticities in other Asian countries are between 0.01 and 0.31. The elasticity of New Zealand export price of butter with respect to Australian price in the main export destinations is between 0.05 and 0.39 while the elasticity of New Zealand export price of cheese and curd with respect to Australian price varies from -0.07 to 0.85 across its export destinations. In addition, the positive co-movement in the pricing strategy on the export price between New Zealand and Australia was found in other products as well such as sheep meat (see Lee and Tcha, 2005) and wool products (see Tantirigama, 2006).

Market share

The relationship between the import price and market share in the importing country indicates how much the exporter charges its price in the importing country market according to market share. The estimated coefficients for New Zealand market share are negative and significant in concentrated milk and cream and total dairy products. These results show that New Zealand exporters reduce their export price (mark-up) for concentrated milk and cream and total dairy products when New Zealand market shares for these two product categories in Thailand increase. This indicates that New Zealand pricing strategy for concentrated milk and cream and total dairy products in Thailand are based on perfect competition. The sign of the estimated coefficient for New Zealand market share in concentrated milk and cream is different from Tantirigama (2006)'s study which showed the relationship between the New Zealand export price for milk and cream and its market share is positive in Thailand but negative in Japan, the Philippines and Sri Lanka.

The estimated coefficients for New Zealand market share in buttermilk and yogurt and butter are positive and statistically significance. These results show that a larger market share of New Zealand buttermilk and yogurt and butter in Thailand results in an increase in the mark-

ups and prices in Thailand. This reflects the monopolistic status of New Zealand for these two dairy products in Thailand. The market shares of New Zealand in the buttermilk and yogurt and butter are significantly high with 53 and 30 percent of total import market shares in Thailand, respectively. The estimated coefficient for New Zealand market share in butter is consistent with Tantirigama (2006)'s study which showed positive effect in New Zealand market share on its export price for butter in Asian countries.

Drought

Drought is an important factor influencing agricultural production and prices. According to New Zealand Treasury (2008), severe drought resulted in a decrease in raw milk production in 1998, 1999, 2001, 2003, 2007 and 2008. As a result, New Zealand dairy products prices increased significantly in those years. The estimated coefficients for the dummy variable for New Zealand drought are positive and y statistically significant in most dairy product categories (concentrated milk and cream, buttermilk and yogurt, cheese and curd and total dairy products). These findings indicate that a drought in New Zealand leads to an increase in Thailand import price of dairy products from New Zealand.

Overall, the exchange rate has the largest impact on the import price of total dairy products from New Zealand, followed by the dummy variable for drought, Australian dairy product price and New Zealand market share. The effect of tariff rate on Thailand import price of total dairy products from New Zealand is insignificant. This implies that there is no effect of the implementation of THNZCEP on Thailand import price of total dairy products from New Zealand.

6.2.2 Import Price Models for Thailand Dairy Imports from Australia

Similarly, the import price models for Thailand dairy imports from Australia are estimated in two models: Model A and Model B. The results of Model A are presented in Table 6.5 and Model B in Table 6.6. The signs of the estimated coefficients for exchange rate (LE_i), import tariff ($LTAR_i$), competitor price (LCP_i) and exporter market share (LZ_i) between Model A and Model B are similar in all dairy product categories. Overall, the explanatory powers (adjusted R^2) and F-statistics of all regressions in Model B are higher than Model A, while the residuals sum of squares of all regressions in Model B are lower than in Model A. The specification F-statistics are statistically significant at the 1% level. These show that the regression results in Model B are more efficient and reliable than Model A. Most of the import price models results for Thailand dairy imports from Australia have similar patterns to the import price model for New Zealand products.

Table 6.5 Estimated import price models (Model A) for Thailand selected dairy imports from Australia by GLS AR(1) method

| Dairy product | Concentrated milk and cream (HS0402) | Buttermilk and yogurt (HS0403) | Whey (HS0404) | Butter (HS0405) | Cheese and curd (HS0406) | Total dairy products |
|---|--------------------------------------|--------------------------------|-------------------|--------------------|--------------------------|----------------------|
| Explanatory variable | Estimated coefficients | | | | | |
| Constant | 0.82 (1.17) | -0.32 (-0.58) | 1.32 (1.32) | 0.11 (0.43) | 4.43*** (6.52) | 1.36** (1.96) |
| Log of exchange rate (LE) | 0.49*** (2.82) | 0.44*** (3.21) | 0.33 (1.33) | 0.30*** (4.80) | 0.20 (1.45) | 0.32** (2.02) |
| Log of import tariff (LTAR) | -0.15* (-1.72) | 0.04 (0.74) | -0.20* (-1.71) | -0.03 (-0.99) | -0.43*** (-6.19) | -0.15* (-1.87) |
| Log of competitor price (LCP) | 0.53*** (6.63) | 0.68*** (10.39) | 0.52*** (5.46) | 0.78*** (29.11) | 0.26*** (3.70) | 0.53*** (7.43) |
| Log of market share (LZ) | -0.02 (-0.55) | -0.02 (-1.56) | 0.003 (0.10) | 0.07*** (4.38) | -0.01 (-0.22) | 0.01 (0.34) |
| No. Of observations | 65 | 65 | 65 | 65 | 65 | 65 |
| Degrees of freedom | 60 | 60 | 60 | 60 | 60 | 60 |
| Mean | 4.31 | 4.13 | 3.33 | 4.25 | 4.70 | 4.23 |
| Standard deviation | 0.31 | 0.33 | 0.39 | 0.31 | 0.27 | 0.28 |
| Residuals sum of squares | 0.68 | 0.84 | 1.96 | 0.20 | 0.54 | 0.67 |
| R ² | 0.8819 | 0.8692 | 0.7798 | 0.9659 | 0.8708 | 0.8584 |
| Adjusted R ² | 0.8741 | 0.8605 | 0.7652 | 0.9636 | 0.8622 | 0.8489 |
| F-Statistics | 112.10*** | 99.70*** | 53.10*** | 424.30*** | 101.10*** | 90.90*** |
| Durbin-Watson | 1.80 | 1.94 | 1.04 | 1.89 | 1.93 | 1.75 |
| Autocorrelation coefficient | 0.10 | 0.03 | 0.48 | 0.05 | 0.03 | 0.12 |
| RHO used for AR(1) | 0.58 | 0.15 | 0.35 | -0.02 | 0.17 | 0.45 |
| Hypothesis testing | Wald Statistics | | | | | |
| 1) H ₀ : b _{1i} = 1, all i | 8.80*** | 16.32*** | 7.09*** | 130.36*** | 34.31*** | 17.84*** |
| 2) H ₀ : b _{2i} = 1, all i | 170.00*** | 357.87*** | 102.65*** | 1,351.17*** | 421.24*** | 216.08*** |
| 3) H ₀ : b _{1i} = b _{2i} , all i | 17.74*** | 10.23*** | 5.88*** | 36.37*** | 34.31*** | 12.45*** |

Note: 1) t statistics are in parentheses

2) ***, ** and * are significance at 1%, 5%, 10% level respectively.

Table 6.6 Estimated import price models (Model B) for Thailand selected dairy imports from Australia by GLS AR(1) method

| Dairy product | Concentrated milk and cream (HS0402) | Buttermilk and yogurt (HS0403) | Whey (HS0404) | Butter (HS0405) | Cheese and curd (HS0406) | Total dairy products |
|---|--------------------------------------|--------------------------------|-------------------|--------------------|--------------------------|----------------------|
| Explanatory variable | Estimated coefficients | | | | | |
| Constant | 0.51 (0.87) | -0.43 (-0.79) | 1.52 (1.63) | 0.11 (0.40) | 4.46*** (6.48) | 1.21** (2.05) |
| Log of exchange rate (LE) | 0.53*** (3.70) | 0.43*** (3.23) | 0.36 (1.54) | 0.30*** (4.83) | 0.20 (1.42) | 0.33** (2.47) |
| Log of import tariff (LTAR) | -0.10 (-1.47) | 0.05 (0.93) | -0.19* (-1.71) | -0.03 (-0.96) | -0.43*** (-6.02) | -0.11* (-1.68) |
| Log of competitor price (LCP) | 0.53*** (7.20) | 0.72*** (9.93) | 0.40*** (4.21) | 0.78*** (28.47) | 0.25*** (3.63) | 0.52*** (8.20) |
| Log of market share (LZ) | -0.01 (-0.35) | -0.02 (-1.31) | 0.03 (0.98) | 0.07*** (4.46) | -0.01 (-0.18) | 0.02 (0.59) |
| Dummy variable for drought (DDROU) | 0.17*** (4.29) | -0.03 (-0.63) | 0.27*** (3.89) | 0.003 (0.18) | 0.003 (0.09) | 0.15*** (4.22) |
| No. Of observations | 65 | 65 | 65 | 65 | 65 | 65 |
| Degrees of freedom | 59 | 59 | 59 | 59 | 59 | 59 |
| Mean | 4.31 | 4.13 | 3.33 | 4.25 | 4.70 | 4.23 |
| Standard deviation | 0.31 | 0.33 | 0.39 | 0.31 | 0.27 | 0.28 |
| Residuals sum of squares | 0.53 | 0.82 | 1.65 | 0.19 | 0.53 | 0.53 |
| R ² | 0.9063 | 0.8701 | 0.8114 | 0.9658 | 0.8709 | 0.8853 |
| Adjusted R ² | 0.8983 | 0.8591 | 0.7954 | 0.9629 | 0.8600 | 0.8755 |
| F-Statistics | 114.10*** | 79.10*** | 50.70*** | 332.90*** | 79.60*** | 91.00*** |
| Durbin-Watson | 1.81 | 1.93 | 1.21 | 1.88 | 1.92 | 1.69 |
| Autocorrelation coefficient | 0.09 | 0.03 | 0.40 | 0.06 | 0.04 | 0.16 |
| RHO used for AR(1) | 0.46 | 0.12 | 0.36 | -0.02 | 0.17 | 0.33 |
| Hypothesis testing | Wald Statistics | | | | | |
| 1) H ₀ : b _{1i} = 1, all i | 10.60*** | 17.90*** | 7.57*** | 123.61*** | 33.68*** | 24.23*** |
| 2) H ₀ : b _{2i} = 1, all i | 247.65*** | 367.43*** | 112.96*** | 1,258.46*** | 394.88*** | 293.20*** |
| 3) H ₀ : b _{1i} = b _{2i} , all i | 26.40*** | 9.68*** | 7.17*** | 36.45*** | 34.18*** | 15.87*** |

Note: 1) t statistics are in parentheses

2) ***, ** and * are significance at 1%, 5%, 10% level respectively.

Exchange rate

The estimated coefficients of the Thailand import prices for dairy products from Australia with respect to the exchange rate movement are positive and statistically significance in four dairy product categories: concentrated milk and cream, buttermilk and yogurt, butter and total dairy products. These results show that when Thailand currency depreciates against the Australian dollar by one percent, import prices for Australian concentrated milk and cream, buttermilk and yogurt, butter and total dairy products denoted in Thailand currency increase by 0.53, 0.43, 0.30 and 0.33 percent, respectively. The estimated coefficients of exchange rate in whey, and cheese and curd are not significantly different from zero which suggests there is no exchange rate pass-through into import prices of Australian whey, butter, and cheese and curd.

For the cases of concentrated milk and cream, buttermilk and yogurt, butter and total dairy products, the null hypothesis of complete exchange rate pass-through to dairy import prices from Australia is rejected at the 1% level of significance. The result indicates incomplete exchange rate pass-through into Thailand import prices for Australian concentrated milk and cream, buttermilk and yogurt, butter and total dairy products. When Thailand currency depreciates, Australian dairy exporters reduce their mark-up partially to maintain their market shares in Thailand. As a result, the import prices of Australian dairy products expressed in Thailand currency increase less than proportionately to Thailand currency depreciation. These results are consistent with Pholphirul (2003) who found that incomplete exchange rate pass-through to the Thailand import prices in nine industries. While, Swift (2004) found the complete exchange rate pass-through to the prices of Australian milk product and cheese exports denoted in US dollar. When the US dollar depreciates against the Australian dollar by one percent, the prices of Australian dairy products export in US dollar decrease by one percent.

Import tariff rate

Thailand has reduced import tariff rates for Australian dairy products after the implementation of the TAFTA. The import tariff captures how Thailand import prices of dairy products from Australia change with respect to a decrease in the dairy import tariff under the TAFTA. The estimated coefficients of exchange rate in concentrated milk and cream, buttermilk and yogurt, and butter are not significantly different from zero. This suggests that there is no tariff rate pass-through into import prices for these three dairy product categories.

The estimated coefficients of tariff rates for Australian dairy products are negative and statistically significance in three dairy product categories (whey, cheese and curd and total

dairy products). The results imply that when Thailand import tariffs for these three Australian dairy products decrease by one percent, Thailand import prices increase by 0.19, 0.43 and 0.11 percent for whey, cheese and curd and total dairy products, respectively. The null hypothesis of complete tariff rate pass-through to dairy import prices from Australia are rejected at the 1% level of significance for whey, cheese and curd and total dairy products. The result indicates that there is an incomplete exchange rate pass-through in Thailand import prices for Australian whey, cheese and curd and total dairy products. When Thailand import tariff for an Australian dairy product decreases by one percent, Australian dairy exporters increase their domestic currency price more than proportionately to the tariff reduction. As a result, the prices of Australian dairy products in Thailand currency increase. The implementation of TAFTA does not decrease the prices of Australian dairy products in Thailand because there is a significant growth in production costs of dairy products in Australia over the study period.

In addition, the null hypothesis of the symmetry of the exchange rate and tariff rate pass-through is rejected in all Australian dairy product categories at the 1% level of significance. This implies that there is a difference between the exchange rate pass-through and tariff rate pass-through in all Australian dairy product categories. We can conclude that the response of the import prices to exchange rate movements cannot be used to predict the effect of change in tariffs in all Australian dairy product categories.

Competitor price

New Zealand dairy product prices are used as competitor prices of Australia in Thailand market. The estimated coefficients of New Zealand prices are positive and statistically significant in all dairy product categories. These findings show that the significant positive co-movement of pricing strategy between Australia and New Zealand. An increase in the prices of New Zealand dairy products results an increase in the prices of Australian dairy products. The finding is consistent with previous literatures. For example, Tantirigama (2006) found positive co-movement in the pricing strategy on the export price between New Zealand and Australia milk and cream, butter, and cheese and curd. Lee and Tcha (2005) found a positive response of Australian export price to New Zealand export price in sheep meat.

Market share

The estimated coefficients for Australian market share vary across dairy product categories but the magnitudes of the estimated coefficients are small. The butter coefficient is positive and statistically significance. This result implies that a larger market share of Australian butter

in Thailand results in an increase in its mark-ups and prices in Thailand. This reflects the monopolistic status of Australia in Thailand butter market. The monopolistic status is also found in whey and total dairy products. The estimated coefficients for Australian market share in concentrated milk and cream, buttermilk and yogurt and cheese and curd are negative and statistically insignificant. These results imply the perfect competition status of Australia in these three dairy product categories in Thailand market.

Drought

The effect of severe drought on Australian dairy production occurred in 2001, 2002, 2003, 2007 and 2008 (Dairy Australia, 2003; Armstrong, Ho, Doyle, Malcolm, Gibb and Brown, 2005; Jesse, 2005; Griffith, 2010). The estimated coefficients for the dummy variable for Australian drought are positive and statistically significant in concentrated milk and cream, whey and total dairy products. These findings indicate that the occurrence of drought in Australia results in an increase in the prices of these three Australian dairy products. For butter and cheese and curd, the effect of the drought on the price of Australian products is positive and insignificant. In contrast, the effect of drought on the price of Australian buttermilk and yogurt is negative and insignificant.

Overall, New Zealand dairy product price has the largest effect on the import price of total dairy products from Australia, followed by exchange rate, the dummy variable for drought and tariff rate. While the effect of Australian market share on Thailand import price for total dairy products from Australia is insignificant. Surprisingly, the tariff reduction in Thailand increases Australian exporters' mark-ups and Thailand import prices for Australian dairy products. This is because Thailand import demand for dairy products increases and is inelastic. As a result, Australian dairy exporters can take advantage to increase their prices in Thailand dairy market according to the tariff reduction.

6.3 Empirical Results of Thailand Import Price Ratio Models for Dairy Imports

Free Trade Agreements not only affect changes in export and import prices among their member countries, but also their non-member country prices. The impacts of the implementation of the THNZCEP and TAFTA on Thailand import prices of dairy products from their non-members are estimated by the import price ratio models of the non-member to the member. The import price ratio of the non-member to the member of the THNZCEP and TAFTA for Thailand dairy imports is influenced by dairy import tariff for the non-FTA member country, dairy import tariff for the member country, production input price of the

non-FTA member country and production input price of the member country. Four factors such as Thailand income, aggregate price index, exporter dairy cost index and exporter capacity utilization index are also considered and tested for their correlation. These four variables are not included into the import price ratio models because they have high correlation with other variables.

The import price ratio models are estimated separately by FTAs and by dairy products. There are six dairy categories: concentrated milk and cream (HS0402), buttermilk and yogurt (HS0403), whey (HS0404), butter (HS0405), cheese and curd (HS0406) and total dairy products. The import price ratio model for each dairy product category is estimated by pooling the yearly data from 1991 to 2009 across three non-FTA member countries.

The four panel estimation techniques including pooled OLS, FEM, REM and TSCS were used to analyse the models. All estimated regression for THNZCEP and TAFTA cases are shown in Appendix E and F, respectively. However, the TSCS procedure is more suitable for estimating the data set which has a larger number of periods than cross sectional units, and provides more robust results. The TSCS procedure by NLOGIT version 4.0 generates nine models. Lagrange Multiplier statistics, Likelihood Ratio statistics and the Likelihood Ratio test are employed to select the best fit model.

6.3.1 Effects of the THNZCEP on Thailand Import Price Ratio of Non-THNZCEP Member to New Zealand for Dairy Products

Table 6.7 shows the estimated results of the import price ratio models for Thailand dairy imports with the THNZCEP by TSCS estimation. The dependent variable in the models is the price ratio of the non-THNZCEP member to New Zealand for Thailand dairy imports which is influenced by dairy import tariff for the non-THNZCEP member (LTARNM), dairy import tariff for New Zealand (LTARNZ), production inputs price of the non-THNZCEP member (LMPNM) and production input price of New Zealand (LMPNZ).

The selected models for the concentrated milk and cream (HS0402), buttermilk and yogurt (HS0403), whey (HS0404), butter (HS0405), cheese and curd (HS0406) and total dairy products are S2R1, S0R0, S2R1, S1R1, S1R1, S2R2 and S0R1, respectively. The likelihood ratio tests for all models are compared with the critical Chi-squared statistic with 4 degrees of freedom at the 5 percent level of significance. The rejection of the null hypothesis of no explanatory power is presented in five models (concentrated milk and cream, buttermilk and yogurt, whey, butter and cheese and curd). This indicates that the explanatory power is satisfactory in these models and these models can be used for forecasting. For total dairy

Table 6.7 Estimated results of import price ratio models for Thailand selected dairy imports in the case of THNZCEP by TSCS estimation

| Dairy product | Concentrated milk and cream (HS0402) | Buttermilk and yogurt (HS0403) | Whey (HS0404) | Butter (HS0405) | Cheese (HS0406) | Total dairy products |
|---|--------------------------------------|--------------------------------|-------------------|--------------------|---------------------|----------------------|
| Model | TSCS: S2,R1 | TSCS: S0,R0 | TSCS: S2,R1 | TSCS: S1,R1 | TSCS: S2,R2 | TSCS: S0,R1 |
| Explanatory variable | Estimated coefficients | | | | | |
| Constant | 1.47 (0.89) | 8.71** (2.55) | 5.30 (0.59) | 0.55 (0.74) | 5.45*** (4.98) | -0.20 (-0.1) |
| Log of Thailand import tariff for non-THNZCEP member (LTARNM) | -0.32 (-0.65) | -1.75** (-2.14) | -2.12 (-0.82) | 0.11 (0.59) | -1.17*** (-4.15) | -0.05 (-0.08) |
| Log of Thailand import tariff for New Zealand (LTARNZ) | -0.32** (-2.4) | -0.35** (-2.15) | -0.24 (-0.55) | -0.22** (-1.97) | 0.09 (0.46) | -0.11 (-0.42) |
| Log of input price (raw milk price) of non-FTA member (LMPNM) | 0.36*** (5.75) | 0.19 (0.52) | 1.27*** (6.22) | -0.04 (-0.26) | -0.01 (-0.03) | 0.35* (1.82) |
| Log of input price (raw milk price) of New Zealand (LMPNZ) | -0.24* (-1.91) | -1.02*** (-2.95) | -0.57 (-1.17) | 0.02 (0.17) | -0.51*** (-3.75) | -0.24 (-1.17) |
| No. Of observations | 57 | 45 | 51 | 57 | 57 | 57 |
| Mean | -0.12 | 0.13 | -0.51 | 0.20 | 0.58 | -0.37 |
| Standard deviation | 0.252 | 0.32 | 0.52 | 0.20 | 0.31 | 0.36 |
| Wald Statistics | | 24.11 | | 97.62 | | 13.02 |
| Lagrange multiplier statistic | | 13.50 | | 6.14 | | 7.30 |
| Likelihood ratio statistic | 12.18 | 12.71 | 36.20 | 24.85 | 21.24 | 7.46 |
| Log-likelihood function | 39.09 | -6.62 | -1.15 | 36.86 | 31.42 | 6.34 |
| Parameter | 12 | 6 | 12 | 9 | 14 | 7 |
| Autocorrelation coefficient | 0.39 | | 0.32 | 0.23 | 0.21, -0.14, 0.45 | 0.56 |

Note: 1) t statistics are in parentheses

2) ***, ** and * are significance at 1%, 5%, 10% level respectively.

product model, the null hypothesis of no explanatory power is accepted. Therefore, the model for total dairy products cannot be used for forecasting. This is because high variation and noise of the unit value prices across the dairy commodities.

Thailand dairy import tariff for the non-THNZCEP member

The coefficients of Thailand dairy import tariff for the non-THNZCEP member are negative in most dairy categories but statistically significance only in two dairy categories: buttermilk and yogurt and cheese and curd. The result shows that when the Thailand dairy import tariff for the non-THNZCEP member decreases by one percent, the import price ratio of the non-THNZCEP member to New Zealand for buttermilk and yogurt and cheese and curd increases by 1.75 and 1.17 percent in Thailand market respectively. This is inconsistent with the hypothesized sign. In fact, Thailand import prices for dairy products continue their upward trend among its main exporters. However, an increase in the price of the non-THNZCEP member is more than an increase in the price of New Zealand. The higher price of the non-THNZCEP member is due to the existence of higher tariff for the non-THNZCEP member. This may cause a rise in the ratio of the non-THNZCEP member to New Zealand prices. However, the increase in the exporter prices for dairy products could be caused by other factors such as an increase in exporter production costs, severe drought and an increase in Thailand import demand for dairy products.

Thailand dairy import tariff for New Zealand

The coefficient of Thailand dairy import tariff for New Zealand indicates the effect of a tariff change for New Zealand dairy products on the relative import price. The estimated coefficients are negative and statistically significant in concentrated milk and cream, buttermilk and yogurt and butter. The results show that a tariff reduction in New Zealand products increases the import price ratio of the non-THNZCEP member to New Zealand. This indicates that the dairy product prices of the non-THNZCEP members are relative high in Thailand market after the implementation of THNZCEP due to the higher tariff for the non-THNZCEP member. The finding is consistent with the study of Winters and Chang (2000) which found the ratio of the US/Japan to European Community prices rise following the tariff reduction for European countries.

Production input price of the non-THNZCEP member

Production input price is a proxy for the production cost for dairy products. Raw milk is a main input for milk products therefore the price of raw milk of the non-THNZCEP member

country is used to measure the effect of production cost changes on the ratio of the non-THNZCEP member to New Zealand prices in Thailand market. According to Doucouliagos and Hone (2000), variable cost of dairy processing industry was significantly influenced by the unit price of raw milk. The estimated coefficients of the raw milk price of the non-THNZCEP member are positive and statistically significant at the 1% level of significance in concentrated milk and cream and whey. A rise in the raw milk price of the non-THNZCEP member leads to an increase in concentrated milk and cream and whey prices of the non-THNZCEP member. As a result, the ratio of the non-THNZCEP member to New Zealand prices increases.

Production input price of New Zealand

The estimated coefficients of the raw milk price of New Zealand are negative and statistically significant in concentrated milk and cream, buttermilk and yogurt and cheese and curd. A one percent increase in the raw milk price of New Zealand increases the ratio of the non-THNZCEP member to New Zealand prices for concentrated milk and cream, buttermilk and yogurt and cheese and curd by 0.24, 1.02 and 0.51 percent, respectively. An increase in the dairy production cost of New Zealand has a positive effect on the New Zealand dairy product price. As a result, the ratio of the non-THNZCEP member to New Zealand prices for dairy products decreases.

6.3.2 Effects of the TAFTA on Thailand Import Price Ratio of Non-TAFTA Member to Australia for Dairy Products

Table 6.8 shows the estimated results of import price ratio models for Thailand dairy imports in the case of the TAFTA by TSCS estimation. The dependent variable in the model is the price ratio of the non-TAFTA member to Australia for Thailand dairy imports which is influenced by dairy import tariff for the non-TAFTA member (LTARNM), dairy import tariff for Australia (LTARAU), production input price of the non-TAFTA member (LMPNM) and production input price of Australia (LMPAU).

The selected TSCS models are S0R1, S2R0, S2R1, S0R2, S2R1, S2R2 and S0R1 for concentrated milk and cream (HS0402), buttermilk and yogurt (HS0403), whey (HS0404), butter (HS0405), cheese and curd (HS0406) and total dairy products, respectively. The likelihood ratio tests for all models are compared with the critical Chi-squared statistic with 4 degrees of freedom at the 5 percent level of significance. The rejection of the null hypothesis of no explanatory power is presented in concentrated milk and cream, buttermilk and yogurt, whey, butter and cheese and curd. This indicates that the explanatory power is satisfactory in

Table 6.8 Estimated results of import price ratio models for Thailand selected dairy imports in the case of TAFTA by TSCS estimation

| Dairy product | Concentrated milk and cream (HS0402) | Buttermilk and yogurt (HS0403) | Whey (HS0404) | Butter (HS0405) | Cheese (HS0406) | Total dairy products |
|--|--------------------------------------|--------------------------------|--------------------|---------------------|---------------------|----------------------|
| Model | TSCS: S0,R1 | TSCS: S2,R0 | TSCS: S2,R1 | TSCS: S0,R2 | TSCS: S2,R1 | TSCS: S0,R1 |
| Explanatory variable | Estimated coefficients | | | | | |
| Constant | -1.37 (-0.93) | 0.72 (0.32) | -7.01 (-1.21) | 1.82** (2.06) | 1.34 (1.41) | -2.84 (-1.64) |
| Log of Thailand import tariff for non-FTA country (LTARNM) | 0.71* (1.78) | -0.41 (-0.78) | 2.83* (1.72) | 0.34 (1.44) | -0.13 (-0.41) | 0.68 (1.16) |
| Log of Thailand import tariff for Australia (LTARAU) | -0.38** (-2.41) | 0.06 (0.32) | -0.93** (-2.32) | -0.67*** (-3.56) | -0.20 (-0.75) | -0.10 (-0.34) |
| Log of input price (raw milk price) of non-FTA country (LMPNM) | 0.31*** (2.88) | 0.32*** (2.67) | 0.99*** (5.11) | 0.15 (0.74) | 0.67*** (3.05) | 0.40** (2.21) |
| Log of input price (raw milk price) of Australia (LMPAU) | -0.23 (-1.04) | -0.10 (-0.26) | -1.10** (-2.11) | -0.47** (-2.14) | -0.67*** (-3.19) | -0.15 (-0.55) |
| No. Of observations | 57 | 45 | 51 | 57 | 57 | 57 |
| Mean | -0.02 | 0.20 | 0.03 | 0.21 | 0.51 | -0.23 |
| Standard deviation | 0.19 | 0.35 | 0.37 | 0.21 | 0.30 | 0.35 |
| Wald Statistics | 86.61 | | | 23.04 | | 10.34 |
| Lagrange multiplier statistic | 22.04 | | | 11.34 | | 7.99 |
| Likelihood ratio statistic | 23.20 | 24.93 | 20.59 | 11.34 | 16.76 | 7.49 |
| Log-likelihood function | 29.07 | 12.44 | 3.23 | 33.64 | 27.24 | 13.34 |
| Parameter | 7 | 11 | 12 | 9 | 12 | 7 |
| Autocorrelation coefficient | 0.26 | | 0.34 | -0.31, 0.28, 0.51 | 0.14 | 0.64 |

Note: t statistics are in parentheses, and ***, ** and * are significance at 1%, 5%, 10% level respectively.

these models and these models can be used for forecasting. For total dairy product model, the null hypothesis of no explanatory power is accepted. Therefore, the model for total dairy products cannot be used for forecasting. This is because high variation and noise of the unit value prices across the dairy commodities.

Thailand dairy import tariff for the non-TAFTA member

The coefficients of Thailand dairy import tariff for the non-TAFTA member are positive and statistically significant in concentrated milk and cream and whey. The result shows that when Thailand dairy import tariff for the non-TAFTA member decreases by one percent, the import price ratio of the non-TAFTA member to Australia for the two dairy product categories decreases by 0.71 and 2.83 percent in the Thailand market. This is consistent with the study of Winters and Chang (2000) which found that the ratio of the US/Japan to European Community prices rises following the tariff reduction in the US or Japanese products. This is because the non-European community members (the US and Japan) partially reduce their mark-ups or export prices with respect to the tariff reduction or they have incomplete tariff pass through in their export prices.

Thailand dairy import tariff for Australia

The coefficient of Thailand dairy import tariff for Australia indicates the effect of a tariff change in Australian dairy products on the relative import price. The estimated coefficients of Thailand dairy import tariff for Australia are negative in most dairy categories. The coefficients are statistically significant only in three cases (concentrated milk and cream, whey and butter). These results show that a one percent reduction in tariff for Australian dairy products increases the price ratio of the non-TAFTA member to Australia for concentrated milk and cream, whey and butter by 0.38, 0.93 and 0.67 percent, respectively. This indicates that the dairy product prices of the non-TAFTA members are relative high in Thailand market after the implementation of TAFTA.

Production input price of the non-TAFTA member

Production input prices of the non-TAFTA members have significant positive effects on changes in the ratio of the non-TAFTA member to Australian prices. The estimated coefficients of the raw milk price of the non-TAFTA member are positive and statistically significant at the 1% level of significance in concentrated milk and cream, buttermilk and yogurt, whey and cheese and curd. When raw milk price of the non-TAFTA member

increases, the dairy product price of the non-TAFTA member also increases. The ratio of the non-THNZCEP member to Australian prices also increases.

Production input price of Australia

The estimated coefficients of Australian raw milk price are negative and statistically significant in whey, butter and cheese and curd. This implies that an increase in the dairy production cost of Australia leads to an increase in Australian dairy product prices. As a result, the ratio of the non-TAFTA member to Australian prices for dairy products in Thailand market decreases.

Chapter 7

Conclusions and Implications

This chapter summarizes the research. Section 7.1 presents the summary of the research objectives, data and methodology and major findings. Section 7.2 discusses the implications of the research findings. Limitations of the research and recommendations for future research are discussed in Sections 7.3 and 7.4 respectively.

7.1 Summary and Major Findings

Free Trade Agreements (FTAs) have become an important trade policy tool in the global trading system. The proliferation of FTAs is driven by the WTO agenda. Thailand is a member of numerous regional trade associations, such as the WTO, APEC, ASEM and ASEAN. In addition, Thailand has established FTAs with many countries, such as Australia, New Zealand and Japan, and is negotiating for FTAs with India, Peru, the United States, Bahrain, BIMSTEC and EFTA. The impacts of FTAs may vary across products within the same FTA and between FTAs therefore the impact assessment of FTAs should be measured at the disaggregated or commodity levels.

In the past, Thailand dairy industry was protected with extensive government intervention. When Thailand embraces trade liberalization, milk and milk products become highly sensitive products. There are two FTAs significantly affecting Thailand's dairy trade namely the Thailand-Australia Free Trade Agreement (TAFTA) and the Thailand-New Zealand Closer Economic Partnership (THNZCEP). The contents of both agreements on dairy products are fairly similar. Thailand will fully eliminate tariffs for all dairy products from Australia and New Zealand after 2025.

Thailand is a small player in the world dairy market. Most Thai dairy farms are small scale farming operations each farm having around 25 cows on average. Thai dairy farmers have low productivity and efficiency compared to the world leaders in dairy production such as New Zealand and Australia. Thailand domestic raw milk supply is insufficient to serve its domestic demand. Thailand processors need to use both domestic raw milk and imported ingredients to produce a few categories of dairy products such as Pasteurized and UHT milk, condensed milk, evaporated milk, yogurt, butter and cheese.

Thailand main dairy imports are concentrated milk and cream (skim and whole milk powder) and whey, which are important raw materials in dairy and food processing. Imports of

buttermilk and yogurt, butter, cheese and curd, and non-concentrated milk and cream are in low volumes with 20% of total dairy imports. The major sources of Thailand dairy imports are New Zealand, Australia, United States, the Netherlands, France, the Czech Republic and Ireland. Thailand also exports some dairy products to neighbouring countries such as Philippines, Malaysia, Indonesia, Cambodia, Lao PDR, Myanmar, Hong Kong, Singapore and China. The most important Thailand dairy exports are concentrated milk and cream which are in terms of re-exported, followed by non-concentrated milk and cream, buttermilk and yoghurt, and whey. Exports of butter, and cheese and curd are insignificant.

Overall, Thailand has long been a net importer of dairy products and the Thai dairy product market has depended on a large proportion of dairy imports from New Zealand and Australia. Both countries together make up over half of Thailand's total dairy imports. Therefore, the free trade agreements with both countries in dairy products directly affect changes in Thailand dairy import volumes and prices. This study is the first empirical study on the post-effect assessment of THNZCEP and TAFTA on Thailand dairy import volumes and prices.

The objectives of this research were to provide an overview of dairy import patterns and policy in Thailand; to assess the effects of the implementations of THNZCEP and TAFTA on Thailand dairy import volumes; to examine the effects of the implementations of THNZCEP and TAFTA on Thailand dairy import prices from New Zealand and Australia; and to examine the effects of the implementations of THNZCEP and TAFTA on the relative price of Thailand dairy imports between non-FTA and FTA members.

Research objective one was answered by descriptive statistics., The modified gravity model was employed to answer research objective Two which examined the determinants of Thailand dairy imports with panel data covering the time period of 1991:Q1 to 2009:Q4 across Thailand top five dairy trading partners. The modified gravity model is widely used for ex-post analysis of the effects of FTAs on trade flows. The modified gravity model is based on international trade theory and explains the relationship between total bilateral trade flow and economic and policy variables. Thailand dairy import volumes were determined by the population of dairy exporting countries, the population of Thailand, per capita GDP of dairy exporting countries, per capita GDP of Thailand, bilateral distance, dummy variable for intra-THNZCEP trade bias, dummy variable for intra-TAFTA trade bias, dummy variable for extra-THNZCEP trade openness and dummy variable for extra-TAFTA trade openness. Parameters of FTA dummy variables from the modified gravity model explained the effects of the implementations of THNZCEP and TAFTA on Thailand dairy import flows in terms of

trade creation and diversion. The net welfare effects of both agreements depended on relative magnitudes of trade creation and trade diversion effects.

Research objective three used the price equation to examine the effects of the implementations of THNZCEP and TAFTA on Thailand dairy import prices from New Zealand and Australia. The import price model is a single price equation derived from profit maximization under the monopolistic competition market. It explains price behaviour of exporting countries under the floating exchange rate system. Thailand import price equations for six dairy product categories from New Zealand and Australia were determined by exchange rates, import tariff rates, competitor prices, exporter market shares and a dummy variable for drought. The six import price equations for each exporting country were estimated together as a system of equations by using quarterly time-series data for the period 1991:Q1 to 2009:Q4.

Research objective four utilised the price ratio equation or the relative price equation to examine the effects of the implementations of THNZCEP and TAFTA on the relative price for Thailand dairy imports between non-FTA and FTA members. The import price ratio equation was estimated by pooling annual data from 1991 to 2009 across Thailand's three dairy trading partners who are non-FTA member countries. The import price ratio model showed that the ratio of non-FTA member prices to FTA member prices for Thailand dairy imports was determined by Thailand tariffs on dairy products from non-FTA members, Thailand tariffs on dairy products from FTA members, dairy product costs of non-FTA members and dairy product costs of FTA members. The raw milk price was a proxy for dairy product costs in this study. Doucouliagos and Hone (2000) study showed the variable cost of the dairy processing industry is significantly influenced by the unit price of raw milk. The relative import price model for Thailand dairy imports implied how Thailand import prices for dairy products from non-FTA members changed in respect to the implementation of the free trade agreements.

This study analysed the effects of THNZCEP and TAFTA on Thailand six dairy import categories following the Harmonized System (HS) 4-digit level such as non-concentrated milk and cream (HS0401), concentrated milk and cream (HS0402), buttermilk and yogurt (HS0403), whey (HS0404), butter (HS0405) and cheese and curd (HS0406). The panel data sets for the modified gravity model and the import price ratio model of Thailand dairy imports in this study were estimated by few panel data estimation techniques such as OLS, FEM, REM and TSCS procedure. TSCS procedure was the most robust method for the panel data set in this research where time series are relatively larger than cross section units. In addition,

TSCS deals well with panel data facing heteroscedasticity, autocorrelation or non-stationary problems. The time-series data set for the Thailand import price models for New Zealand and Australian dairy products were analysed by the SURE estimation. An equation system of the Thailand dairy import prices from New Zealand and Australia consisted of six import price equations for six dairy products. The prices of various dairy products were likely to move together which caused contemporaneous correlation of error terms across the dairy import price equations. There were two methods for the SURE estimation: GLS and GLS AR (1). The GLS AR (1) method was used in this study due to the presence of the positive autocorrelation. The GLS AR(1) method corrected the autocorrelation and provided more efficient and robust results. The econometric software NLOGIT version 4.0 was used to estimate all econometric models in this study.

The results of the gravity models for Thailand imports in six dairy products are summarized as follows:

- All standard gravity variables: exporter population, Thailand population, exporter per capita GDP, Thailand per capita GDP and bilateral distance were found to be statistically significant in most dairy products. Exporter population and bilateral distance had negative impacts on Thailand dairy imports while Thailand population had positive impacts on Thailand dairy imports.
- The coefficient of exporter per capita GDP showed mix signs across dairy products. The positive coefficient of exporter per capita GDP found in non-concentrated milk and cream, concentrated milk and cream and total dairy products implied that these dairy products are capital-intensive production in the exporting countries. While the negative coefficient of exporter per capita GDP found in buttermilk and yogurt and cheese and curd implied that these dairy products are labour-intensive production in the exporting countries.
- The coefficient of Thailand per capita GDP is positive in most dairy products, except in whey. This is because most dairy products are normal goods whereas whey is inferior goods in Thailand. Thailand imports low quality whey in UHT milk and food processing industries. When Thai customers income increases, they will decrease the demand for whey and switch to consume higher quality dairy products such as concentrated milk and cream or whole milk powder.
- The estimated coefficients of dummy variables for intra THNZCEP trade bias and intra TAFTA trade bias were statistically significant and positive for non-concentrated

milk and cream, concentrated milk and cream and total dairy products. The implementation of THNZCEP boosted Thailand imports for non-concentrated milk and cream, concentrated milk and cream and total dairy products from New Zealand while the implementation of TAFTA boosted Thailand imports for non-concentrated milk and cream from Australia only. The results indicate trade creation effects of THNZCEP and TAFTA in those dairy products.

- Dummy variables for extra THNZCEP trade openness and extra TAFTA trade openness were statistically significant and negative for a few Thailand dairy imports. Thailand imports for butter and total dairy products from non-THNZCEP member countries decreased after the implementation of THNZCEP while Thailand imports for non-concentrated milk and cream, concentrated milk and cream and total dairy products from non-TAFTA member countries decreased after the implementation of TAFTA. The results indicate trade diversion effects of THNZCEP and TAFTA in those dairy products.
- Total impacts of the implementation of THNZCEP and TAFTA were measured from the relative magnitudes of trade creation and trade diversion effects which varied across trade agreements and dairy products. The implementation of THNZCEP resulted in net positive trade creation (welfare improvement) for its members in most dairy products, except in whey. This is because New Zealand is not a main exporter for whey in Thailand and New Zealand whey is more expensive than non-THNZCEP member countries. The implementation of TAFTA led to net positive trade creation (welfare improvement) for its members in most dairy products, except in concentrated milk and cream. This is because Thailand switch to import from lower cost (price) concentrated milk and cream from other non-TAFTA member countries.
- Overall, the largest net trade creation of both agreements was found in non-concentrated milk and cream. The implementation of THNZCEP exhibited more benefits than the implementation of TAFTA. The difference in impacts of trade agreements depended on market structures and demand patterns of Thailand dairy imports.

The results of Thailand import price models for New Zealand and Australian dairy products are summarized as follows:

- The pattern of pricing behaviour of New Zealand and Australian dairy products in the Thailand market were similar. Competitor price, drought and exchange rate showed

significant positive impacts on Thailand import prices for New Zealand and Australian dairy products. New Zealand and Australian dairy exporters competed with each other in the Thailand dairy import market and there was a significant positive co-movement in dairy product prices between New Zealand and Australian dairy products. The occurrence of drought was an important factor influencing an increase in prices of New Zealand and Australian dairy products. Incomplete (less than) exchange rate pass-through into Thailand import prices was found in most dairy products from New Zealand and Australia. When Thailand currency depreciated against the New Zealand and Australian dollars by one percent, New Zealand and Australian dairy exporters reduced their mark-up partially to maintain their market shares in Thailand, hence the import price expressed in Thailand currency increased less than one percent. This implies the presence of monopolistic behaviour of New Zealand and Australia in the Thailand dairy import market.

- The effect of import tariff on Thailand import prices for New Zealand and Australian dairy products was negative. When Thailand reduced import tariffs for New Zealand and Australian dairy products, New Zealand and Australian dairy exporters reacted to the tariff reduction by increasing their mark-ups. As a result, the prices of New Zealand and Australian dairy products in Thailand currency increased. This indicates that the implementation of THNZCEP and TAFTA does not decrease the prices of New Zealand and Australian dairy products in Thailand because both dairy exporting countries experience a significant growth in their dairy production costs over the study period.
- The effect of exporter market share on Thailand import prices for New Zealand and Australian dairy products was small. The estimated coefficient of exporter market share showed mixed signs across dairy products in New Zealand and Australian models. A significantly positive relationship between exporter market share and price was found in buttermilk and yogurt and butter for New Zealand and in butter for Australia. This indicates that New Zealand and Australian pricing strategies for these dairy products are based on monopolistic. A significantly negative relationship between exporter market share and price was found in concentrated milk and cream and total dairy products for New Zealand. This reflects the perfect competition of New Zealand for concentrated milk and cream and total dairy products in Thailand.

- However, exchange rate, competitor price, and drought play a larger role than tariff rate and market share in New Zealand and Australian pricing for dairy products in the Thailand market.

The results of Thailand import price ratio models for dairy imports are summarized as follows:

- The pattern of changes in the Thailand import price ratio for dairy products with the implementation of THNZCEP was similar to the implementation of TAFTA. The reduction in the Thailand import tariff for New Zealand/ (Australian) dairy products increased the Thailand import price ratio of the non-FTA member countries to New Zealand/ (Australian) dairy products. This finding indicates that the dairy product prices of the non-FTA member countries are relatively high in the Thailand market after the implementation of THNZCEP and TAFTA.
- The reduction of the Thailand import tariff for the non-THNZCEP member countries increased the Thailand import price ratio of the non- THNZCEP member countries to New Zealand dairy products. While the reduction of the Thailand import tariff for the non-TAFTA member countries decreased the Thailand import price ratio of the non-TAFTA member countries to Australian dairy products.
- Raw milk price of New Zealand/ (Australia) exhibited a negative impact on the Thailand import price ratio of the non-FTA member countries to New Zealand/ (Australian) dairy products. The raw milk price was proxied for the production cost for dairy products. An increase in the raw milk price of New Zealand/ (Australia) resulted in a rise in the price of New Zealand/ (Australian) dairy products. As a result, the Thailand import price ratio of the non-FTA member country to New Zealand (Australian) dairy products decreased.
- The raw milk price of the non-FTA member countries had a positive impact on the Thailand import price ratio of the non-FTA member countries to New Zealand/ (Australian) dairy products. When the raw milk price of the non-FTA member countries increased, the dairy product prices of the non-FTA member countries increased. As a result, the Thailand import price ratio of the non-FTA member countries to New Zealand/ (Australian) dairy products increases.

7.2 Implications of the Research Findings

7.2.1 Academic Implications

This study is the first research on *ex-post* impact assessment of the implementation of THNZCEP and TAFTA across Thailand dairy import volumes and prices. The findings of this study provide academic contributions to the fields of FTAs impact assessment.

The results from the modified gravity model enhance our understanding of the determinants of Thailand dairy imports and the *ex-post* effects of the implementation of THNZCEP and TAFTA on Thailand dairy import volumes. Thailand dairy import volumes are determined by economic and policy variables including the population of dairy exporting countries, population of Thailand, per capita GDP of dairy exporting countries, per capita GDP of Thailand, bilateral distance, dummy variable for intra-THNZCEP trade bias, dummy variable for intra-TAFTA trade bias, dummy variable for extra-THNZCEP trade openness and dummy variable for extra-TAFTA trade openness. The basic gravity model variables (population, income and distance) are significant with expected signs while the dummy variables for FTAs vary across dairy products and FTAs. Parameters of the dummy variables for intra-FTA trade bias and extra-FTA trade openness indicate the *ex-post* effects of the FTA on Thailand dairy import flows in terms of trade creation and trade diversion respectively. The findings confirm that the modified gravity model is successfully implemented to determine trade flows and assess the *ex-post* effects of FTAs for single commodity or disaggregate trade data levels. This is consistent to the suggestion of Jayasinghe and Sarker (2004)'s study that trade creation and diversion effects of an FTA vary across products because there are different structures across product categories. Hence, the FTA impact assessment at disaggregate or commodity trades indicates more accurate effects than focusing on aggregate trades.

The results from the import price models improve our understanding of the New Zealand and Australian pricing strategies for dairy products in the Thailand market. The findings suggest that exchange rate, competitor price, and drought play a larger role than market share and tariff rate in New Zealand and Australian pricing for dairy products in the Thailand market. Exchange rate, competitor price, and drought have positive impacts on Thailand import prices for New Zealand and Australian dairy products while the impact of market share varies across dairy products. Tariff rate has a negative impact which is inconsistent with the hypothesis and previous literatures. Thailand tariff reduction for dairy imports from New Zealand and Australia increases the prices of New Zealand and Australian dairy products in the Thailand market. This may be caused by significant increase in New Zealand and Australian dairy production costs and the presence of monopolistic behaviour of both countries in the Thailand

dairy import market. In addition, the results show that the dummy variable for drought in the import price model enhances the efficiency of regression estimation because drought is an important influence on agricultural product prices. Severe droughts in New Zealand in 1998, 1999, 2001, 2003, 2007 and 2008 (New Zealand Treasury, 2008) and in Australia in 2001, 2002, 2003, 2007 and 2008 (Dairy Australia, 2003; Armstrong *et al.*, 2005; Jesse, 2005; Griffith, 2010) affected a shortage of milk supply and an increase in prices of New Zealand and Australian dairy products significantly as a result of reduced export volumes.

The results from the import price ratio models explain how the relative price of imports from FTA member and non-FTA member countries changes with respect to their tariffs and production costs. The main interest of the model is the coefficient of tariff for FTA member country product which indicates the FTA effect on the relative price of imports from FTA member and non-FTA member countries and implies the FTA effect on non-FTA member prices. For example, the reduction in Thailand's import tariff for New Zealand/ (Australian) dairy products increases the Thailand import price ratio of the non-FTA member countries to New Zealand/ (Australian) dairy products. This finding implies that the dairy product prices of the non-FTA member countries are relatively high in the Thailand market after the implementation of THNZCEP and TAFTA. Furthermore, we found that the Thailand import price ratio model for total dairy products cannot be used for forecasting due to high variation and noise of the unit value prices across the dairy products. This indicates that the analysis of the unit value price model should focus on disaggregate or single product price level instead of aggregate price level.

The gravity models and import price ratio models were estimated by four panel data estimation methods such as pooled OLS, FEM, REM and TSCS. The results show that the TSCS procedure is the most efficient estimation method for the panel data set in which the data are observed for a relatively large number of periods for a relatively small number of cross sectional units. In addition, the TSCS procedure can perform well with panel data facing groupwise heteroscedasticity, autocorrelation and non-stationary while other panel estimation methods can correct for groupwise heteroscedasticity but not for autocorrelation and non-stationary problems.

7.2.2 Practical and Policy Implications

The findings of this study provide important information for Thailand and foreign dairy producers to plan their production and pricing strategies in the Thailand dairy market and for Thailand dairy importers, traders and processors to predict the cost of dairy imports and

improve their pricing strategies. In addition, policy makers in Thailand can use some of the findings to frame their dairy production and trade policies.

The empirical findings from the gravity model for Thailand dairy import flows can help Thailand and foreign dairy producers to predict Thailand dairy import demand with respect to changes in exporting country population, Thailand population, exporting country income, Thailand income, bilateral distance and the implementation of THNZCEP and TAFTA. The main findings show that while holding other factors constant, the implementation of THNZCEP leads to a significant increase in Thailand imports for New Zealand non-concentrated milk and cream, concentrated milk and cream and total dairy products and a significant decrease in Thailand imports for butter and total dairy products from non-THNZCEP members. The implementation of TAFTA leads to a significant increase in Thailand imports for Australian non-concentrated milk and cream and a significant decrease in Thailand imports for non-concentrated milk and cream, concentrated and cream and total dairy products from non-TAFTA members. Therefore, New Zealand and Australian dairy producers are likely to expand their production in those potential dairy products for exporting to Thailand. A decrease in Thailand imports for those dairy products from non-THNZCEP and TAFTA members suggests that non-THNZCEP and TAFTA dairy producers should develop new marketing strategies to increase Thai consumer demand and satisfaction such as competitive pricing and sales promotion strategies.

Economic variables such as Thailand population and per capita GDP show that the growth in Thailand population and per capita GDP boosts significantly the growth in Thailand dairy import demand in most dairy products. Thailand milk consumption is highly depended on imports because domestic milk and milk products in Thailand are inadequate, low quality and limited variety (Rabobank, 2004). Thai dairy processors should produce more varieties of dairy products or extend product lines to meet Thai consumer taste and preference which most of Thai people prefer sweet. This can solve the problem of the excess supply of raw milk during the school break. In addition, Thailand dairy farmers should improve their efficiency and productivity by dairy herd improvement and quality control of raw milk.

Thailand has become an important exporter for some milk products such as Pasteurized and UHT milk, condensed milk and yoghurt in Southeast Asia and is an important dairy manufacturing hub for multinational companies like Foremost, Nestle, Dumex, Mead Johnson and Fonterra for the distribution dairy products to neighbouring and Asian countries. The implementation of THNZCEP and TAFTA leads to an opportunity for Thailand processors to be potential exporters for dairy products in Asia. Thai processors can import lower cost dairy

ingredients such as milk powder and whey to process into added value milk products and expand dairy exports to Asian countries.

The results from the import price models for New Zealand and Australian dairy products provide some information for Thai dairy processors and traders to predict the cost of dairy imports and to set their dairy product prices in Thailand. When competitor price, drought and exchange rate increase, Thailand import prices for New Zealand and Australian dairy products increase significantly. While a reduction in Thailand tariffs for dairy imports from New Zealand and Australia leads to an increase in Thailand import prices for New Zealand and Australian dairy products. Although, the implementation of THNZCEP and TAFTA leads to an increase in the Thailand import prices for New Zealand and Australian dairy products, the dairy product prices of the non-FTA member countries are also relatively high in Thailand market after the implementation of THNZCEP and TAFTA. In addition, Thai policy makers can also apply the findings from the prediction of dairy import price to set the price guarantee for raw milk and the ceiling price for ready-to-drink milk (Pasteurized and UHT milk) in Thailand. Most of ready to drink milk depends on imported milk ingredients such milk powder and whey. If the import price of skim milk powder, whole milk powder and whey increase, the price guarantee for raw milk and the ceiling price for ready-to-drink milk should increase.

Overall, after the implementation of THNZCEP and TAFTA, Thailand has imported more dairy products from FTA member countries (New Zealand and Australia) than from non-FTA member countries. New Zealand and Australia exhibit monopolistic behaviour in the Thailand dairy import market but their prices are still lower than non-FTA member countries. New Zealand and Australian dairy producers have expanded their dairy exports to Thailand while Thailand consumers have gained from consuming the higher quality and lower price dairy products. This indicates that the implementation of THNZCEP and TAFTA results in welfare improvement for their members in dairy products. The implementation of THNZCEP and TAFTA helps trade liberalization in dairy products. But due to the monopoly power of New Zealand and Australia in the Thailand dairy market, Thai policy makers should be concerned with improving market competition between imported dairy products and domestic dairy products. The government policies toward market competition for Thai dairy farmers and processors are dairy production assistance programs such as technical support and training and low interest loan supports. There is another way to decrease the monopoly power of New Zealand and Australia in the Thailand dairy market. Thai policy makers should consider liberalizing the dairy market with other dairy exporting countries such as the US and

European countries. This will enhance global dairy trade liberalization and improve perfect competition in the global dairy market.

The Thai government should cooperate with FTA member countries in dairy industry development joint projects. For example, Fonterra is collaborating on a joint project of milk quality improvement with Thailand government. This project aims to develop milk quality management systems and processes on farm and at milk chilling centre for enhancing the quality and food safety of raw milk from farm to factory in Thailand. The transfer of technology or know-how between Thailand and FTA-member countries is an essential and suitable way to improve long-term dairy industry productivity and development in Thailand. This can also increase export potential for local high quality milk.

In addition, the research findings provide the interim impacts of THNZCEP and TAFTA on Thailand dairy imports which are useful information for understanding Thailand dairy import patterns. This could also be relevant for considering the implementation of FTAs in other commodities which have similar import market structure to dairy products. If the import market of a product is monopolised by members of a FTA and the product has inelastic demand, a tariff reduction may not affect any change in the product price.

7.3 Limitations of the Research

Although the study provides valuable information to the Thailand dairy industry, there are a number of limitations related to the data set, variables and estimation techniques used in the study.

Thailand is a net importer in dairy products and mainly imports from New Zealand and Australia. Thailand exports a few dairy products to New Zealand and Australia but mainly exports to Asian countries. The assessment of the impacts of THNZCEP and TAFTA in this study focused on Thailand dairy import trade flows and prices only.

The analysis for the impacts of THNZCEP and TAFTA on Thailand dairy imports is a static analysis and focuses on short run impacts. It is rather early to measure short run effects empirically because the import tariffs for dairy products are partially reduced, and are not completely eliminated yet. This may cause ambiguous impacts of the implementation of THNZCEP and TAFTA in some dairy products such whey and cheese. In addition, the sample size used in the analysis is limited to the number of dairy exporting countries. The data set covers dairy import flows for the top 5 Thailand trading partners which are more than 75% of Thailand total imports. Some trading partners are excluded due to a lack of available

information during the study period. The model considers only the economic relationships between Thailand and its trading partners, excludes cultural, political and geographical factors. This is because the cultural, political and geographical factors between the top 5 Thailand trading partners are not likely to have affected Thailand dairy import flows. Some variable such as GDP, exchange rates, wholesale price index, and production index are excluded from the gravity model due to the presence of multicollinearity problem.

The empirical analysis of the import price effects of the implementation of FTAs is more complex than looking at import flows. Firstly, CIF prices of dairy products are not available on Thailand import database. Unit value series are used as a proxy for CIF prices of dairy products which can produce noise in the estimation. Secondly, the analysis of the impacts of THNZCEP and TAFTA on Thailand dairy import prices is a static analysis and captures only the tariff barrier. The changes in Thailand dairy import prices resulting from the reduction in import tariffs are likely to be small relative to other causes such as competitor prices, drought and exchange rates. Lastly, some important explanatory variable such as dairy cost index and income are not included into the price model for New Zealand and Australian dairy products due the presence of multicollinearity problem.

7.4 Recommendations for Future Research

To improve the study models and results, there are several suggestions for future studies.

The analysis of the impacts of THNZCEP and TAFTA on Thailand dairy import flows and prices is short run impacts. The THNZCEP and TAFTA were implemented in 2005. The study period covers the post-FTA period for 5 years. The short time of the post-FTA period may have caused ambiguous results. Future studies should cover a longer study period including the fully free trade period, and assess the short-run and long-run impacts of the implementation of THNZCEP and TAFTA on Thailand dairy import flows and prices. This will provide more efficient results and more robust policy inferences.

Future studies should be extended to include more trading partners and different regions. With regards to the diverse geographical locations, it can capture more factors such as culture, politics, law and technology which may have influenced on Thailand dairy import flows and prices. For example, the dairy industry structural reform in New Zealand in 2001 and Australia in 2000 may cause changes in dairy production, trade and price. Such research would be highly beneficial to both dairy exporting countries and Thailand policy makers.

Future studies could consider the impacts of the implementation of THNZCEP and TAFTA on both dairy import and export flows and prices. This will provide complete effects of the THNZCEP and TAFTA. Future research should add other FTAs and economic integration regions into the models of dairy trade flows and prices. It would be more interesting and useful for trade policy purposes of the dairy industry.

Panel framework is the most appropriate methodology for the gravity model of trade flows. If future studies employ a panel data set in which the data set has a larger number of periods than cross sectional units, the TSCS procedure is highly recommended for the estimation of the panel data set.

The analysis of the ex-post effects of FTAs on Thailand dairy import price ratio is quite new. There is also need to study the price effects of other products and FTAs. The results provide us with a more complete view of the effects of FTAs on both member and non-members countries which is highly useful for trade policy decision making.

Future studies could also measure the impacts of FTAs on trade flows and prices at disaggregated or commodity levels. The import price models proxied by unit value prices of imports should not be measured at the aggregated level because it will produce high variation and spurious fluctuation. Although the unit value prices produce noise in the estimation, it is commonly used for a proxy of real prices when they are inaccessible. However, it is likely to need robust econometric methods for estimation. In addition, considering trade flows and prices at the disaggregated level would help domestic producers, foreign producers and policy makers to understand the nature of each product better. The studies of specific commodities would allow policy makers to develop better strategies for the commodities.

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Appendix A

Estimated Gravity Models for Thailand Dairy Imports from 4 Panel Estimation Methods

A.1 Estimated Gravity Models for Thailand Import Flow of Non-Concentrated Milk and Cream (HS0401)

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|--|---------------|--------------------------|--------------|--------------|-------------|-------------|
| | | | OLS | FEM | REM | TSCS: S1,R2 |
| Constant | | | -112.29* | | -161.22** | -136.24* |
| Log of Exporter's Population (LPOPI1) | (+)/(-) | 0.36 | 1.21*** | 12.53** | 1.29** | 0.81268*** |
| Log of Thailand's Population (LPOPJ1) | (+)/(-) | 0.32 | 6.99 | 4.99 | 11.30* | 9.50 |
| Log of Exporter's Per Capita Gross Domestic Products (LGDPP11) | (+)/(-) | 0.44 | 2.58*** | -0.51 | 1.28 | 1.26** |
| Log of Thailand's Per Capita Gross Domestic Products (LGDPPJ1) | (+)/(-) | 0.31 | 2.43** | 3.68*** | 3.00*** | 3.02** |
| Distance (LDIS1) | (-) | 0.18 | -1.26*** | 0.00 | -0.39 | -0.51 |
| Intra TH-NZCEP Trade Bias (THNZCEP) | (+) | 0.26 | 6.40*** | 6.07*** | 6.22*** | 5.72*** |
| ImoExtra TH-NZCEP Trade Openness (THNZCEPO) | (-) | 0.15 | -1.67 | -1.79* | -1.68 | -0.20 |
| Intra TAFTA Trade Bias (TAFTA) | (+) | 0.45 | 5.84*** | 8.37*** | 8.12*** | 6.03*** |
| Extra TAFTA Trade Openness (TAFTAO) | (-) | 0.04 | -2.10* | -2.52** | -2.55** | -2.22** |
| No. Of observations | | | 380 | 380 | 380 | 380 |
| Degrees of freedom | | | 370 | 366 | 366 | |
| Mean | | | 2.57 | 2.57 | 2.57 | 2.57 |
| Standard deviation | | | 4.30 | 4.30 | 4.30 | 4.30 |
| Residuals sum of squares | | | 3892.13 | 3340.72 | 4055.29 | |
| R ² | | | 0.45 | 0.52 | 0.42 | |
| Adjusted R ² | | | 0.43 | 0.51 | | |
| F-Statistics | | | 33.00 (0.00) | 31.00 (0.00) | | |
| F-Statistics for FEM Testing | | | | 15.10*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 109.28*** | |
| Hausman Statistics | | | | | 5.04 (0.41) | |
| Wald Statistics | | | | | | 141.58 |
| Lagrange multiplier statistic | | | | | | 12.68 |
| Likelihood ratio statistic | | | | | | 61.49 |
| Log-likelihood function | | | | | | -896.01 |
| Parameter | | | | | | 20 |
| Autocorrelation coefficient | | | | 0.48 | | |

A.2 Estimated Gravity Models for Thailand Import Flow of Concentrated Milk and Cream (HS0402)

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|--|---------------|--------------------------|--------------|--------------|--------------|-------------|
| | | | OLS | FEM | REM | TSCS: S2,R1 |
| Constant | | | -90.20** | | -192.82*** | 72.08** |
| Log of Exporter's Population (LPOPI2) | (+)/(-) | -0.47 | -0.85*** | 28.12*** | -0.04 | -1.24*** |
| Log of Thailand's Population (LPOPJ2) | (+)/(-) | 0.16 | 12.51*** | -9.09 | 20.30*** | -0.09 |
| Log of Exporter's Per Capita Gross Domestic Products (LGDPPI2) | (+)/(-) | -0.35 | 0.33 | -0.33 | -1.43*** | 0.62*** |
| Log of Thailand's Per Capita Gross Domestic Products (LGDPPI2) | (+)/(-) | 0.15 | 1.12 | 1.10 | 1.89*** | 0.27 |
| Distance (LDIS2) | (-) | -0.47 | -3.74*** | 0.00 | -1.66 | -5.58*** |
| Intra TH-NZCEP Trade Bias (THNZCEP) | (+) | 0.17 | -0.08 | -2.37** | -0.85 | 0.67* |
| Extra TH-NZCEP Trade Openness (THNZCEPO) | (-) | 0.04 | -0.50 | -0.15 | -0.45 | -0.13 |
| Intra TAFTA Trade Bias (TAFTA) | (+) | 0.10 | -0.79 | -3.09*** | -1.18 | -0.38 |
| Extra TAFTA Trade Openness (TAFTAO) | (-) | 0.08 | -0.46 | 0.27 | -0.08 | -0.63** |
| No. Of observations | | | 380 | 380 | 380 | 380 |
| Degrees of freedom | | | 370 | 366 | 366 | |
| Mean | | | 14.95 | 14.95 | 14.95 | 14.95 |
| Standard deviation | | | 2.90 | 2.90 | 2.90 | 2.90 |
| Residuals sum of squares | | | 2086.18 | 1833.11 | 2413.40 | |
| R ² | | | 0.34 | 0.42 | 0.24 | |
| Adjusted R ² | | | 0.33 | 0.40 | | |
| F-Statistics | | | 21.50 (0.00) | 20.80 (0.00) | | |
| F-Statistics for FEM Testing | | | | 12.84*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 1.49 | |
| Hausman Statistics | | | | | 20.29 (0.00) | |
| Wald Statistics | | | | | | |
| Lagrange multiplier statistic | | | | | | |
| Likelihood ratio statistic | | | | | | 26.59 |
| Log-likelihood function | | | | | | -459.85 |
| Parameter | | | | | | 26 |
| Autocorrelation coefficient | | | | | | 0.60 |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var. = (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

A.3 Estimated Gravity Models for Thailand Import Flow of Buttermilk and Yogurt (HS0403)

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|--------------|--------------|-------------|-------------|
| Model | | | OLS | FEM | REM | TSCS: S2,R1 |
| Constant | | | -848.65*** | | -837.10*** | -288.09*** |
| Log of Exporter's Population (LPOPI3) | (+)/(-) | -0.33 | -1.53*** | -7.52 | -1.57*** | -2.20*** |
| Log of Thailand's Population (LPOPJ3) | (+)/(-) | 0.22 | 85.71*** | 83.34*** | 84.54*** | 33.08*** |
| Log of Exporter's Per Capita Gross Domestic Products (LGDPPPI3) | (+)/(-) | -0.00 | -6.61*** | -4.50** | -6.29*** | -2.78*** |
| Log of Thailand's Per Capita Gross Domestic Products (LGDPPJ3) | (+)/(-) | 0.19 | 4.90*** | 4.08*** | 4.77*** | 2.56*** |
| Distance (LDIS3) | (-) | 0.07 | -5.00* | 0.00 | -5.01 | -4.11 |
| Intra TH-NZCEP Trade Bias (THNZCEP) | (+) | 0.22 | -0.59 | -0.63 | -0.68 | 0.41 |
| Extra TH-NZCEP Trade Openness (THNZCEPO) | (-) | 0.06 | -1.03 | -0.77 | -0.98 | -0.26 |
| Intra TAFTA Trade Bias (TAFTA) | (+) | 0.15 | -0.21 | -0.44 | -0.27 | 1.88 |
| Extra TAFTA Trade Openness (TAFTAO) | (-) | 0.09 | -2.78* | -3.17** | -2.83* | -0.69 |
| | | | | | | |
| No. Of observations | | | 380 | 380 | 380 | 380 |
| Degrees of freedom | | | 370 | 366 | 366 | |
| Mean | | | 10.13 | 10.13 | 10.13 | 10.13 |
| Standard deviation | | | 5.42 | 5.42 | 5.42 | 5.42 |
| Residuals sum of squares | | | 6493.81 | 6430.61 | 6496.17 | |
| R ² | | | 0.42 | 0.42 | 0.42 | |
| Adjusted R ² | | | 0.40 | 0.40 | | |
| F-Statistics | | | 29.40 (0.00) | 20.60 (0.00) | | |
| F-Statistics for FEM Testing | | | | 0.90 | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 0.73 | |
| Hausman Statistics | | | | | 4.04 (0.85) | |
| Wald Statistics | | | | | | |
| Lagrange multiplier statistic | | | | | | |
| Likelihood ratio statistic | | | | | | 42.16 |
| Log-likelihood function | | | | | | -972.07 |
| Parameter | | | | | | 26 |
| Autocorrelation coefficient | | | | | | 0.30 |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

A.4 Estimated Gravity Models for Thailand Import Flow of Whey (HS0404)

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|--|---------------|--------------------------|--------------|--------------|--------------|-------------|
| | | | OLS | FEM | REM | TSCS: S2,R1 |
| Constant | | | -227.15*** | | -553.33*** | -78.32 |
| Log of Exporter's Population (LPOPI4) | (+)/(-) | 0.40 | 0.01 | -72.18*** | 2.03*** | 0.14 |
| Log of Thailand's Population (LPOPJ4) | (+)/(-) | 0.32 | 26.05*** | 122.54*** | 47.43*** | 8.71** |
| Log of Exporter's Per Capita Gross Domestic Products (LGDPPI4) | (+)/(-) | 0.44 | 3.27*** | -5.18*** | -4.22*** | 0.88 |
| Log of Thailand's Per Capita Gross Domestic Products (LGDPPI4) | (+)/(-) | 0.27 | -0.14 | 3.63*** | 2.66*** | -0.15 |
| Distance (LDIS4) | (-) | 0.10 | -8.35*** | 0.00 | 4.63 | -1.45 |
| Intra TH-NZCEP Trade Bias (THNZCEP) | (+) | -0.09 | -1.88* | 1.89* | -1.21 | -0.61 |
| Extra TH-NZCEP Trade Openness (THNZCEPO) | (-) | 0.35 | -0.34 | -1.49* | -1.00 | 0.03 |
| Intra TAFTA Trade Bias (TAFTA) | (+) | 0.14 | -2.37** | 3.73*** | -0.03 | 0.36 |
| Extra TAFTA Trade Openness (TAFTAO) | (-) | 0.24 | -0.67 | -0.48 | 0.19 | 0.13 |
| | | | | | | |
| No. Of observations | | | 380 | 380 | 380 | 380 |
| Degrees of freedom | | | 370 | 366 | 366 | |
| Mean | | | 12.15 | 12.15 | 12.15 | 12.15 |
| Standard deviation | | | 3.41 | 3.41 | 3.41 | 3.41 |
| Residuals sum of squares | | | 2651.91 | 1877.43 | 3793.98 | |
| R ² | | | 0.40 | 0.57 | 0.14 | |
| Adjusted R ² | | | 0.38 | 0.56 | | |
| F-Statistics | | | 27.10 (0.00) | 37.90 (0.00) | | |
| F-Statistics for FEM Testing | | | | 37.75*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 7.23*** | |
| Hausman Statistics | | | | | 79.92 (0.00) | |
| Wald Statistics | | | | | | |
| Lagrange multiplier statistic | | | | | | |
| Likelihood ratio statistic | | | | | | 24.97 |
| Log-likelihood function | | | | | | -563.77 |
| Parameter | | | | | | 26 |
| Autocorrelation coefficient | | | | | | 0.80 |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

A.5 Estimated Gravity Models for Thailand Import Flow of Butter (HS0405)

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|--------------|--------------|--------------|-------------|
| | | | OLS | FEM | REM | TSCS: S1,R1 |
| Constant | | | 182.64*** | | 334.66*** | 115.51*** |
| Log of Exporter's Population (LPOPI5) | (+)/(-) | -0.30 | -0.25 | 39.73*** | -1.06 | -1.34*** |
| Log of Thailand's Population (LPOPJ5) | (+)/(-) | -0.04 | -1.78 | -50.07*** | -18.33*** | 3.02 |
| Log of Exporter's Per Capita Gross Domestic Products (LGDPPPI5) | (+)/(-) | -0.29 | -6.63*** | -0.50 | -0.28 | -1.17 |
| Log of Thailand's Per Capita Gross Domestic Products (LGDPPJ5) | (+)/(-) | -0.02 | 5.71*** | 2.41* | 2.69** | 1.76** |
| Distance (LDIS5) | (-) | -0.24 | -13.97*** | 0.00 | -13.72* | -13.63*** |
| Intra TH-NZCEP Trade Bias (THNZCEP) | (+) | 0.17 | -0.18 | -2.86** | -0.44 | 0.98 |
| Extra TH-NZCEP Trade Openness (THNZCEPO) | (-) | -0.21 | -4.12*** | -3.22*** | -3.54*** | -1.10* |
| Intra TAFTA Trade Bias (TAFTA) | (+) | 0.15 | 5.52*** | 0.74 | 3.33** | 0.40 |
| Extra TAFTA Trade Openness (TAFTAO) | (-) | -0.17 | 3.04** | 2.75** | 2.16** | -0.10 |
| No. Of observations | | | 380 | 380 | 380 | 380 |
| Degrees of freedom | | | 370 | 366 | 366 | |
| Mean | | | 11.92 | 11.92 | 11.92 | 11.92 |
| Standard deviation | | | 4.11 | 4.11 | 4.11 | 4.11 |
| Residuals sum of squares | | | 4307.93 | 3396.69 | 4738.14 | |
| R ² | | | 0.33 | 0.47 | 0.26 | |
| Adjusted R ² | | | 0.31 | 0.45 | | |
| F-Statistics | | | 19.90 (0.00) | 24.90 (0.00) | | |
| F-Statistics for FEM Testing | | | | 24.55*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 251.66*** | |
| Hausman Statistics | | | | | 51.20 (0.00) | |
| Wald Statistics | | | | | | 161635.43 |
| Lagrange multiplier statistic | | | | | | 9.51 |
| Likelihood ratio statistic | | | | | | 468.83 |
| Log-likelihood function | | | | | | -748.76 |
| Parameter | | | | | | 16 |
| Autocorrelation coefficient | | | | | | 0.35 |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

A.6 Estimated Gravity Models for Thailand Import Flow of Cheese and Curd (HS0406)

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|--|---------------|--------------------------|--------------|--------------|--------------|-------------|
| | | | OLS | FEM | REM | TSCS: S1,R2 |
| Constant | | | -43.74** | | -14.44 | -27.76 |
| Log of Exporter's Population (LPOPI6) | (+)/(-) | -0.25 | -0.54*** | 11.95*** | -0.61*** | -0.57*** |
| Log of Thailand's Population (LPOPJ6) | (+)/(-) | 0.37 | 11.68*** | -4.92 | 7.29*** | 9.73*** |
| Log of Exporter's Per Capita Gross Domestic Products (LGDPPI6) | (+)/(-) | 0.12 | -1.83*** | 0.50 | -0.22 | -1.16*** |
| Log of Thailand's Per Capita Gross Domestic Products (LGDPPI6) | (+)/(-) | 0.35 | 1.97*** | 0.78* | 1.22*** | 1.64*** |
| Distance (LDIS6) | (-) | -0.28 | -7.10*** | 0.00 | -5.95*** | -6.87*** |
| Intra TH-NZCEP Trade Bias (THNZCEP) | (+) | 0.27 | 0.37 | -0.62 | 0.18 | 0.39 |
| Extra TH-NZCEP Trade Openness (THNZCEPO) | (-) | 0.23 | -0.13 | 0.23 | 0.04 | 0.16 |
| Intra TAFTA Trade Bias (TAFTA) | (+) | 0.31 | 0.85* | -0.79 | 0.29 | 0.32 |
| Extra TAFTA Trade Openness (TAFTAO) | (-) | 0.21 | 0.43 | 0.31 | 0.22 | 0.29 |
| | | | | | | |
| No. Of observations | | | 380 | 380 | 380 | 380 |
| Degrees of freedom | | | 370 | 366 | 366 | |
| Mean | | | 12.16 | 12.16 | 12.16 | 12.16 |
| Standard deviation | | | 1.62 | 1.62 | 1.62 | 1.62 |
| Residuals sum of squares | | | 516.88 | 440.93 | 582.60 | |
| R ² | | | 0.48 | 0.56 | 0.41 | |
| Adjusted R ² | | | 0.47 | 0.54 | | |
| F-Statistics | | | 37.80 (0.00) | 35.20 (0.00) | | |
| F-Statistics for FEM Testing | | | | 15.76*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 69.42*** | |
| Hausman Statistics | | | | | 12.57 (0.08) | |
| Wald Statistics | | | | | | 8501.74 |
| Lagrange multiplier statistic | | | | | | 12.79 |
| Likelihood ratio statistic | | | | | | 408.38 |
| Log-likelihood function | | | | | | -376.89 |
| Parameter | | | | | | 20 |
| Autocorrelation coefficient | | | | | | |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

A.7 Estimated Gravity Models for Thailand Import Flow of Total Dairy Products

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|--------------|--------------|--------------|-------------|
| Model | | | OLS | FEM | REM | TSCS: S2,R2 |
| Constant | | | 29.96** | | -59.96*** | 1.84 |
| Log of Exporter's Population (LPOPIT) | (+)/(-) | -0.34 | -0.49*** | 8.61*** | 0.33 | -0.69*** |
| Log of Thailand's Population (LPOPJT) | (+)/(-) | 0.23 | -0.21 | -3.10 | 6.85*** | 1.86 |
| Log of Exporter's Per Capita Gross Domestic Products (LGDPPIIT) | (+)/(-) | -0.14 | 0.65*** | -0.36 | -0.96*** | 0.41*** |
| Log of Thailand's Per Capita Gross Domestic Products (LGDPPIJT) | (+)/(-) | 0.22 | 0.35 | 0.70*** | 1.06*** | 0.56*** |
| Distance (LDIST) | (-) | -0.37 | -1.63*** | 0.00 | -0.17 | -0.78* |
| Intra TH-NZCEP Trade Bias (THNZCEP) | (+) | 0.37 | 0.99*** | -0.23 | 0.15 | 0.59*** |
| Extra TH-NZCEP Trade Openness (THNZCEPO) | (-) | 0.00 | -0.23 | -0.05 | -0.15 | -0.35* |
| Intra TAFTA Trade Bias (TAFTA) | (+) | 0.21 | 0.25 | -0.83*** | -0.27 | 0.30 |
| Extra TAFTA Trade Openness (TAFTAO) | (-) | 0.09 | -0.24 | 0.21 | 0.15 | -0.33* |
| | | | | | | |
| No. Of observations | | | 380 | 380 | 380 | 380 |
| Degrees of freedom | | | 370 | 366 | 366 | |
| Mean | | | 15.78 | 15.78 | 15.78 | 15.78 |
| Standard deviation | | | 1.01 | 1.01 | 1.01 | 1.01 |
| Residuals sum of squares | | | 211.13 | 106.36 | 506.39 | |
| R ² | | | 0.45 | 0.72 | -0.31 | |
| Adjusted R ² | | | 0.44 | 0.71 | | |
| F-Statistics | | | 33.90 (0.00) | 73.80 (0.00) | | |
| F-Statistics for FEM Testing | | | | 90.13*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 725.59*** | |
| Hausman Statistics | | | | | 18.80 (0.00) | |
| Wald Statistics | | | | | | |
| Lagrange multiplier statistic | | | | | | |
| Likelihood ratio statistic | | | | | | 41.24 |
| Log-likelihood function | | | | | | -259.47 |
| Parameter | | | | | | 30 |
| Autocorrelation coefficient | | | | | | |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

Appendix B

Estimated Thailand Import Price Models for New Zealand Dairy Products from 3 Estimation Methods

B.1 Estimated Thailand Import Price Models for New Zealand Concentrated Milk and Cream (HS0402)

| Estimation methods | Model A | | | Model B | | |
|------------------------------------|-------------------------------|-----------------|-----------------|-------------------------------|-----------------|-----------------|
| | OLS | GLS | GLS AR (1) | OLS | GLS | GLS AR (1) |
| Explanatory variables | Estimated coefficients | | | Estimated coefficients | | |
| Constant | 1.61** | 1.90*** | 1.43** | 2.38*** | 2.54*** | 2.24*** |
| Log of Exchange rate (LE) | 0.21 | 0.65*** | 0.74*** | 0.22* | 0.47*** | 0.52*** |
| Log of Tariff (LTAR) | -0.02 | -0.03 | 0.03 | -0.09 | -0.07 | -0.03 |
| Log of Competitor's price (LCP) | 0.52*** | 0.12*** | 0.13*** | 0.34*** | 0.10*** | 0.12*** |
| Log of Market share (LZ) | -0.02 | -0.11*** | -0.08** | -0.05 | -0.10*** | -0.07** |
| Dummy variable for drought (DDROU) | | | | 0.17*** | 0.25*** | 0.19*** |
| No. Of observations | 60 | 60 | 60 | 60 | 60 | 60 |
| Degrees of freedom | 55 | 55 | 55 | 54 | 54 | 54 |
| Mean | 4.38 | 4.38 | 4.38 | 4.38 | 4.38 | 4.38 |
| Standard deviation | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 |
| Residuals Sum of squares | 1.46 | 2.01 | 1.20 | 1.21 | 1.29 | 0.94 |
| R ² | 0.62 | 0.43 | 0.66 | 0.68 | 0.63 | 0.73 |
| Adjusted R ² | 0.59 | 0.39 | 0.64 | 0.66 | 0.59 | 0.70 |
| F-Statistics | 22.60 (0.00) | 10.50 (0.00) | 26.70 (0.00) | 23.50 (0.00) | 18.30 (0.00) | 29.10 (0.00) |
| Durbin-Watson | 1.21 | 0.59 | 1.29 | 1.22 | 0.97 | 1.71 |
| Autocorrelation coefficient | | 0.71 | 0.35 | | 0.51 | 0.15 |
| RHO used for AR(1) | 0.40 | 0.40 | 0.40 | 0.39 | 0.39 | 0.39 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

B.2 Estimated Thailand Import Price Models for New Zealand Buttermilk and Yogurt (HS0403)

| Estimation methods | Model A | | | Model B | | |
|------------------------------------|-------------------------------|-----------------|-----------------|-------------------------------|-----------------|-----------------|
| | OLS | GLS | GLS AR (1) | OLS | GLS | GLS AR (1) |
| Explanatory variables | Estimated coefficients | | | Estimated coefficients | | |
| Constant | 0.92* | 1.68*** | 1.82*** | 1.19** | 2.03*** | 2.25*** |
| Log of Exchange rate (LE) | -0.04 | 0.40*** | 0.46*** | -0.04 | 0.27** | 0.32** |
| Log of Tariff (LTAR) | -0.13** | -0.16*** | -0.18*** | -0.15*** | -0.18*** | -0.20*** |
| Log of Competitor's price (LCP) | 0.93*** | 0.45*** | 0.38*** | 0.87*** | 0.46*** | 0.38*** |
| Log of Market share (LZ) | 0.04 | 0.06** | 0.06*** | 0.03 | 0.05* | 0.05** |
| Dummy variable for drought (DDROU) | | | | 0.06 | 0.16*** | 0.15*** |
| No. Of observations | 60 | 60 | 60 | 60 | 60 | 60 |
| Degrees of freedom | 55 | 55 | 55 | 54 | 54 | 54 |
| Mean | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| Standard deviation | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 |
| Residuals Sum of squares | 1.16 | 1.81 | 1.37 | 1.13 | 1.45 | 1.09 |
| R ² | 0.86 | 0.76 | 0.82 | 0.86 | 0.81 | 0.85 |
| Adjusted R ² | 0.85 | 0.75 | 0.81 | 0.85 | 0.79 | 0.84 |
| F-Statistics | 84.70 (0.00) | 44.20 (0.00) | 63.10 (0.00) | 68.60 (0.00) | 45.00 (0.00) | 63.40 (0.00) |
| Durbin-Watson | 1.45 | 0.55 | 0.76 | 1.38 | 0.71 | 0.995 |
| Autocorrelation coefficient | | 0.73 | 0.62 | | 0.64 | 0.50 |
| RHO used for AR(1) | 0.27 | 0.27 | 0.27 | 0.31 | 0.31 | 0.31 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

B.3 Estimated Thailand Import Price Models for New Zealand Whey (HS0404)

| Estimation methods | Model A | | | Model B | | |
|------------------------------------|-------------------------------|----------------|-----------------|-------------------------------|----------------|-----------------|
| | OLS | GLS | GLS AR (1) | OLS | GLS | GLS AR (1) |
| Explanatory variables | Estimated coefficients | | | Estimated coefficients | | |
| Constant | 4.15*** | 3.90*** | 2.59 | 5.28*** | 5.08*** | 3.51** |
| Log of Exchange rate (LE) | -0.40 | 0.25 | -0.06 | -0.31 | 0.03 | -0.23 |
| Log of Tariff (LTAR) | -0.07 | -0.09 | -0.10 | -0.22 | -0.18 | -0.16 |
| Log of Competitor's price (LCP) | 0.46** | -0.10 | 0.52** | 0.08 | -0.22 | 0.43* |
| Log of Market share (LZ) | 0.06 | 0.05 | -0.03 | 0.03 | 0.04 | -0.03 |
| Dummy variable for drought (DDROU) | | | | 0.36** | 0.45*** | 0.19 |
| No. Of observations | 60 | 60 | 60 | 60 | 60 | 60 |
| Degrees of freedom | 55 | 55 | 55 | 54 | 54 | 54 |
| Mean | 3.84 | 3.84 | 3.84 | 3.84 | 3.84 | 3.84 |
| Standard deviation | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 |
| Residuals Sum of squares | 9.30 | 9.75 | 4.46 | 8.30 | 7.77 | 4.37 |
| R ² | 0.14 | 0.02 | 0.55 | 0.23 | 0.20 | 0.55 |
| Adjusted R ² | 0.08 | -0.06 | 0.52 | 0.16 | 0.13 | 0.51 |
| F-Statistics | 2.20 (0.08) | 0.20 (0.92) | 16.80 (0.00) | 3.30 (0.01) | 2.70 (0.03) | 13.20 (0.00) |
| Durbin-Watson | 0.69 | 0.66 | 1.89 | 0.78 | 0.86 | 1.77 |
| Autocorrelation coefficient | | 0.67 | 0.06 | | 0.57 | 0.11 |
| RHO used for AR(1) | 0.66 | 0.66 | 0.66 | 0.61 | 0.61 | 0.61 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

B.4 Estimated Thailand Import Price Models for New Zealand Butter (HS0405)

| Estimation methods | Model A | | | Model B | | |
|------------------------------------|-------------------------------|------------------|------------------|-------------------------------|------------------|------------------|
| | OLS | GLS | GLS AR (1) | OLS | GLS | GLS AR (1) |
| Explanatory variables | Estimated coefficients | | | Estimated coefficients | | |
| Constant | 0.39 | 1.18*** | 1.10*** | 0.48 | 1.36*** | 1.16*** |
| Log of Exchange rate (LE) | -0.14* | 0.15* | 0.06 | -0.14 | 0.10 | 0.01 |
| Log of Tariff (LTAR) | -0.05 | -0.11*** | -0.10** | -0.06 | -0.12*** | -0.09** |
| Log of Competitor's price (LCP) | 1.06*** | 0.71*** | 0.79*** | 1.03*** | 0.71*** | 0.81*** |
| Log of Market share (LZ) | 0.02 | 0.02 | 0.03* | 0.01 | 0.02 | 0.03** |
| Dummy variable for drought (DDROU) | | | | 0.02 | 0.07** | 0.04 |
| No. Of observations | 60 | 60 | 60 | 60 | 60 | 60 |
| Degrees of freedom | 55 | 55 | 55 | 54 | 54 | 54 |
| Mean | 4.25 | 4.25 | 4.25 | 4.25 | 4.25 | 4.25 |
| Standard deviation | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 |
| Residuals Sum of squares | 0.31 | 0.52 | 0.40 | 0.31 | 0.46 | 0.36 |
| R ² | 0.95 | 0.91 | 0.93 | 0.95 | 0.92 | 0.94 |
| Adjusted R ² | 0.95 | 0.91 | 0.93 | 0.95 | 0.92 | 0.93 |
| F-Statistics | 277.90 (0.00) | 146.90 (0.00) | 192.10 (0.00) | 221.40 (0.00) | 129.50 (0.00) | 166.60 (0.00) |
| Durbin-Watson | 1.83 | 0.93 | 1.24 | 1.86 | 1.09 | 1.39 |
| Autocorrelation coefficient | | 0.54 | 0.38 | | 0.46 | 0.31 |
| RHO used for AR(1) | 0.08 | 0.08 | 0.08 | 0.07 | 0.07 | 0.07 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

B.5 Estimated Thailand Import Price Models for New Zealand Cheese and Curd (HS0406)

| Estimation methods | Model A | | | Model B | | |
|------------------------------------|-------------------------------|-----------------|-----------------|-------------------------------|-----------------|-----------------|
| | OLS | GLS | GLS AR (1) | OLS | GLS | GLS AR (1) |
| Explanatory variables | Estimated coefficients | | | Estimated coefficients | | |
| Constant | 1.24 | 3.25*** | 3.22*** | 2.22* | 3.75*** | 3.34*** |
| Log of Exchange rate (LE) | 0.20 | 0.31** | 0.46** | 0.18 | 0.20 | 0.25 |
| Log of Tariff (LTAR) | -0.05 | -0.22** | -0.23* | -0.13 | -0.25** | -0.23** |
| Log of Competitor's price (LCP) | 0.64*** | 0.27** | 0.18 | 0.49*** | 0.25* | 0.29** |
| Log of Market share (LZ) | 0.02 | 0.05 | 0.002 | -0.01 | 0.04 | 0.01 |
| Dummy variable for drought (DDROU) | | | | 0.14*** | 0.15*** | 0.12*** |
| No. Of observations | 60 | 60 | 60 | 60 | 60 | 60 |
| Degrees of freedom | 55 | 55 | 55 | 54 | 54 | 54 |
| Mean | 4.63 | 4.63 | 4.63 | 4.63 | 4.63 | 4.63 |
| Standard deviation | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 |
| Residuals Sum of squares | 1.30 | 1.29 | 1.00 | 1.08 | 1.02 | 0.89 |
| R ² | 0.70 | 0.67 | 0.75 | 0.75 | 0.73 | 0.77 |
| Adjusted R ² | 0.67 | 0.65 | 0.73 | 0.72 | 0.71 | 0.75 |
| F-Statistics | 31.50 (0.00) | 28.20 (0.00) | 40.40 (0.00) | 31.90 (0.00) | 29.80 (0.00) | 35.80 (0.00) |
| Durbin-Watson | 1.27 | 1.00 | 1.58 | 1.47 | 1.29 | 1.77 |
| Autocorrelation coefficient | | 0.50 | 0.21 | | 0.35 | 0.12 |
| RHO used for AR(1) | 0.37 | 0.37 | 0.37 | 0.26 | 0.26 | 0.26 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

B.6 Estimated Thailand Import Price Models for New Zealand Total Dairy Products

| Estimation methods | Model A | | | Model B | | |
|------------------------------------|-------------------------------|-----------------|-----------------|-------------------------------|-----------------|-----------------|
| | OLS | GLS | GLS AR (1) | OLS | GLS | GLS AR (1) |
| Explanatory variables | Estimated coefficients | | | Estimated coefficients | | |
| Constant | 0.97 | 1.92*** | 1.48** | 1.78** | 2.54*** | 2.18*** |
| Log of Exchange rate (LE) | 0.27** | 0.67*** | 0.74*** | 0.27** | 0.48*** | 0.54*** |
| Log of Tariff (LTAR) | 0.004 | -0.06 | -0.002 | -0.07 | -0.10* | -0.04 |
| Log of Competitor's price (LCP) | 0.61*** | 0.13*** | 0.14*** | 0.46*** | 0.12*** | 0.14*** |
| Log of Market share (LZ) | 0.01 | -0.09*** | -0.05* | -0.04 | -0.09*** | -0.05* |
| Dummy variable for drought (DDROU) | | | | 0.13** | 0.24*** | 0.18*** |
| No. Of observations | 60 | 60 | 60 | 60 | 60 | 60 |
| Degrees of freedom | 55 | 55 | 55 | 54 | 54 | 54 |
| Mean | 4.36 | 4.36 | 4.36 | 4.36 | 4.36 | 4.36 |
| Standard deviation | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 |
| Residuals Sum of squares | 1.24 | 1.92 | 1.08 | 1.12 | 1.25 | 0.82 |
| R ² | 0.70 | 0.50 | 0.72 | 0.73 | 0.66 | 0.78 |
| Adjusted R ² | 0.68 | 0.46 | 0.70 | 0.71 | 0.63 | 0.76 |
| F-Statistics | 32.40 (0.00) | 13.50 (0.00) | 34.80 (0.00) | 29.50 (0.00) | 21.40 (0.00) | 38.30 (0.00) |
| Durbin-Watson | 1.22 | 0.49 | 1.06 | 1.15 | 0.82 | 1.52 |
| Autocorrelation coefficient | | 0.75 | 0.47 | | 0.59 | 0.24 |
| RHO used for AR(1) | 0.39 | 0.39 | 0.39 | 0.42 | 0.42 | 0.42 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

Appendix C

Estimated Thailand Import Price Models for Australian Dairy Products from 3 Estimation Methods

C.1 Estimated Thailand Import Price Models for Australian Concentrated Milk and Cream (HS0402)

| Estimation methods | Model A | | | Model B | | |
|------------------------------------|-------------------------------|-----------------|------------------|-------------------------------|-----------------|------------------|
| | OLS | GLS | GLS AR (1) | OLS | GLS | GLS AR (1) |
| Explanatory variables | Estimated coefficients | | | Estimated coefficients | | |
| Constant | -0.32 | -0.50 | 0.82 | 0.01 | -0.14 | 0.51 |
| Log of Exchange rate (LE) | 0.48*** | 0.61*** | 0.49*** | 0.47*** | 0.54*** | 0.53*** |
| Log of Tariff (LTAR) | -0.10 | -0.05 | -0.15* | -0.09 | -0.05 | -0.10 |
| Log of Competitor's price (LCP) | 0.78*** | 0.65*** | 0.53*** | 0.69*** | 0.63*** | 0.53*** |
| Log of Market share (LZ) | 0.01 | -0.07** | -0.02 | 0.02 | -0.04 | -0.01 |
| Dummy variable for drought (DDROU) | | | | 0.17*** | 0.18*** | 0.17*** |
| No. Of observations | 65 | 65 | 65 | 65 | 65 | 65 |
| Degrees of freedom | 60 | 60 | 60 | 59 | 59 | 59 |
| Mean | 4.31 | 4.31 | 4.31 | 4.31 | 4.31 | 4.31 |
| Standard deviation | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 |
| Residuals Sum of squares | 1.08 | 1.11 | 0.68 | 0.72 | 0.69 | 0.53 |
| R ² | 0.83 | 0.81 | 0.88 | 0.88 | 0.88 | 0.91 |
| Adjusted R ² | 0.81 | 0.79 | 0.87 | 0.87 | 0.87 | 0.90 |
| F-Statistics | 70.80 (0.00) | 62.50 (0.00) | 112.10 (0.00) | 90.20 (0.00) | 84.50 (0.00) | 114.10 (0.00) |
| Durbin-Watson | 0.85 | 0.81 | 1.80 | 1.08 | 1.05 | 1.81 |
| Autocorrelation coefficient | | 0.60 | 0.10 | | 0.47 | 0.09 |
| RHO used for AR(1) | 0.58 | 0.58 | 0.58 | 0.46 | 0.46 | 0.46 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

C.2 Estimated Thailand Import Price Models for Australian Buttermilk and Yogurt (HS0403)

| Estimation methods | Model A | | | Model B | | |
|------------------------------------|-------------------------------|-----------------|-----------------|-------------------------------|-----------------|-----------------|
| | OLS | GLS | GLS AR (1) | OLS | GLS | GLS AR (1) |
| Explanatory variables | Estimated coefficients | | | Estimated coefficients | | |
| Constant | -0.40 | -0.44 | -0.32 | -0.49 | -0.48 | -0.43 |
| Log of Exchange rate (LE) | 0.41*** | 0.40*** | 0.44*** | 0.40*** | 0.42*** | 0.43*** |
| Log of Tariff (LTAR) | 0.05 | 0.05 | 0.04 | 0.05 | 0.05 | 0.05 |
| Log of Competitor's price (LCP) | 0.72*** | 0.73*** | 0.68*** | 0.75*** | 0.74*** | 0.72*** |
| Log of Market share (LZ) | -0.02 | -0.02 | -0.02 | -0.02 | -0.01 | -0.02 |
| Dummy variable for drought (DDROU) | | | | -0.04 | -0.03 | -0.03 |
| No. Of observations | 65 | 65 | 65 | 65 | 65 | 65 |
| Degrees of freedom | 60 | 60 | 60 | 59 | 59 | 59 |
| Mean | 4.13 | 4.13 | 4.13 | 4.13 | 4.13 | 4.13 |
| Standard deviation | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 |
| Residuals Sum of squares | 0.93 | 0.86 | 0.84 | 0.91 | 0.83 | 0.82 |
| R ² | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 |
| Adjusted R ² | 0.86 | 0.86 | 0.86 | 0.86 | 0.86 | 0.86 |
| F-Statistics | 97.70 (0.00) | 97.50 (0.00) | 99.70 (0.00) | 78.10 (0.00) | 78.00 (0.00) | 79.10 (0.00) |
| Durbin-Watson | 1.70 | 1.71 | 1.94 | 1.77 | 1.76 | 1.93 |
| Autocorrelation coefficient | | 0.14 | 0.03 | | 0.12 | 0.03 |
| RHO used for AR(1) | 0.15 | 0.15 | 0.15 | 0.12 | 0.12 | 0.12 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

C.3 Estimated Thailand Import Price Models for Australian Whey (HS0404)

| Estimation methods | Model A | | | Model B | | |
|------------------------------------|-------------------------------|-----------------|-----------------|-------------------------------|-----------------|-----------------|
| | OLS | GLS | GLS AR (1) | OLS | GLS | GLS AR (1) |
| Explanatory variables | Estimated coefficients | | | Estimated coefficients | | |
| Constant | 0.95 | 1.10 | 1.32 | 1.15 | 1.42* | 1.52 |
| Log of Exchange rate (LE) | 0.03 | 0.36* | 0.33 | 0.11 | 0.25 | 0.36 |
| Log of Tariff (LTAR) | -0.14 | -0.18* | -0.20* | -0.14 | -0.16* | -0.19* |
| Log of Competitor's price (LCP) | 0.78*** | 0.51*** | 0.52*** | 0.64*** | 0.49*** | 0.40*** |
| Log of Market share (LZ) | -0.14*** | -0.04 | 0.002 | -0.11*** | -0.02 | 0.03 |
| Dummy variable for drought (DDROU) | | | | 0.19*** | 0.26*** | 0.27*** |
| No. Of observations | 65 | 65 | 65 | 65 | 65 | 65 |
| Degrees of freedom | 60 | 60 | 60 | 59 | 59 | 59 |
| Mean | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 |
| Standard deviation | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 |
| Residuals Sum of squares | 2.51 | 2.92 | 1.96 | 2.16 | 2.22 | 1.65 |
| R ² | 0.74 | 0.67 | 0.78 | 0.78 | 0.75 | 0.81 |
| Adjusted R ² | 0.72 | 0.65 | 0.77 | 0.76 | 0.72 | 0.80 |
| F-Statistics | 42.70 (0.00) | 30.80 (0.00) | 53.10 (0.00) | 40.80 (0.00) | 34.70 (0.00) | 50.70 (0.00) |
| Durbin-Watson | 1.29 | 0.60 | 1.04 | 1.28 | 0.78 | 1.21 |
| Autocorrelation coefficient | | 0.70 | 0.48 | | 0.61 | 0.40 |
| RHO used for AR(1) | 0.35 | 0.35 | 0.35 | 0.36 | 0.36 | 0.36 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

C.4 Estimated Thailand Import Price Models for Australian Butter (HS0405)

| Estimation methods | Model A | | | Model B | | |
|------------------------------------|-------------------------------|------------------|------------------|-------------------------------|------------------|------------------|
| | OLS | GLS | GLS AR (1) | OLS | GLS | GLS AR (1) |
| Explanatory variables | Estimated coefficients | | | Estimated coefficients | | |
| Constant | 0.05 | 0.06 | 0.11 | 0.04 | 0.13 | 0.11 |
| Log of Exchange rate (LE) | 0.26*** | 0.33*** | 0.30*** | 0.26*** | 0.33*** | 0.30*** |
| Log of Tariff (LTAR) | -0.02 | -0.02 | -0.03 | -0.02 | -0.03 | -0.03 |
| Log of Competitor's price (LCP) | 0.82*** | 0.76*** | 0.78*** | 0.82*** | 0.76*** | 0.78*** |
| Log of Market share (LZ) | 0.08*** | 0.07*** | 0.07*** | 0.08*** | 0.07*** | 0.07*** |
| Dummy variable for drought (DDROU) | | | | 0.004 | 0.006 | 0.003 |
| No. Of observations | 65 | 65 | 65 | 65 | 65 | 65 |
| Degrees of freedom | 60 | 60 | 60 | 59 | 59 | 59 |
| Mean | 4.25 | 4.25 | 4.25 | 4.25 | 4.25 | 4.25 |
| Standard deviation | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 | 0.31 |
| Residuals Sum of squares | 0.21 | 0.20 | 0.20 | 0.21 | 0.20 | 0.19 |
| R ² | 0.97 | 0.96 | 0.97 | 0.97 | 0.96 | 0.97 |
| Adjusted R ² | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 |
| F-Statistics | 435.40 (0.00) | 413.30 (0.00) | 424.30 (0.00) | 343.00 (0.00) | 322.60 (0.00) | 332.90 (0.00) |
| Durbin-Watson | 2.05 | 1.85 | 1.89 | 2.04 | 1.82 | 1.88 |
| Autocorrelation coefficient | | 0.08 | 0.05 | | 0.09 | 0.06 |
| RHO used for AR(1) | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

C.5 Estimated Thailand Import Price Models for Australian Cheese and Curd (HS0406)

| Estimation methods | Model A | | | Model B | | |
|------------------------------------|-------------------------------|-----------------|------------------|-------------------------------|-----------------|-----------------|
| | OLS | GLS | GLS AR (1) | OLS | GLS | GLS AR (1) |
| Explanatory variables | Estimated coefficients | | | Estimated coefficients | | |
| Constant | 4.44*** | 4.41*** | 4.43*** | 4.44*** | 4.49*** | 4.46*** |
| Log of Exchange rate (LE) | 0.11 | 0.16 | 0.20 | 0.11 | 0.15 | 0.20 |
| Log of Tariff (LTAR) | -0.44*** | -0.43*** | -0.43*** | -0.44*** | -0.44*** | -0.43*** |
| Log of Competitor's price (LCP) | 0.31*** | 0.29*** | 0.26*** | 0.31*** | 0.28*** | 0.25*** |
| Log of Market share (LZ) | -0.02 | -0.002 | -0.01 | -0.02 | -0.002 | -0.01 |
| Dummy variable for drought (DDROU) | | | | -0.0009 | 0.001 | 0.003 |
| No. Of observations | 65 | 65 | 65 | 65 | 65 | 65 |
| Degrees of freedom | 60 | 60 | 60 | 59 | 59 | 59 |
| Mean | 4.70 | 4.70 | 4.70 | 4.70 | 4.70 | 4.70 |
| Standard deviation | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 |
| Residuals Sum of squares | 0.60 | 0.56 | 0.54 | 0.60 | 0.55 | 0.53 |
| R ² | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 |
| Adjusted R ² | 0.86 | 0.86 | 0.86 | 0.86 | 0.85 | 0.86 |
| F-Statistics | 97.30 (0.00) | 96.90 (0.00) | 101.10 (0.00) | 76.60 (0.00) | 76.20 (0.00) | 79.60 (0.00) |
| Durbin-Watson | 1.66 | 1.62 | 1.93 | 1.66 | 1.61 | 1.92 |
| Autocorrelation coefficient | | 0.19 | 0.03 | | 0.20 | 0.04 |
| RHO used for AR(1) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

C.6 Estimated Thailand Import Price Models for Australian Total Dairy Products

| Estimation methods | Model A | | | Model B | | |
|------------------------------------|-------------------------------|-----------------|-----------------|-------------------------------|-----------------|-----------------|
| | OLS | GLS | GLS AR (1) | OLS | GLS | GLS AR (1) |
| Explanatory variables | Estimated coefficients | | | Estimated coefficients | | |
| Constant | 0.81 | 0.56 | 1.36** | 0.95* | 0.84* | 1.21** |
| Log of Exchange rate (LE) | 0.15 | 0.37*** | 0.32** | 0.18 | 0.31*** | 0.33** |
| Log of Tariff (LTAR) | -0.14** | -0.07 | -0.15* | -0.11** | -0.07 | -0.11* |
| Log of Competitor's price (LCP) | 0.78*** | 0.61*** | 0.53*** | 0.71*** | 0.59*** | 0.52*** |
| Log of Market share (LZ) | 0.03 | -0.03 | 0.01 | 0.06 | -0.002 | 0.02 |
| Dummy variable for drought (DDROU) | | | | 0.14*** | 0.16*** | 0.15*** |
| No. Of observations | 65 | 65 | 65 | 65 | 65 | 65 |
| Degrees of freedom | 60 | 60 | 60 | 59 | 59 | 59 |
| Mean | 4.23 | 4.23 | 4.23 | 4.23 | 4.23 | 4.23 |
| Standard deviation | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 |
| Residuals Sum of squares | 0.86 | 0.91 | 0.67 | 0.61 | 0.62 | 0.53 |
| R ² | 0.83 | 0.81 | 0.86 | 0.88 | 0.87 | 0.89 |
| Adjusted R ² | 0.82 | 0.79 | 0.85 | 0.87 | 0.85 | 0.88 |
| F-Statistics | 74.00 (0.00) | 62.60 (0.00) | 90.90 (0.00) | 86.40 (0.00) | 76.40 (0.00) | 91.00 (0.00) |
| Durbin-Watson | 1.11 | 0.88 | 1.75 | 1.34 | 1.12 | 1.69 |
| Autocorrelation coefficient | | 0.56 | 0.12 | | 0.44 | 0.16 |
| RHO used for AR(1) | 0.45 | 0.45 | 0.45 | 0.33 | 0.33 | 0.33 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

Appendix D

Estimated Models for Thailand Dairy Import Price Ratio in THNZCEP from 4 Estimation Methods

D.1 Estimated Models for Thailand Import Price Ratio of Concentrated Milk and Cream (HS0402) in THNZCEP

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|-----------------|-----------------|----------------|-------------|
| | | | OLS | FEM | REM | TSCS: S2,R1 |
| Constant | | | 1.95 | | 2.05 | 1.47 |
| Log of Thailand's import tariff for non-FTA country (LTARNM2) | (+) | -0.60 | -0.38 | -0.42 | -0.41 | -0.327 |
| Log of Thailand's import tariff for New Zealand (LTARNZ2) | (-) | -0.63 | -0.41*** | -0.41*** | -0.41*** | -0.32** |
| Log of input price (raw milk price) of non-FTA country (LMPNM2) | (+) | 0.62 | 0.32*** | 0.29** | 0.30** | 0.36*** |
| Log of input price (raw milk price) of New Zealand (LMPNZ2) | (-) | 0.59 | -0.21 | -0.20 | -0.20 | -0.24* |
| No. Of observations | | | 57 | 57 | 57 | 57 |
| Degrees of freedom | | | 52 | 50 | 50 | 52 |
| Mean | | | -0.12 | -0.12 | -0.12 | -0.12 |
| Standard deviation | | | 0.25 | 0.25 | 0.25 | 0.25 |
| Residuals sum of squares | | | 1.81 | 1.33 | 1.81 | |
| R ² | | | 0.50 | 0.63 | 0.50 | |
| Adjusted R ² | | | 0.46 | 0.59 | | |
| F-Statistics | | | 13.00 (0.00) | 14.40 (0.00) | | |
| F-Statistics for FEM Testing | | | | 9.08*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 25.99*** | |
| Hausman Statistics | | | | | 0.01 (1.00) | |
| Wald Statistics | | | | | | |
| Lagrange multiplier statistic | | | | | | |
| Likelihood ratio statistic | | | | | | 12.18 |
| Log-likelihood function | | | | | | 39.09 |
| Parameter | | | | | | 12 |
| Autocorrelation coefficient | | | | | | 0.39 |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

D.2 Estimated Models for Thailand Import Price Ratio of Buttermilk and Yogurt (HS0403) in THNZCEP

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|----------------|----------------|----------------|-------------|
| | | | OLS | FEM | REM | TSCS: S0,R0 |
| Constant | | | 8.71** | | 9.28*** | 8.71** |
| Log of Thailand's import tariff for non-FTA country (LTARNM3) | (+) | -0.20 | -1.75* | -1.90** | -1.84** | -1.75** |
| Log of Thailand's import tariff for New Zealand (LTARNZ3) | (-) | -0.21 | -0.35** | -0.32* | -0.33** | -0.35** |
| Log of input price (raw milk price) of non-FTA country (LMPNM3) | (+) | 0.07 | 0.19 | -0.07 | 0.02 | 0.19 |
| Log of input price (raw milk price) of New Zealand (LMPNZ3) | (-) | 0.03 | -1.01*** | -0.93** | -0.96*** | -1.02*** |
| No. Of observations | | | 45 | 45 | 45 | 45 |
| Degrees of freedom | | | 40 | 38 | 38 | 40 |
| Mean | | | 0.13 | 0.13 | 0.13 | 0.13 |
| Standard deviation | | | 0.32 | 0.32 | 0.32 | 0.32 |
| Residuals sum of squares | | | 3.54 | 2.82 | 3.55 | |
| R ² | | | 0.21 | 0.37 | 0.20 | |
| Adjusted R ² | | | 0.13 | 0.27 | | |
| F-Statistics | | | 2.60 (0.05) | 3.70 (0.01) | | |
| F-Statistics for FEM Testing | | | | 4.78** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 5.86** | |
| Hausman Statistics | | | | | 0.22 (0.99) | |
| Wald Statistics | | | | | | 24.11 |
| Lagrange multiplier statistic | | | | | | 13.50 |
| Likelihood ratio statistic | | | | | | 12.71 |
| Log-likelihood function | | | | | | -6.62 |
| Parameter | | | | | | 6 |
| Autocorrelation coefficient | | | | | | |
| Pooled OLS residual variance (SS/nT) | | | | | | 0.08 |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

D.3 Estimated Models for Thailand Import Price Ratio of Whey (HS0404) in THNZCEP

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|----------------|----------------|----------------|-------------|
| | | | OLS | FEM | REM | TSCS: S2,R1 |
| Constant | | | 11.11 | | 12.81* | 5.30 |
| Log of Thailand's import tariff for non-FTA country (LTARNM4) | (+) | -0.55 | -3.39* | -4.12** | -3.80** | -2.12 |
| Log of Thailand's import tariff for New Zealand (LTARNZ4) | (-) | -0.44 | -0.42 | -0.28 | -0.34 | -0.24 |
| Log of input price (raw milk price) of non-FTA country (LMPNM4) | (+) | 0.55 | 1.10** | 0.51 | 0.77* | 1.27*** |
| Log of input price (raw milk price) of New Zealand (LMPNZ4) | (-) | 0.45 | -0.81* | -0.58 | -0.68 | -0.57 |
| No. Of observations | | | 51 | 51 | 51 | 51 |
| Degrees of freedom | | | 46 | 44 | 44 | 46 |
| Mean | | | -0.51 | -0.51 | -0.51 | -0.51 |
| Standard deviation | | | 0.52 | 0.52 | 0.52 | 0.52 |
| Residuals sum of squares | | | 8.03 | 6.91 | 8.13 | |
| R ² | | | 0.40 | 0.48 | 0.39 | |
| Adjusted R ² | | | 0.34 | 0.41 | | |
| F-Statistics | | | 7.50 (0.00) | 6.80 (0.00) | | |
| F-Statistics for FEM Testing | | | | 3.58** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 1.38 | |
| Hausman Statistics | | | | | 1.32 (0.86) | |
| Wald Statistics | | | | | | |
| Lagrange multiplier statistic | | | | | | |
| Likelihood ratio statistic | | | | | | 36.20 |
| Log-likelihood function | | | | | | -1.15 |
| Parameter | | | | | | 12 |
| Autocorrelation coefficient | | | | | | 0.32 |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

D.4 Estimated Models for Thailand Import Price Ratio of Butter (HS0405) in THNZCEP

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|----------------|----------------|----------------|-------------|
| | | | OLS | FEM | REM | TSCS: S1,R1 |
| Constant | | | 1.47 | | 0.97 | 0.55 |
| Log of Thailand's import tariff for non-FTA country (LTARNM5) | (+) | -0.41 | -0.22 | -0.13 | -0.14 | 0.11 |
| Log of Thailand's import tariff for New Zealand (LTARNZ5) | (-) | -0.41 | -0.09 | -0.13 | -0.12 | -0.22** |
| Log of input price (raw milk price) of non-FTA country (LMPNM5) | (+) | 0.31 | -0.07 | 0.13 | 0.11 | -0.04 |
| Log of input price (raw milk price) of New Zealand (LMPNZ5) | (-) | 0.37 | -0.01 | -0.07 | -0.07 | 0.02 |
| No. Of observations | | | 57 | 57 | 57 | 57 |
| Degrees of freedom | | | 52 | 50 | 50 | 52 |
| Mean | | | 0.20 | 0.20 | 0.20 | 0.20 |
| Standard deviation | | | 0.20 | 0.20 | 0.20 | 0.20 |
| Residuals sum of squares | | | 1.83 | 1.17 | 1.84 | |
| R ² | | | 0.17 | 0.47 | 0.17 | |
| Adjusted R ² | | | 0.11 | 0.41 | | |
| F-Statistics | | | 2.70 (0.04) | 7.40 (0.00) | | |
| F-Statistics for FEM Testing | | | | 14.03*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 50.61*** | |
| Hausman Statistics | | | | | 0.21 (1.00) | |
| Wald Statistics | | | | | | 97.62 |
| Lagrange multiplier statistic | | | | | | 6.14 |
| Likelihood ratio statistic | | | | | | 24.85 |
| Log-likelihood function | | | | | | 36.86 |
| Parameter | | | | | | 9 |
| Autocorrelation coefficient | | | | | | 0.23 |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

D.5 Estimated Models for Thailand Import Price Ratio of Cheese and Curd (HS0406) in THNZCEP

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|----------------|-----------------|----------------|-------------|
| | | | OLS | FEM | REM | TSCS: S2,R2 |
| Constant | | | 9.30*** | | 6.54*** | 5.45*** |
| Log of Thailand's import tariff for non-FTA country (LTARNM6) | (+) | -0.21 | -1.72*** | -1.27*** | -1.28*** | -1.17*** |
| Log of Thailand's import tariff for New Zealand (LTARNZ6) | (-) | -0.17 | 0.37 | 0.18 | 0.19 | 0.09 |
| Log of input price (raw milk price) of non-FTA country (LMPNM6) | (+) | -0.02 | -1.31*** | -0.42 | -0.44* | -0.01 |
| Log of input price (raw milk price) of New Zealand (LMPNZ6) | (-) | 0.08 | -0.19 | -0.41*** | -0.41*** | -0.51*** |
| No. Of observations | | | 57 | 57 | 57 | 57 |
| Degrees of freedom | | | 52 | 50 | 50 | 52 |
| Mean | | | 0.58 | 0.58 | 0.58 | 0.58 |
| Standard deviation | | | 0.31 | 0.31 | 0.31 | 0.31 |
| Residuals sum of squares | | | 3.93 | 1.08 | 4.22 | |
| R ² | | | 0.25 | 0.79 | 0.20 | |
| Adjusted R ² | | | 0.20 | 0.77 | | |
| F-Statistics | | | 4.40 (0.00) | 32.30 (0.00) | | |
| F-Statistics for FEM Testing | | | | 65.96*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 208.14*** | |
| Hausman Statistics | | | | | 6.94 (0.01) | |
| Wald Statistics | | | | | | |
| Lagrange multiplier statistic | | | | | | |
| Likelihood ratio statistic | | | | | | 21.24 |
| Log-likelihood function | | | | | | 31.42 |
| Parameter | | | | | | 14 |
| Autocorrelation coefficient | | | | | | |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

D.6 Estimated Models for Thailand Import Price Ratio of Total Dairy Products in THNZCEP

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|----------------|-----------------|----------------|-------------|
| | | | OLS | FEM | REM | TSCS: S0,R1 |
| Constant | | | 1.39 | | 0.68 | -0.20 |
| Log of Thailand's import tariff for non-FTA country (LTARNM7) | (+) | -0.15 | -0.22 | -0.04 | -0.05 | -0.05 |
| Log of Thailand's import tariff for New Zealand (LTARNZ7) | (-) | -0.16 | -0.24 | -0.29 | -0.28 | -0.11 |
| Log of input price (raw milk price) of non-FTA country (LMPNM7) | (+) | 0.13 | 0.08 | 0.27 | 0.26 | 0.35* |
| Log of input price (raw milk price) of New Zealand (LMPNZ7) | (-) | 0.12 | -0.23 | -0.30 | -0.30 | -0.24 |
| No. Of observations | | | 57 | 57 | 57 | 57 |
| Degrees of freedom | | | 52 | 50 | 50 | 52 |
| Mean | | | -0.37 | -0.37 | -0.37 | -0.37 |
| Standard deviation | | | 0.36 | 0.36 | 0.36 | 0.36 |
| Residuals sum of squares | | | 6.92 | 2.33 | 7.00 | |
| R ² | | | 0.04 | 0.68 | 0.02 | |
| Adjusted R ² | | | -0.04 | 0.64 | | |
| F-Statistics | | | 0.50 (0.75) | 17.30 (0.00) | | |
| F-Statistics for FEM Testing | | | | 49.26*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 208.89*** | |
| Hausman Statistics | | | | | 0.03 (1.00) | |
| Wald Statistics | | | | | | 13.02 |
| Lagrange multiplier statistic | | | | | | 7.30 |
| Likelihood ratio statistic | | | | | | 7.46 |
| Log-likelihood function | | | | | | 6.34 |
| Parameter | | | | | | 7 |
| Autocorrelation coefficient | | | | | | 0.56 |
| Pooled OLS residual variance (SS/nT) | | | | | | 0.05 |
| Corrected residual var.= (s2/(1-r2)) | | | | | | 0.07 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

Appendix E

Estimated Models for Thailand Dairy Import Price Ratio in TAFTA from 4 Estimation Methods

E.1 Estimated Models for Thailand Import Price Ratio of Concentrated Milk and Cream (HS0402) in TAFTA

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|----------------|----------------|----------------|-------------|
| | | | OLS | FEM | REM | TSCS: S0,R1 |
| Constant | | | -1.27 | | -1.19 | -1.37 |
| Log of Thailand's import tariff for non-FTA country (LTARNM2) | (+) | -0.28 | 0.69* | 0.65* | 0.66* | 0.71* |
| Log of Thailand's import tariff for Australia (LTARAU2) | (-) | -0.39 | -0.39** | -0.38** | -0.38** | -0.38** |
| Log of input price (raw milk price) of non-FTA country (LMPNM2) | (+) | 0.44 | 0.33*** | 0.30** | 0.31*** | 0.31*** |
| Log of input price (raw milk price) of Australia (LMPAU2) | (-) | 0.35 | -0.25 | -0.24 | -0.24 | -0.23 |
| No. Of observations | | | 57 | 57 | 57 | 57 |
| Degrees of freedom | | | 52 | 50 | 50 | 52 |
| Mean | | | -0.02 | -0.02 | -0.02 | -0.02 |
| Standard deviation | | | 0.19 | 0.19 | 0.19 | 0.19 |
| Residuals sum of squares | | | 1.43 | 0.94 | 1.43 | |
| R ² | | | 0.29 | 0.53 | 0.29 | |
| Adjusted R ² | | | 0.24 | 0.48 | | |
| F-Statistics | | | 5.40 (0.00) | 9.50 (0.00) | | |
| F-Statistics for FEM Testing | | | | 12.76*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 46.39*** | |
| Hausman Statistics | | | | | 0.01 (1.00) | |
| Wald Statistics | | | | | | 86.61 |
| Lagrange multiplier statistic | | | | | | 22.04 |
| Likelihood ratio statistic | | | | | | 23.20 |
| Log-likelihood function | | | | | | 29.07 |
| Parameter | | | | | | 7 |
| Autocorrelation coefficient | | | | | | 0.26 |
| Pooled OLS residual variance (SS/nT) | | | | | | 0.02 |
| Corrected residual var.= (s2/(1-r2)) | | | | | | 0.02 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

E.2 Estimated Models for Thailand Import Price Ratio of Buttermilk and Yogurt (HS0403) in TAFTA

| Variable Model | Expected sign | Correlation coefficients | Coefficients | | | |
|---|------------------|-----------------------------|----------------|----------------|----------------|-------------|
| | | | OLS | FEM | REM | TSCS: S2,R0 |
| Constant | | | 3.03 | | 3.23 | 0.72 |
| Log of Thailand's import tariff for non-FTA country (LTARNM3) | (+) | -0.23 | 0.03 | -0.07 | -0.02 | -0.41 |
| Log of Thailand's import tariff for Australia (LTARAU3) | (-) | -0.30 | -0.64** | -0.60** | -0.62** | 0.06 |
| Log of input price (raw milk price) of non-FTA country (LMPNM3) | (+) | 0.16 | 0.47 | 0.35 | 0.41 | 0.32*** |
| Log of input price (raw milk price) of Australia (LMPAU3) | (-) | 0.18 | -1.04* | -0.97 | -1.01* | -0.10 |
| No. Of observations | | | 45 | 45 | 45 | 45 |
| Degrees of freedom | | | 40 | 38 | 38 | 40 |
| Mean | | | 0.20 | 0.20 | 0.20 | 0.20 |
| Standard deviation | | | 0.35 | 0.35 | 0.35 | 0.35 |
| Residuals sum of squares | | | 4.59 | 3.94 | 4.60 | |
| R ² | | | 0.16 | 0.28 | 0.16 | |
| Adjusted R ² | | | 0.07 | 0.16 | | |
| F-Statistics | | | 1.90 (0.14) | 2.40 (0.04) | | |
| F-Statistics for FEM Testing | | | | 3.15* | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 2.02 | |
| Hausman Statistics | | | | | 0.04 (1.00) | |
| Wald Statistics | | | | | | |
| Lagrange multiplier statistic | | | | | | |
| Likelihood ratio statistic | | | | | | 24.93 |
| Log-likelihood function | | | | | | 12.44 |
| Parameter | | | | | | 11 |
| Autocorrelation coefficient | | | | | | |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

E.3 Estimated Models for Thailand Import Price Ratio of Whey (HS0404) in TAFTA

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|----------------|----------------|----------------|-------------|
| | | | OLS | FEM | REM | TSCS: S2,R1 |
| Constant | | | -7.46 | | -4.49 | -7.01 |
| Log of Thailand's import tariff for non-FTA country (LTARNM4) | (+) | 0.09 | 3.26** | 1.97 | 2.32* | 2.83* |
| Log of Thailand's import tariff for Australia (LTARAU4) | (-) | -0.09 | -1.15*** | -0.82** | -0.91*** | -0.93** |
| Log of input price (raw milk price) of non-FTA country (LMPNM4) | (+) | 0.08 | 1.05*** | 0.34 | 0.54 | 0.99*** |
| Log of input price (raw milk price) of Australia (LMPAU4) | (-) | -0.02 | -1.22** | -0.74 | -0.87* | -1.10** |
| No. Of observations | | | 51 | 51 | 51 | 51 |
| Degrees of freedom | | | 46 | 44 | 44 | 46 |
| Mean | | | 0.03 | 0.03 | 0.03 | 0.03 |
| Standard deviation | | | 0.37 | 0.37 | 0.37 | 0.37 |
| Residuals sum of squares | | | 5.22 | 4.00 | 5.44 | |
| R ² | | | 0.23 | 0.41 | 0.19 | |
| Adjusted R ² | | | 0.16 | 0.33 | | |
| F-Statistics | | | 3.40 (0.02) | 5.00 (0.00) | | |
| F-Statistics for FEM Testing | | | | 6.67*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 6.95*** | |
| Hausman Statistics | | | | | 1.52 (0.82) | |
| Wald Statistics | | | | | | |
| Lagrange multiplier statistic | | | | | | |
| Likelihood ratio statistic | | | | | | 20.59 |
| Log-likelihood function | | | | | | 3.23 |
| Parameter | | | | | | 12 |
| Autocorrelation coefficient | | | | | | 0.34 |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

E.4 Estimated Models for Thailand Import Price Ratio of Butter (HS0405) in TAFTA

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|----------------|-----------------|----------------|-------------|
| | | | OLS | FEM | REM | TSCS: S0,R2 |
| Constant | | | 1.74 | | 1.00 | 1.82** |
| Log of Thailand's import tariff for non-FTA country (LTARNM5) | (+) | -0.48 | 0.10 | 0.39 | 0.36 | 0.34 |
| Log of Thailand's import tariff for Australia (LTARAU5) | (-) | -0.51 | -0.47* | -0.66*** | -0.64*** | -0.67*** |
| Log of input price (raw milk price) of non-FTA country (LMPNM5) | (+) | 0.38 | 0.18 | 0.56** | 0.52** | 0.15 |
| Log of input price (raw milk price) of Australia (LMPAU5) | (-) | 0.43 | -0.38 | -0.63** | -0.60** | -0.47** |
| No. Of observations | | | 57 | 57 | 57 | 57 |
| Degrees of freedom | | | 52 | 50 | 50 | 52 |
| Mean | | | 0.21 | 0.21 | 0.21 | 0.21 |
| Standard deviation | | | 0.21 | 0.21 | 0.21 | 0.21 |
| Residuals sum of squares | | | 1.73 | 1.00 | 1.78 | |
| R ² | | | 0.28 | 0.58 | 0.26 | |
| Adjusted R ² | | | 0.22 | 0.53 | | |
| F-Statistics | | | 5.00 (0.00) | 11.70 (0.00) | | |
| F-Statistics for FEM Testing | | | | 18.35*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 68.33*** | |
| Hausman Statistics | | | | | 0.42 (0.98) | |
| Wald Statistics | | | | | | 23.04 |
| Lagrange multiplier statistic | | | | | | 11.34 |
| Likelihood ratio statistic | | | | | | 11.34 |
| Log-likelihood function | | | | | | 33.64 |
| Parameter | | | | | | 9 |
| Autocorrelation coefficient | | | | | | |
| Pooled OLS residual variance (SS/nT) | | | | | | 0.02 |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

E.5 Estimated Models for Thailand Import Price Ratio of Cheese and Curd (HS0406) in TAFTA

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|----------------|-----------------|----------------|-------------|
| | | | OLS | FEM | REM | TSCS: S2,R1 |
| Constant | | | 5.32** | | 2.32** | 1.34 |
| Log of Thailand's import tariff for non-FTA country (LTARNM6) | (+) | -0.18 | -1.64** | -0.55 | -0.57 | -0.13 |
| Log of Thailand's import tariff for Australia (LTARAU6) | (-) | -0.12 | 0.88 | 0.13 | 0.15 | -0.20 |
| Log of input price (raw milk price) of non-FTA country (LMPNM6) | (+) | 0.05 | -0.95* | 0.24 | 0.22 | 0.67*** |
| Log of input price (raw milk price) of Australia (LMPAU6) | (-) | 0.05 | 0.26 | -0.41 | -0.39 | -0.67*** |
| No. Of observations | | | 57 | 57 | 57 | 57 |
| Degrees of freedom | | | 52 | 50 | 50 | 52 |
| Mean | | | 0.51 | 0.51 | 0.51 | 0.51 |
| Standard deviation | | | 0.30 | 0.30 | 0.30 | 0.30 |
| Residuals sum of squares | | | 4.20 | 1.01 | 4.63 | |
| R ² | | | 0.14 | 0.79 | 0.05 | |
| Adjusted R ² | | | 0.07 | 0.77 | | |
| F-Statistics | | | 2.10 (0.09) | 31.70 (0.00) | | |
| F-Statistics for FEM Testing | | | | 78.45*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 215.88*** | |
| Hausman Statistics | | | | | 0.00 (1.00) | |
| Wald Statistics | | | | | | |
| Lagrange multiplier statistic | | | | | | |
| Likelihood ratio statistic | | | | | | 16.76 |
| Log-likelihood function | | | | | | 27.24 |
| Parameter | | | | | | 12 |
| Autocorrelation coefficient | | | | | | 0.14 |
| Pooled OLS residual variance (SS/nT) | | | | | | |
| Corrected residual var.= (s2/(1-r2)) | | | | | | |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.

E.6 Estimated Models for Thailand Import Price Ratio of Total Dairy Products in TAFTA

| Variable | Expected sign | Correlation coefficients | Coefficients | | | |
|---|---------------|--------------------------|----------------|-----------------|----------------|-------------|
| | | | OLS | FEM | REM | TSCS: S0,R1 |
| Constant | | | -1.29 | | -2.10 | -2.84 |
| Log of Thailand's import tariff for non-FTA country (LTARNM7) | (+) | -0.00 | 0.40 | 0.73* | 0.71* | 0.68 |
| Log of Thailand's import tariff for Australia (LTARAU7) | (-) | -0.04 | -0.16 | -0.30 | -0.29 | -0.10 |
| Log of input price (raw milk price) of non-FTA country (LMPNM7) | (+) | 0.04 | 0.10 | 0.33* | 0.32* | 0.40** |
| Log of input price (raw milk price) of Australia (LMPAU7) | (-) | 0.04 | -0.01 | -0.18 | -0.18 | -0.15 |
| No. Of observations | | | 57 | 57 | 57 | 57 |
| Degrees of freedom | | | 52 | 50 | 50 | 52 |
| Mean | | | -0.23 | -0.23 | -0.23 | -0.23 |
| Standard deviation | | | 0.35 | 0.35 | 0.35 | 0.35 |
| Residuals sum of squares | | | 6.79 | 2.17 | 6.91 | |
| R ² | | | 0.01 | 0.68 | -0.01 | |
| Adjusted R ² | | | -0.07 | 0.65 | | |
| F-Statistics | | | 0.10 (0.97) | 18.00 (0.00) | | |
| F-Statistics for FEM Testing | | | | 53.23*** | | |
| Lagrange Multiplier Statistics for REM Testing | | | | | 218.92*** | |
| Hausman Statistics | | | | | 0.05 (1.00) | |
| Wald Statistics | | | | | | 10.34 |
| Lagrange multiplier statistic | | | | | | 7.99 |
| Likelihood ratio statistic | | | | | | 7.49 |
| Log-likelihood function | | | | | | 13.34 |
| Parameter | | | | | | 7 |
| Autocorrelation coefficient | | | | | | 0.64 |
| Pooled OLS residual variance (SS/nT) | | | | | | 0.04 |
| Corrected residual var.= (s2/(1-r2)) | | | | | | 0.06 |

Note: ***, **, * ==> Significance at 1%, 5%, 10% level.