TRADE POLICY, TRADE PERFORMANCE AND FIRM'S PRODUCTIVITY IN THAILAND

BY

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ABSTRACT

This paper examines impacts of trade policy in Thailand, both in terms of tariffs and non-tariff measures (NTM), on trade performance and firm's productivity during 2012 – 2021. This study considers tariff protection both in terms of nominal and effective rate of protection as well as applying utilization rates of in-effect FTA to adjust the protection in Thai industries. Non-tariff measures, especially in terms of technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) measures, which have aggressively increased over the past decade, are employed in the study through analyzing a frequency ratio, coverage ratio and ad valorem equivalent. The results show that an effective rate of protection reveals a greater impact on import volume than nominal rate of protection. Preferential tariff rates under free trade agreements also play an important role in helping amplify the positive impacts of trade liberalization on import volume, though utilization rates are relatively low. NTM policies support the improvement in quality of imported products which stimulate the imported demand in Thailand, especially in terms of technical barrier to trade (TBT). Tariffs and NTM policies show the different effects on each product with the greatest impacts on intermediate products, followed by finished and capital products, respectively. For country-wise analysis, the positive and significant impact of NTM is revealed only in developed countries while the negative and significant impacts of tariffs on imported products are founded in LDC and developing countries. In addition, the result shows that both tariff reduction and free trade agreement can boost firm performance, especially tariff on intermediate input. The result also confirms us that NTMs policy in Thailand does not create the excessive responsibility to the domestic industry but can be used to increase the product quality that can help to improve firm productivity.

Keywords: Trade policy, Trade performance, Productivity, FTAs, NTMs

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Saveera Thammasiri

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LIST OF ABBREVIATIONS

Symbols/Abbreviations	Terms
FTAs	Free Trade Agreements
NTMs	Non-tariff Measures
TBT	Technical Barrier to Trade
SPS	Sanitary and Phytosanitary
Inspect	Pre-shipment inspection and other formalities

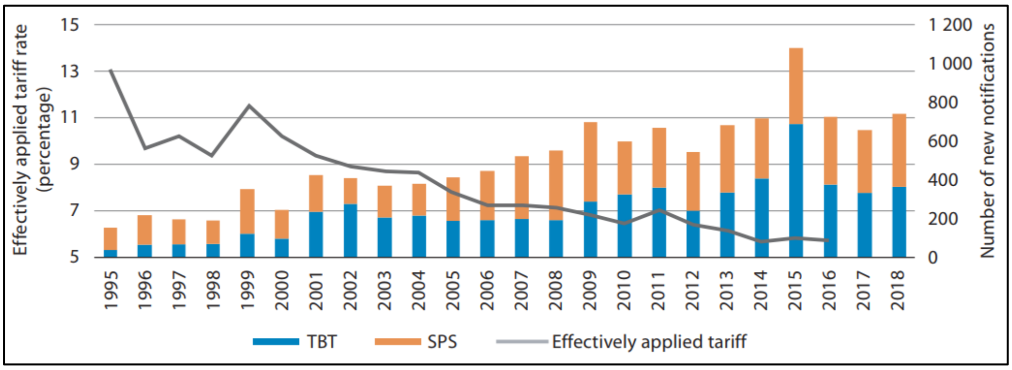
CHAPTER 1
INTRODUCTION

1.1 Statement of Problem

In the past few decades, trade policy has been continuously changed as a tool for economic growth. At the beginning, the pattern of trade policy focused on unilateral and multilateral trade liberalization, i.e., the General Agreement on Tariffs and Trade (GATT) which later developed to the World Trade Organization (WTO). Since WTO has been established, average world tariff has been gradually decreased from 6.44% in 1995 to 2.59% in 2017. However, with a large number of members, the liberalization progress under WTO has been unsatisfied and resulted in a switch in political attention toward preferential trade agreements and bilateral free trade accords. The number of in-effect FTA around the globe has increased from 23 FTAs in 1995 to 185 FTAs in 2022. In addition, non-tariff measures, especially technical measures such as technical barrier to trade (TBT) and sanitary and phytosanitary (SPS), have become more crucial, particularly in the Asia-Pacific region. According to estimates made by ESCAP and UNCTAD, the trade costs of NTMs are more than double that of ordinary customs tariffs (UNCTAD, 2019, P.4).

Figure 1.1

Average applied tariffs and annual new notifications to WTO of SPS and TBT measures in the Asia-Pacific region

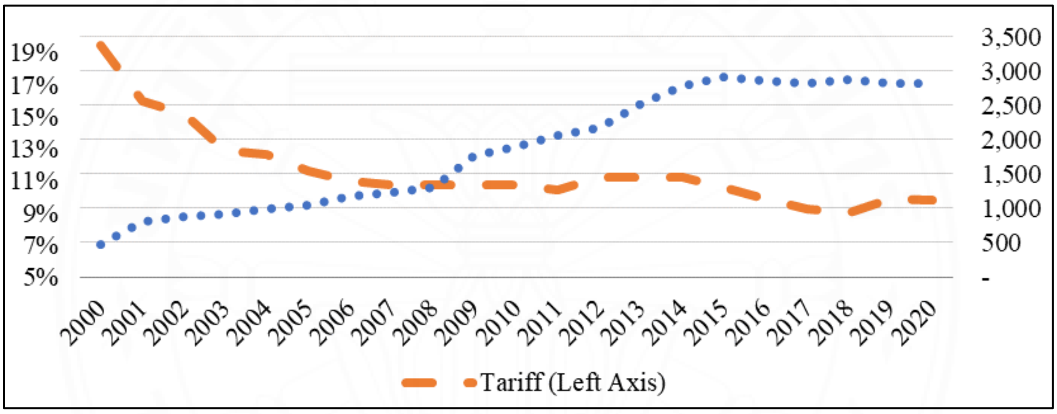


Note. From *Navigation Non-tariff Measures towards Sustainable Development: Asia- Pacific Trade and Investment Report 2019*, by UNCTAD, 2019, New York, United nations publication.

The policy changes in Thailand also follow the global trade policy attention. Tariff rates in Thailand have been declined, from 19% in 2000 and 9% in 2020. FTAs were initiated in Thailand at the beginning of 2000s in the Prime minister Thaksin Shinawatra era. From only AFTA in 2000, Thailand has 14 agreements in effected in 2020 and around 10 are under negotiation. Non-tariff measures implemented by Thailand also gradually increased from 466 measures in 2000 to 2,821 measures in 2020.

Figure 1.2

Thailand tariff and non-tariff measure in 2000-2020



Note. Author's compilation from Tariff analysis online (TAO) and TRAINS database

Shifting trade policy attention raises an empirical question concerning trade performance and firm productivity. In fact, both traditional trade theory (Ricardian model and Heckscher-Ohlin model) and the new trade theory (Krugman, 1979; Krugman, 1985; Melitz, 2003) support international trade to enhance economic growth and productivity. Many empirical studies (e.g., Amiti and Konnings, 2007; Topalova and Khandelwal, 2011) also found that trade liberalization, especially in terms of tariff reductions, has help enhance trade and improve firm productivity. Product varieties, higher market competition, technology transfer and spillover induced by trade liberalization are among reasons to support opening up to international trade.

However, the benefits of trade liberalization on firm productivity are ambiguous. Jongwanich and Kohpaiboon (2017), based on Thai data during 1996 – 2011, show that reductions of output tariffs did not increase productivity of non-exporting firms and productivity of non-importing firms decrease when input tariffs declined. Ahn et al. (2019) also found that the reduction in output tariff cannot increase firm productivity in 18 high income countries over the period 1991 – 2012. The level of firm productivity also related to the effect from tariff reduction on firm productivity. Esaku and Krugel (2020) found that firm productivity improvement from tariff has concentrated around 25th and 50th quantiles in Kenya manufacturing over the period 1992 – 1999. Fiorini et al. (2019) shown that, without infrastructure, input tariff reduction did not affect firm productivity in Ethiopia between 1998-2009.

Regarding impacts of FTAs, inconclusive effects of FTA on trade promoting and firm productivity are evident. For example, Karkanis and Fotopoulou (2021), employing Chinese trading data during 1995 -2018, found that FTA can increase or decrease Chinese trade volume. The sensitivity and inconsistent result of FTA in Chinese import volume depends on modelling approach. Abbas (2018) found that bilateral trade agreement has increase trade volume in Pakistan during 1998 -2016. However, regional trade agreement has harmed trade sector in Pakistan. Timsina and Culas (2020) have shown the tangle effect on trade creation from overlapping FTA in Australia over the period 1996-2017. Kohpaiboon and Jongwanich (2022), using Thai manufacturing data during 1996 – 20016, found the ineffectiveness of FTA in productivity improvement among Thai manufacturing.

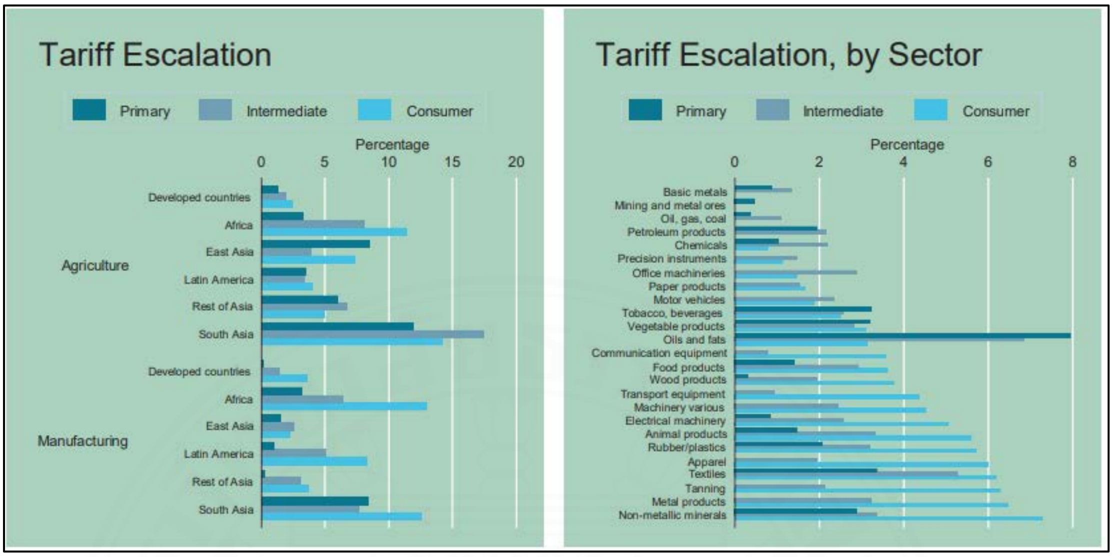
On the one hand, NTMs generate a negative impact on trade and firm productivity. Jongwanich (2009), using 79 developing countries during the period 1990–2006, shows that sanitary and phytosanitary (SPS) measures could retard processed food exports in developing countries. Elisabeth et al. (2020) found that NTMs has decreased labor productivity and firm profitability in Indonesia during 2010-2015. Shepotyo et al. (2022) found that both NTMs in input and output have decreased firm productivity in Ukraine between 2008-2012. The recent study by Cali et al. (2021) shows that NTMs did not affect Indonesian firm productivity over the period 2008 – 2015.

On the other hand, some studies show that imposed NTMs can increase firm productivity. Goldar et al. (2020) found that relaxing quantitative restrictions (QR) can improve firm productivity in India over the period 1998-2010. Gupta (2021) found that firm productivity has increased when technical barriers to trade (TBT) in Indonesia has increased between 2008-2012. Navaretti et al. (2023) also found an increase in firm productivity when TBT has increased in 15 EU countries during 2001 – 2012. Even NTMs did not directly affect labor productivity, it can increase labor productivity indirectly through industrial linkages. Ghodsi and Strehrer (2016) show that NTMs imposed on non-services sector can increase labor productivity indirectly in 41 countries between 2002 -2011. NTMs policy can also increase product quality. Hu et al. (2019) found that NTMs policy can induce quality improvement in China between 2001 -2010. Ghodsi and Stehrer (2022) show that TBT and SPS policy can increase quality of traded products in 151 countries over the period 1995 – 2011. Hu et al. (2021) also found that NTMs in public policy can upgrade quality of imported intermediate inputs in China during 1978 – 2012. Liu et al. (2020), using Chinese manufacturing data during 2004 – 2006, found that non-tariff barrier has played an important role in productivity improvement from output tariff.

In addition to ambiguity of empirical studies, many governments have disappointed with consequences of trade openness policy, especially in terms of spurring economic growth and widening income inequality. Trade liberalization was blamed as one of the key factors leading to such consequences. Combined with the political tensions between the US-China, Russia-Ukraine and also pandemic crisis, anti-globalization has been evoked in the policy attention to protect their domestic industry. Even in the United States and European Union, the nationalism also has more favor than liberalism (Kohpaiboon, 2018). Both developed and developing countries have shown evidence in tariff escalation and protection tends to be more pervasive in manufacturing product than agricultural product at this moment (UNCTAD, 2022) (Figure 1.3).

Figure 1.3

Tariff escalation by region, broad category and sector in 2020



Note. From *Key Statistics and Trends in Trade Policy 2021: The Regional Comprehensive Economic Partnership Tariff Concessions*., by UNCTAD, 2022, New York, United nations publication.

With the unsettled solutions concerning impacts of trade liberalization, the key objective of this dissertation is to examine impacts of trade policy on trade performance and firms' productivity using Thailand as a case study during 2012-2021. This study contributes to existing literature in two ways. First, this study examines both tariff and non-tariff policies in Thailand simultaneously on trade performance and firms' productivity. So far, there has not been any empirical studies investigating these two issues simultaneously in Thailand. In addition, we consider tariff protection both in terms of nominal and effective rate of protection as well as the protection adjusted for FTA utilization rates. The idea of tariff protection's measurements has been developed from Jongwanich ang Kohpaiboon (2020) which consider the rate of protection associated with FTA but did not include the utilization rate of FTA in their study. Non-tariff measures, particularly technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) measures are analyzed through various estimates.

As mentioned earlier, Thailand stands as a good case study at hand because tariffs in Thailand have been declined noticeably over the past decades while FTAs, both bilateral and regional agreements, have noticeably gone up. In addition, non-tariff measures, especially in terms of technical barriers to trade (TBT) and sanitary and phytosanitary (SPS) measures aggressively increased over the past decade. These developments could influence trade and firm performance in Thailand, but the direction of their effects has still been debatable and not yet been concluded. So far there has been no empirical study investigating relationship between NTMs and productivity in Thailand. Hence, this study contributes to the literature by examining impacts of NTMs on firm productivity in Thai manufacturing

1.2 Research Objective

1.2.1 To examine development of trade policy in Thailand, both in terms of tariffs and non-tariff measures during 2012 – 2021.

1.2.2 To investigate impacts of trade policy on total imports and disaggregated imports, composing of finished products, capital and raw materials, in Thailand.

1.2.3 To investigate impacts of trade policy on firms' productivity in Thai manufacturing sector.

1.3 Scope of Study

Trade policy focused in this study is composed of tariff and non-tariff measures. Liberalization of Thailand's trade policy through both unilateral and FTAs is considered in the study. Since liberalization of trade policy is mainly focused on Thailand, trade performance investigated here focuses mainly on imports, which are disaggregated into finished, capital and raw material products. As mentioned in the introduction, some studies (Amiti and Konnings, 2007; Topalova and Khandelwal, 2011; Jongwanich and Kohpaiboon, 2017; Linarello, 2018; Hu et al., 2019; Ghodsi and Stehrer, 2022; Hu et al., 2021; Cirera et al.,2021) show that trade liberalization could help enhance only some categories of imports, particularly capital and raw materials. Our study covers observations between 2012 – 2021 due to limitation of the data since utilization rate before 2011 was incomplete. In addition, the Harmonize system and Thai industrial census has been updated every 5 years which exactly match with our study period.

1.4 Structure of the Dissertation

There are 6 Chapters in the study as follows:

Chapter 1 laydowns the background of the study, especially the possible impacts of trade policy, both tariff and non-tariff measures on imports and firms' productivity.

Chapter 2 wraps up the theoretical studies concerning gains from trade and discussed the arguments against trade liberalization. Tools for implementation of trade policies including tariff, non-tariff measures and free trade agreement have been discussed. Thereafter, we discuss empirical evidence from all three policies mentioned. Especially in tariff policies, the empirical evidence of tariff has been separated into the tariff measurement and gains from tariff reductions.

Chapter 3 introduces measurements of trade protection used in this study which are tariff, free trade agreements, non-tariff measures and firm productivity. Tariff associated with FTA is discussed in this section. The following, modelling techniques and expected relationships have been discussed, which is divided into trade equation and productivity equation. Lastly, we identify the source of data.

Chapter 4 reviews the overview of trade policy in Thailand from 2007 to 2021. Firstly, tariff protection has been separated in terms of nominal rate of protection (NRP) and effective rate of protection (ERP). Free trade agreement has been discussed in terms of tariff margin and utilization rate. In addition, calculation of tariff protection by using the tariff associated with FTA which is newly created in this study has been introduced. NTM in terms of coverage ratio, frequency index and ad-valorem equivalent (AVEs) has been analyze. Finally, the estimation results of trade policies on import performance are discussed.

Chapter 5 analyzes the impact of trade policy on firm performance in Thailand from 2007 to 2012. The effect of firm productivity are discusses based on three different methods which are value-added methods, Levinsohn and Petrin (LP) (2003) and Ackerberg et al. (ACF) (2015). Subsequently, the estimation results of trade policies on firm performance have been wrapped up.

Chapter 6 provides conclusions and implications from this study.

CHAPTER 2
REVIEW OF LITERATURE

There are three sections in the Chapter. The first section reviews theoretical studies concerning gains from trade and discusses the arguments against trade liberalization. In the second section, we discussed the main tools for implementing trade policies, including tariff, non-tariff measures and free trade agreement. The last section presents empirical studies relevant to three trade policies discussed in the second section.

2.1 Trade Theory

2.1.1 Gain from Trade

"Probably the most important single insight in all of international economics is that there are gains from trade – that is, when countries sell goods and services to each other, this exchange is almost always to their mutual benefit. The range of circumstances under which international trade is beneficial is much wider than most people imagine" (Krugman et al., 2018, p.32)

The traditional theoretical studies to explain the gains from trade have been explained by the concept of comparative advantage in Ricardian model and Heckscher-Ohlin model. These two models used this concept to explain the dynamic of trade between two countries but little difference in detail. The Ricardian model is a basic model with two countries, two goods and only labor as one factor of production. A country has a comparative advantage in producing goods if the opportunity cost of producing that good in terms of other goods is lower compared to other countries. The economy specializes in production if the relative price of it exceeds its opportunity cost in terms of the other things. So, each country will specialize in different goods which reflect the difference in labor productivity in each country. From the different specializations, trade will create gains from trade in Ricardian model by either of the following two channels. On one hand, both countries have benefited from the exchange of their specialized products which better produced by themselves. On the other hand, trade-expanded consumption possibilities in each country make consumers better off by enlarging the range of consumption choice.

Ohlin (1933) explains the concept of comparative advantage by the interaction between nation's resource (relative factor abundance) and the technology of production (relative difference in production) in the name of Heckscher-Ohlin model. This model did not require the difference in labor productivity to create the international trade as in Ricardian model. The model is set by using two countries, two commodities, and two factors of production. Since this theory emphasizes the interplay between different available factors and different uses of factors in production, sometime, this model also referred to as factor-proportions theory. The fundamental mechanism in this model came from the different input used in different production of goods. Therefore, the proportional of factors used depends on the relative price of that factor. In this model, an economy will tend to be relatively effective at producing goods that are intensive in the factors with the country is relatively well endowed. Thus, a country would produce and export products which have relative resource abundances and import the other scarce factors in production. Since we know that the price of a product has a one-to-one relationship to the factor price, the owner of a country's relatively abundant factors receives gains from trade, but the owner of a country's relatively scarce factors loses. The income distribution effect from trade has been confirmed by the specific factor model which was developed by Samuelson (1971) and Jones (1971).[1]

The earlier traditional models explain trade by using the factor endowment or technology and specialization with constant return to scale. The new trade theory in the 1980s introduced the importance of economies of scale in explaining

[1] They added the specific factor in the factor of production set to explain the short run that some factor cannot move freely as in Ricardian model. In this model, the factor specific owner to export sectors in each country has gained from trade. On the other hand, the factor specific owner in the import-competing sector has lost. The mobile factor like labor has either gain or lose. Therefore, the overall gain can occur only when those who gain from trade can compensate those who lose from trade.

gains from trade, or the so-called intra-industry trade.[1] The intra-industry trade is the term to call the two-way exchange of similar goods which has been explained in the monopolistic competition market. In this kind of market, increasing return to scale can explain gains from trade even in a situation of identical tastes, technology, and factor endowment. Also, the wider range of available products in the market increased consumer utility since the market has assumed to be monopolistic (Krugman, 1979). Krugman (1985) also use increasing return to scale to explain trade and gain from trade by using oligopoly market structure and Cournot approaches. Increasing return to scale which lead to decreasing in costs are an independent source of both trade and gain from trade. In addition, both increasing returns and differences in factor endowments drive the pattern of specialization and trade. Therefore, the increasing return to scale can generate gain from trade in the imperfect competition market.

Even if each country has gain from trade in imperfect competition markets, unequally distributed income among firms is evident. Hence, in the early 2000s, the differences in firm's performance have been proposed in the trade theory by the name of firm heterogeneity. Melitz (2003) develops a dynamic industry model with heterogeneous firms to analyze the intra-industry effects of international trade. By allowing firms to entry and exit, they found that the least productive firms can no longer earn positive profit and therefore exit. The high productivity firms gained from entering export markets and reallocating domestic market share contributed to an aggregate productivity gain. On the other hand, consumers in the country still enjoy greater product variety from foreign firms. Although countries will lose welfare from foreign firm replacement, the negative welfare effect has been dominated by the positive contribution of the aggregate productivity gain. Therefore, trade-induced reallocations towards more efficient firms can explain the aggregate productivity gains from trade without necessarily improving the productive efficiency of individual firms. Bernard et al. (2003) also reconciles trade theory with plant-level export behavior by extending the Ricardian model to accommodate many countries, geographic barriers and imperfect competition. The greater efficiency plants are more likely to export and also have higher

[1] Economies of Scale refer here is internal economies of scale which is the cost per unit on size of an individual firm, i.e., increasing return to scale

productivity. The aggregate productivity rises from employment shift from low-productivity plants which driven out by import competition and more intensive domestic competition to high-productivity export plants.

Economic growth can benefit from international trade. At the early stage, technological progress which deviated the factor-price equalization in H-O theory had been used as the main explanation in the standard economic growth model, i.e., Solow (1956). This model explains the reason of economic growth arising from capital accumulation investment. Then, the economy has moved into its own steady state. To improve their own steady state, it required technological improvement. So, trade does not have a clear effect on growth in the economic growth model in the early stage. Nonetheless, when economists turned their interest to the endogenous growth model, economic growth can be explained by the knowledge accumulation (technology and human capital). Since knowledge can flow through business transaction, human interactions and learning from aboard, international trade can explain economic growth by knowledge transfer between countries.

Knowledge creation or innovation has occurred to profit-seeking firms to differentiate their product and generate more profit than selling in homogenous product market. Then, knowledge creation has occurred as long as firms can generate profit from them. When trade occurred, knowledge was transferred between trade partners, and knowledge spillover began. So, knowledge spillover is the most mentioned in the relationship between international trade and economic growth. To explain the knowledge spillover, Feenstra (1996) use the intermediate input as the representation of knowledge spillover between each economy. When the intermediate input has assumed to be nontradables, the relative price of small countries, compared with large country, has increased. Thus, it creates welfare loss in the economy. Even if they still gained welfare from foreign consumers in final goods, the findings show that trade only in final goods but not in intermediate inputs create low welfare. On the other hand, the relative price is lower than in autarky when the intermediate inputs are allowed to trade. Then, the welfare in small countries has benefited from both relative price and foreign consumer demand. The worth emphasizing from this study is the international trade can slow down the rate of product development in smaller countries when there is zero spillovers of knowledge. In conclusion, they pointed out that international trade without knowledge spillovers will increase the growth rate in larger countries but slow the growth rate in smaller countries. However, the international trade with knowledge spillover leads to an increase in growth rates of both countries (Feenstra, 2016). International knowledge spillovers also tend to accelerate growth in all countries, as the cost of further innovation declines in every country with advances made elsewhere. When knowledge spillovers are complete, inventors in every country are equally effective at conducting R&D (Grossman and Helpman, 1991).

Although an increase in the extent of spillovers from an arbitrary country to any others raises long-run growth rates everywhere in a many-country world economy, knowledge spillover may not lead to aggregate economic growth in those countries if countries do not create the innovation themselves (Grossman and Helpman, 2014). For example, based on H-O model, when human capital endowments are factors for knowledge creation, countries that have abundance of human capital (lower cost for innovation) will conduct more R&D to sell the differentiate products in both markets and grow faster than countries that have higher cost of innovation. In contrast, a country that is abundant in labor will reallocate to labor-intensive production that has comparative advantages. Thus, globalization can cause the growth rate of country with abundance of labor to either rise or fall depending on the positive effect from knowledge spillover and negative effect from labor-intensive activity (Grossman and Helpman, 2015).

Some studies also analyze the impact of trade liberalization directly on firm productivity. Baldwin and Robert-Nicoud (2008) consider endogenous growth model with heterogeneity firms as in Melitz (2003). They found that declining in trade cost raises the cutoff productivity level, which is needed to survive in domestic market and reduces the required productivity to compete in exporting market. Hence, trade liberalization has improved firm productivity by two channels. On the one hand, lowering trade cost will induce high-productivity foreign firms to entry in the domestic market. When domestic markets have more intensive competition, low-productivity firms have left the market, or the so-called competition effect. On the other hand, high-productivity firms can easily enter foreign markets which helps expand demand for their products. Therefore, they will get the scale effect of increasing return to scale as in the intra-industry trade explanation. Both channels can improve domestic productivity, which leads to economic growth in each country. In conclusion, trade can induce economic growth by scale effect, competition effect and knowledge spillover which is directly related to productivity.

However, it still has some studies that discuss the inefficient economic growth from international trade. Immiserating growth is a long-term phenomenon that occurs when the gain in a country's social welfare arising from economic growth is more than offset by the loss in welfare associated with an adverse shift in the terms of trade (Pryor, 2007, P.208). This phenomenon was first explained by Bhagwati (1958). It would happen in the large countries where the expansion of exports affects the world price. If the world demand curve is inelastic, the price of products will decline when export products have increased. Hence, the terms of trade in the exporting country will decrease and also lead to a decline in the country's welfare. If the decrease in terms of trade is greater than the benefit arising from economic growth, for example expansion in production frontier, the country's welfare will finally decrease. Samuelson (2004) also explains this phenomenon. If the importing country uses import-substitution policy, the term of trade of exporting country will deteriorate, especially in the inelastic demand case. Thus, it would lead to a decline in exporting country's welfare as argued by Bhagwati (1958). Even though trade may reduce the welfare from economic growth in the next period, international trade still increases social welfare in a country, especially when it is compared to the autarky level.

2.1.2 Arguments Against Trade Liberalization

In the previous section, we discussed the benefits from international trade which led to economic growth and productivity. However, there are some arguments explaining the loss from international trade and considering that trade protection is better than trade liberalization policy in some respects.

2.1.2.1 Infant Industrial Arguments

As discussed above, most trade theories tell us that free trade can improve economic growth and productivity. However, the realistic world shows us that import tariffs still have been imposed even in developed countries. One of the explanations regarding the protection is the infant industry argument. The main idea of this argument is based on the belief that economies of scale in the production process can improve economic efficiency. It also relates to comparative advantage which is the main idea of international trade. Even though the protection policy has contrast with the efficiency allocation, considering static comparative advantage, this argument can be explained by using the dynamic comparative advantage idea. So, this idea considers efficiency allocation in the long run instead of the short run as in static comparative advantage.

At the beginning, it is undeniable that products from developed countries which have high technology and lower cost can increase economic efficiency from higher productivity. Hence, the efficient solution for less-developed countries (LDC) is to import this product from developed countries. Thus, if the government does not impose any policy, firms from LDC cannot remain in this business. Protection policy, such as import tariff, could protect the firms in LDC to remain in the business by increasing imported product price in domestic market. While remaining in the business, a firm in LDC which has low technology can get the benefit from technology spillover by learning and imitating to improve their productivity. Then, their cost gradually decreases and more chance to compete with imported products. In addition, they got more benefit from increasing return to scale when they have higher market share. Hence, firm productivity in LDC will increase and often rapidly increase faster than developed countries because they have relatively low technology at the beginning. Finally, the protection policy will not be necessary because they can compete with foreign firms with their own potential and the market would become free trade at the end. Therefore, this argument claims about the benefit of dynamic comparative advantage may escalate the country's growth rate faster than the static comparative advantage by using protection policy.

In terms of welfare, countries that imposed protection policy faces a welfare loss from reduction in consumer surplus. However, after firms can improve their efficiency, the country's welfare shows greater effect than the welfare at the beginning of free trade policy from increasing in producer surplus. Therefore, the benefit from using protection policy can improve country welfare. The main criticism for this argument is the period of protection. If the efficiency improvement process takes a long time, a country will suffer larger costs from welfare loss. Hence, the benefit from efficiency improvement may not be enough to compensate the prior welfare loss.

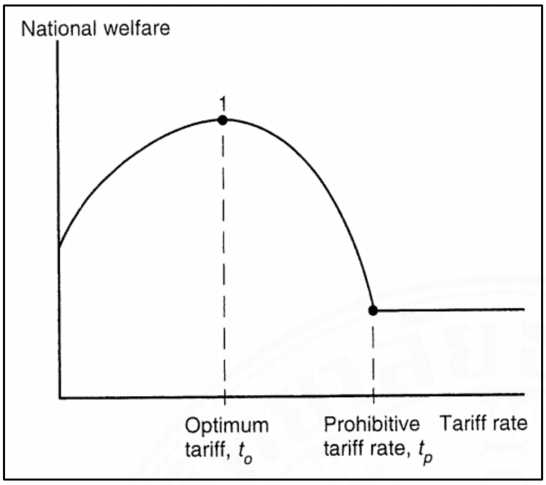
Even infant industry arguments are the most notable argument for protection policy in the government perspective, many countries that pursued the kind import-substitution strategies like infant industry argument have shown the less economic performance than the many countries in Asia that employed the export-oriented strategies. This evidence suggests the opposite view from infant industry argument which may imply that the sector that has been protected by tariff cannot improve their efficiency (Krugman, 2018).

2.1.2.2 Term of Trade Argument

The terms of the trade argument are based on cost-benefit analysis of trade protection especially in large countries that could change world prices. When tariffs are imposed, import demand and product prices decrease. Such a decrease leads to an increase in a country's terms of trade (the ratio of export price to import price), or benefits receiving from tariff protection. In some cases, this benefit is greater than the cost which distorts production and consumption in domestic markets. However, it only occurred in small tariff rate. When the tariff rate is higher, the cost of tariff will rapidly increase and faster than the benefit because of the steeper of demand and supply. Hence, tariffs will lead to the level that prohibits all imported products and have the same welfare as in autarky. Therefore, there is a level of optimal tariffs that lead to a maximum national welfare which higher than free trade case. In figure 2.1, at point 1, the national welfare for large countries is higher than free trade and also autarky. The limitation of this argument is that it can only happen in large countries that their import demand lowers world prices. It cannot occur in a small country because their demand will not be affected to world prices. In addition, an increase in large country welfare came from the loss of a partner country which means it will decrease some country welfare.

Figure 2.1

Optimal tariff and national welfare in large countries



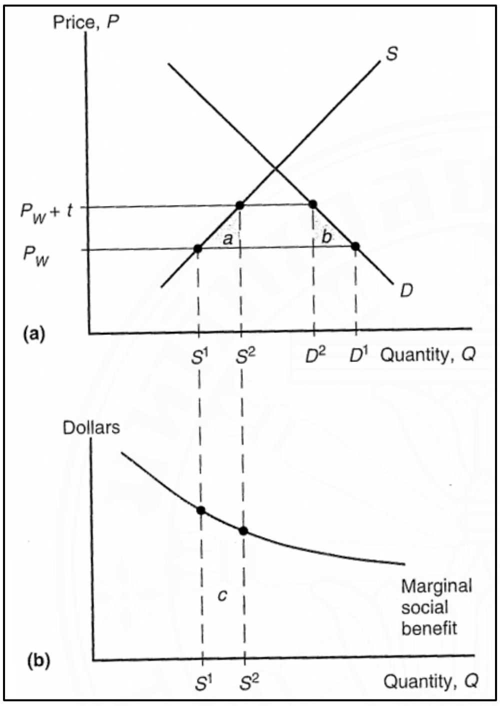
Note. From *International Economics: Theory and Policy*, by Krugman, 2018, Harlow, Pearson Education.

2.1.2.3 Domestic Failure Argument

Domestic failure argument discusses the failure which occurs in domestic market. A popular example for this argument is the marginal social benefit in the domestic market. The domestic market failure came from the missing out of the social benefit in firm production. This happens when the supply is steeper than it should be, which leads to lower quantity at all prices. When tariffs are imposed, the domestic producer can produce more products which means it can generate more social benefits to the country. Hence, if social benefit exceeds welfare loss from tariff protection, tariff can lead to higher country's welfare when comparing to free trade. In figure 2.2, if area c, which is social benefit from tariff is larger than area a and b which is welfare loss from tariff, protection policy like tariffs can generate greater welfare than free trade policy. However, this argument can be explained in the more general concept as the theory of second best. This theory has been published by Lipsey and Lancaster (1956) which stated government policy should be imposed on only one market if all other markets are working properly. If the intervention has affected other markets that already work well, an increasing welfare from the policy may be offset by the decreasing welfare elsewhere. Hence, imposing tariffs on the product that has been used in many industries may not be good ideas to solve the problem. Trade policy still has the second best policy to solve this problem. The government should solve this problem by using the first-best policy, which is domestic policy instead.

Figure 2.2

Tariff and marginal social benefit



Note. From *International Economics: Theory and Policy*, by Krugman, 2018, Harlow, Pearson Education.

2.1.2.4 Cost Discovery Argument

In some products, social returns from innovation are larger than private returns because the knowledge from discovery can easily be imitated by other firms. Also, the laissez-faire economy leads to the provision of innovation. Hence, free trade cannot induce firms to innovate their own production to generate new knowledge in economy. The government has to encourage firms to discover new innovations and increase productivity by using policy to lower their costs and increase their expected profit. Hausman and Rodrik (2003) argued that trade openness policy and institutional reform were not enough to spark a significant new wave of entrepreneurship and investment in non-traditional activities. Government has to use a variety of instruments to promote innovation by increasing the expected payoff to innovation. In addition, the government policy should discriminate between innovators and copycats to promote innovation. Trade protection can increase expected profit for innovators to discover innovation. However, it requires more export activities by domestic firms and a discriminatory policy to separate investors and copycats. Since tariff protection needs to be cancelled out at some point, trade protection policy is not an efficient way to promote self-discovery without other instruments.

Self-discovery also reflects significant economic performance in future. Hausman et al. (2007) show that specialization patterns have related to the level of economic growth. Countries that export higher productivity products have rapid growth than countries that export lower productivity products. Countries with initially high level of export productivity also show greater export growth than other countries. The key reason is the information spillover from knowledge discovery that mentioned in Hausman and Rodrik (2003). The reason that countries only produce lower-income goods (less sophisticated goods) entailed with important externalities from cost discovery. So, countries that can overcome these externalities (either from policy or self-incentive) can enjoy with the higher economic growth. Hidalgo and Hausman (2009) also show that complexity in economy can generate sustainable growth and prosperity. Country which has more capability to produce more diversified product will face less ubiquitous products in world market. Also, countries which many capabilities can be able to combine new capabilities with existing capabilities more easily than few capabilities countries. Hence, higher capabilities countries will have higher growth rate than lower capabilities.

As we discussed above, the argument against trade liberalization is commonly discussed in specific cases which either can be refuted by some explanation or require complementary policy to impose. For this reason, trade liberalization has become a popular policy to induce economic growth around the world.

2.2 Tool for Trade Liberalization

At the beginning of the open economy, countries used both tariff and non-tariff measures (or non-tariff barriers) to protect domestic industry. So, these two tools always be the main discussion about trade liberalization. Then, this section will discuss both tariff and non-tariff measures separately. In addition, the most controversial topic in this century as free trade agreements (FTAs) also discussed in this section

2.2.1 Tariff: Theoretical Perspective

The tariff on imports and exports can be separated into two types, which is the ad valorem tariff and specific tariff. The ad valorem tariff is more widely used than the specific tariff. The reason is that they are easier to aggregate and to compare and are thus more transparent, which is important when countries negotiate tariff commitments under FTAs. In contrast, specific tariffs are more difficult to compare across products since they correspond to difference in unit of measurements (Bacchetta et al., 2012).

When tariff has been imposed on imports, the imported product prices are higher than free trade which leads to a reduction in import demand. In the case of small importing countries, the reduction in import demand will not affect the price in an exporting country. Hence, the policy only affected the importing country which created welfare loss from larger decrease in consumer surplus than increasing from producer surplus and government revenue. However, in the case of large importing countries, the reduction in import demand from tariff policy has generated welfare loss to exporting country from losing their producer surplus from free trade. Even though it still benefits the exporting country when compared with the closed economy, no country wants to get less benefit from trade. Hence, it may generate retaliation and trade wars around the world. Then, the General Agreement on Tariff and Trade (GATT) was initiated to promote trade liberalization which decreased the chance of retaliation and trade wars.

Tariff policy on export has not been used since every country aims to increase their export to foreign countries. The oftenly used policy on export is the export subsidy to induce firms to export their products. The export subsidy will intervene the price of exporting product by subsidizing their prices. Then, the price of that product will be less than the price of the same good which sells in the domestic market. In small exporting countries, this price will not affect the importing country. However, for large exporting countries, export subsidy policy affected welfare in importing countries. Even though this policy gives a benefit to importing countries from larger increase in consumer surplus than decreasing in producer surplus, it still affected to income distribution in their market. In addition, this policy also affected the competitiveness in world market. For this reason, WTO allows countries to impose countervailing duties (CVD) as import tariff to retaliate against this policy. CVD is allowed to apply equally to the export subsidy policy from trading partners. When CVD has been imposed to retaliate the export subsidy, the effect of export subsidy policy has been vanished in exporting country and the resource of the export subsidy policy has been transferred to the CVD country in terms of government revenue while consumer surplus and producer surplus are unchanged.

The analysis In standard trade model by Krugman et al. (2018) also shows that export subsidized countries also lose from term of trade deterioration and from the distorting effect of its policy. In addition, foreign countries will get more benefit from this policy in terms of trade improvement. Hence, they argued that the use of export subsidies as a policy tool usually has to do with the peculiarities of trade politics than with economic logic. However, we must consider other factors which are return to scale in production and income distribution especially on producer side such as workers and investors in importing countries. Because the producer and related factor incorporated in production will be the ones who worse off from export subsidy policy such as dumping.

2.2.2 Non-Tariff Measures: Theoretical Perspective

Non-tariff measures (NTMs) are known as policy measures other than ordinary customs tariffs that can potentially have an economic effect on international trade in goods, changing quantities traded, or prices or both (UNCTAD, 2012). The classification, called the International Classification of Non-Tariff Measures (ICNTM), has been established and updated by the full name (MAST) team. The latest version of ICNTM has been published in UNCTAD (2016). It has been categorized into 16 chapters from A to P (see more detail in table 2.3). Note that the definition of non-tariff measures (NTMs) and non-tariff barriers (NTBs) is different. NTBs are the policies that induce an adverse impact on trade due to the specific discriminatory and protectionist intent such as import quota and voluntary export restraints (VER).[1] We can see that NTBs are involved with discrimination and protection propose. In contrast, NTMs covers a wide range of policy measures other than tariff rate that could affect an economy. Purposes of implementing NTMs are also broader than NTBs, including for example, consumer protection, environmental impact, etc (UNCTAD, 2019). So, we can identify NTBs as a subset of NTMs.

[1] Welfare effect from import quota is the same as in tariff analysis. The first difference is the government revenue has been replaced by quota rent. However, Quota rent can be converted to the government revenue or importing firm depend on the method that has been used. The second different is the level of protection response to the change in demand, supply and price. The quota method has more protective than tariff when domestic demand increase or world price decrease. While, tariff has more protective than quota when domestic supply increase. Voluntary export restraints (VER) are the quota on traded that imposed on export by exporting country to limit their export product. VER can cost more damage to importing country since it is working like import tariff but giving quota rent to exporting country instead of giving a revenue to importing government. (Krugman et al., 2018).

Table 2.1

Classification of NTMs in the UNCTAD Trade Analysis Information System (TRAINS)

Imports	Technical measures	A. Sanitary and phytosanitary measures
		B. Technical barriers to trade
		C. Pre-shipment inspection and other formalities
	Non-technical measures	D. Contingent trade-protective measures
		E. Non-automatic licensing, quotas, prohibitions and quantity-control measures other than for SPS or TBT
		F. Price-control measures, including additional taxes and charges
		G. Finance measures
		H. Measures affecting competition
		I. Trade-related investment measures
		J. Distribution restrictions
		K. Restrictions on post-sales service
		L. Subsidies (excluding export subsidies under P7)
		M. Government procurement restrictions
		N. Intellectual property
		O. Rule of origin
Exports		P. Export-related measures

Note. From *Guidelines to Collect Data on Official Non-Tariff Measures*, by UNCTAD, 2016, New York, United nations publication.

Since the objectives of imposing NTMs are principally not involved with protection proposals, impacts of NTMs on trade seem to be ambiguous (Cadot et al. 2018). Cadot et al. (2018) show that compliance cost of NTMs decreases import volume in destination countries. However, NTMs can increase the confidence in quality of product so that it can increase demand of that product, called “market-creating effects”. For this reason, we can find three different effects of NTMs even ad-valorem equivalents (AVEs) are positive. First there is an increase in trade volume, this results from NTM’s market-creating effects outweighing its business costs. Second is a decline in trade volume, this occurs when NTM’s business costs exceed market-creating effects. Lastly, both effects can be offset, which means trade volume will not change even though AVEs are positive.Imposing NTMs also affects the firms in exporting countries in different ways. Bratt (2017) explains that the different degrees to cope with NTMs from destination countries will affect exporters in different ways. The advantage will emerge in countries that can cope with NTMs easier. If exporter A can deal with the non-tariff measure (such as quality restriction), the fixed cost and variable cost will not sharply increase. In contrast, if exporter B cannot reach that quality, it may hoist their cost more than former exporter. Hence, with the different costs, it may affect the exporter in a different way. Exporter A will get more market share in the destination country. Meanwhile, the market share of exporter B will fade. For this reason, exporters will face different challenges from each non-tariff measure.

To sum up, imposing NTMs can have either positive or negative to trade. On the one hand, NTMs can create a barrier on import which creates compliance cost by required additional procedure or certification on importing products. On the other hand, the additional requirement can create a higher standard for importing products which creates more confidence to domestic consumers that stimulates import volume of products. Since the effect of NTMs depends on the potential of exporting firms from originating countries, NTMs could have different effects in each country.

2.2.3 Free Trade Agreement: Theoretical Perspective

The term “economic integration” is subject to varying interpretations within the economic literature, lacking a universally accepted definition. At one end of the spectrum, it may refer simply to the existence of trade relations between sovereign economies, while at the other, it denotes the complete unification of national economies into a single entity. Economic integration can be conceptualized both as a process and as a resulting condition. As a process, it involves the systematic removal of discriminatory practices among economic agents belonging to different states. As a condition, it reflects the absence of such discrimination in economic interactions across national boundaries (Balassa, 1991). Jovanovic (2015) identifies seven theoretical models of international economic integration, which need not evolve in a strictly sequential manner. The adoption of any specific form depends on the mutual consent of the participating states.

A preferential trade agreement (PTA) entails the reduction of tariffs among member states relative to those imposed on non-members.

A free trade area (FTA) eliminates tariffs and quantitative restrictions on trade among its members, while each state retains autonomy over its trade policies with external countries. To prevent trade deflection—where goods are imported into the member state with the lowest external tariff and subsequently re-exported—rules of origin are applied. Nonetheless, production deflection may occur when firms relocate production to countries with lower tariffs if such cost advantages surpass differences in production efficiency.

A partial customs union involves the Introduction of a common external tariff on trade with third countries, while internal tariffs among member states may still remain.

A customs union combines the removal of internal trade barriers with a uniform external trade policy. Member states negotiate trade agreements with third parties as a unified bloc.

A common market incorporates the elements of a customs union and extends integration to include the free movement of factors of production, along with harmonized external regulations concerning these movements.

An economic union further deepens integration by coordinating key economic policies across member states, including fiscal, monetary, industrial, and regional development policies.

A total economic union represents the most advanced stage of integration, characterized by a unified economic policy framework under the governance of a supranational authority. In such a union, there are no administrative barriers to the movement of goods, services, or factors of production, resulting in price equalization across the union, aside from transport costs.

Table 2.2

Basic theoretical forms of international economic integration

Policy action	Forms				
	Free trade area	Customs union	Common market	Economic union	Total economic union
Removal of tariffs and quotas	Yes	Yes	Yes	Yes	Yes
Common external tariff	No	Yes	Yes	Yes	Yes
Factor mobility	No	No	Yes	Yes	Yes
Harmonization of economic policies	No	No	No	Yes	Yes
Total unification of economic policies	No	No	No	No	Yes

Note. From *The economics of international integration*, by Jovanovic, 2015, Cheltenham, Edward Elgar Publishing.

Since free trade agreements have generated by a group of countries, it only removes the tariff and non-tariff measures among the member countries. However, the effect from removal tariff and non-tariff measures not only affected members but also non-member countries. Hence, trade creation and trade diversion become the most popular topic when we discuss free trade agreements. On the one hand, trade creation represents the meaning of trade that created from free trade agreement that would not have existed otherwise before an agreement. On the other hand, trade diversion represents the meaning of trade that diverted from more efficient non-member supplier to less efficient member supplier when an agreement is in effect. When FTAs are formed, product prices from member countries will decrease. Hence, product prices from non-member countries will lose their competitive power and market share has been transferred to member countries.[1] This is the reason why every country tries to engage in any FTA that they can participate. With this idea, FTA has

[1] See further analysis in Suranovic (2012).

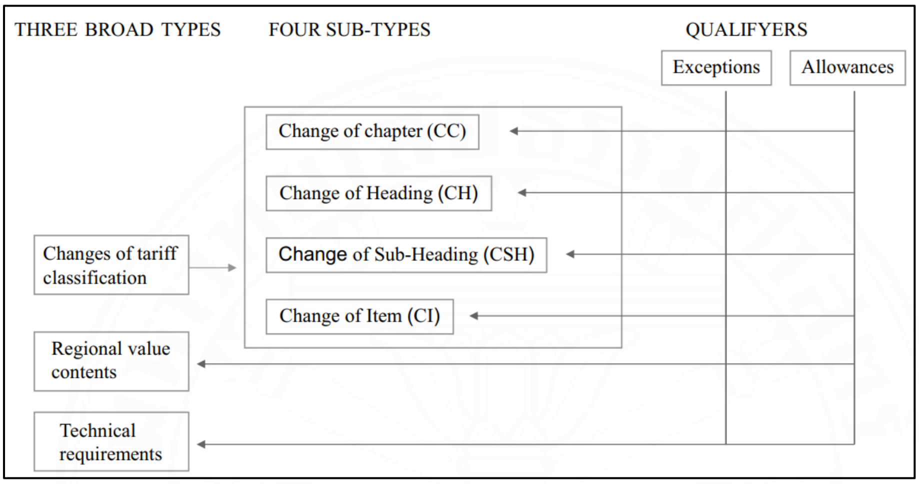
become popular trade policy in every country. Hence, the rapid FTA formed around the world lead to the other concern which is spaghetti bowl effect.

The spaghetti bowl effect has been firstly used by Bhagwati (1995) to identify the proliferation of preferential trading arrangements with discrimination depending on the nationality of a good. As we know that free trade agreement is the only initial state of economic integration, it removes tariffs and non-tariffs among member countries while external tariffs are still improved. So, the proliferation of FTA has led to many problems which are based on the different external tariff between members of FTA. It also caused the problem to rule of origin in FTA and can transmuting trade creation into trade diversion. Bhagwati et al. (1958) also emphasize that it is important to analyze the static welfare effect from FTA since the increasing number of preferential trade agreements has resulted in consistent policy implications. The systematic implication mainly came from the idea of PTA that tries to restrict or liberalize trade based on the origin of that product. Then, the different externality has led to the arbitrary behavior that nonmember product will enter the member country from the lower tariff territory member than other members. Hence, more FTA joined become more complex in the FTA effect.

Rule of origins which is mentioned as the main problem in spaghetti bowl can be divided into two board types: product-specific rules and regime-wide rules (figure 2.3). On the one hand, rules tied to specific products define the minimum level of local processing required for eligibility under preferential trade terms. The required transformation can be distinguished into three broad types: change in tariff classification (CTCs), regional value contents (RVCs) or technical requirement. The change in tariff classification (CTCs) is separated into four types related to Harmonized system (HS): modifications such as chapter (CC), heading (CH), subheading (SH), and item (CI) classifications under the HS system. Regional value contents (RVCs) refer to either the highest proportion of imported components within intermediates or the lowest permissible share of local value in the final product. Technical criteria vary widely and are often customized to serve specific or limited objectives. On the other hand, regime-wide rules specify the treatment of intermediates imported from other countries in the same bloc or countries with special status in terms of cumulation. There are three board types of cumulation: bilateral, diagonal and full. In bilateral cumulation, only materials sourced from the two participating countries are considered local inputs. Although full cumulation is more complex, it tends to be less restrictive compared to diagonal cumulation. (Cadot and Ing, 2019).

Figure 2.3

Types of Product-Specific RoOs



Note. From *How restrictive are ASEAN's rules of origin?*, by O. Cadot., and L.Y. Ing., 2019, East Asian Integration: Goods, Services and Investment, P.149.

From many differences in rules of origin as well as the different requirements to get the origin in each product on FTA, they caused further problem in the proliferation of trade agreement along with the spaghetti bowl. For example, for HS 5201.00 (Cotton, not carded or combed), the product specific rule to get the origin in ASEAN-Japan FTA is only CC. While the product specific rule in ASEAN-Australia-New Zealand FTA is RVC 40% or CC. This different requirement from each FTA can create arbitrary behavior to get the origin to entry ASEAN market. Hence, the manipulation on rule of origin can become protectionist capture (Bhagwati et al., 1998). As a result, rules of origin are categorized among the instruments of non-tariff trade regulations.

2.3 Empirical Studies

According to tariff measure studies, this section first discusses the literature review on tariff measurement following with the gain from trade liberalization. Then, we discuss the effect of NTMs both on trade volume and firm productivity. The effect of FTA will be discussed in the last section.

2.3.1 Tariffs

2.3.1.1 Tariff Measurements

Basically, tariff protection is assessed by referencing the most favored nation (MFN) rates applied by each country. The nominal rate of protection (NRP) is used to approximate the level of tariff that would generate the observed gap between local and global market prices (USAID, 2008). However, the NRP falls short in accurately capturing the extent of protection for firms or industries, as it overlooks the role of imported inputs in production. To gain a more precise understanding, the effective protection rate (EPR) is widely adopted as a tool to evaluate the overall impact of trade-related regulations and strategies.

The conventional concept behind the effective protection rate is calculated by measuring the gap between the tariff imposed on final goods and the cumulative tariffs applied to all intermediate inputs. Foundational studies by Balassa (1965) and Corden (1966), which have been widely cited, introduced this measurement commonly referred to as the effective rate of protection (ERP). This framework evaluates the level of protection for each sector by comparing the tariff costs on inputs with the protection on outputs. The two studies differ primarily in their treatment of non-traded inputs. Balassa (1965) proposed that non-traded inputs may be regarded as perfectly elastic traded goods priced at world market levels without tariffs, making them unresponsive to protective policies. In contrast, Corden (1966) asserted that value added from non-traded inputs should be incorporated alongside other domestic factors, thereby receiving equivalent protection. The ERP can yield three types of outcomes. A positive ERP indicates that the tariff on outputs exceeds that on the inputs required for production. So, it can tell us that these goods or industries have been protected by policy makers. By contrast, the negative value of ERP tells us that tariff on finished goods or outputs are less than the tariff for all intermediate inputs used in the production process. Finally, but rarely happened, when the value of ERP is equal to zero it means that the tariff on finished goods or outputs is equal to that of tariffs for all intermediate inputs that use in the production process.

However, since the concept and ideas were published 50 years ago, there are alternative explanations in different ways. On one hand, some studies compare the protection for domestic products and foreign products. Athukorala (2006) analyses the different protection policy between domestic products and exported products by using ERP to construct export bias index (EBI). The concept of export bias is protection policies that aim to protect producers in import substitution industry resulting in the bias decision of the producer in export-oriented industry. When tariff is imposed, both import substitution industry and export-oriented industry would face increasing costs from input prices. However, import substitution industry which sells products in domestic market is protected by tariffs that raise the competitor's cost in domestic market. This different effect has the probability to make biased decisions to producers in export-oriented industry to sell in the domestic market instead of foreign market. The result of EBI calculation can be reported in three different ways. First, the positive value of EBI tells us that production for the domestic market in that industry has higher benefits compared to production for export. In contrast, the negative value of EBI tells us that production for export yielded higher benefit compared to production for the domestic market. Finally, but rarely happens, when the value of EBI is equal to zero it means that there is no difference between production for the domestic market and production for export. A bit different from Athukorala (2006), USAID (2008) divided goods into 2 groups then use ERP to measure the level of protection. First, the final product that has been sold in domestic market is affected by tariffs on input and final products (called as ERPd). Another one is the final product that has been sold in international market which is affected by tariff only on input but did not get the protection from tariff on final competitive product (called as ERPw). They analyze the differences in the protection between domestic and foreign products. This concept leads to bias for the export-oriented producer who only receive burdens but did not have any protection from policy as shown in Athukorala (2006).

On the other hand, certain studies introduced modifications to the traditional ERP formula. Diakantoni and Escaith (2012) revised the method to reflect both the explicit and implicit value added embedded in the exports of intermediate and final products by applying the Leontief inverse instead of conventional technical coefficients. As a result, the adjusted ERP is capable of identifying the indirect utilization of intermediate inputs. Additionally, they decomposed the ERP to isolate the impacts of technological changes and tariff adjustments over two different time periods. By tracking variations in input-output coefficients, they could assess how changes in production technologies contributed to ERP shifts. Likewise, the influence of applied tariff variations was captured through a similar analytical approach. Based on data from 1995 to 2005, they observed that in developing nations, the sectoral value added per output unit declined due to heavier reliance on intermediate inputs, thereby reducing the overall value generated in production. The shift in applied tariffs had a clearly negative effect on both agricultural and industrial sectors, suggesting that tariff levels were the dominant factors behind the observed changes. In contrast, in developed economies, technological changes had a minimal influence on the manufacturing sector. In agriculture, however, the reduction in tariffs significantly impacted input costs more than final output prices, resulting in net benefits. Furthermore, they discovered that sectors such as chemicals, metals, computers and electronic devices, and petroleum are the most highly integrated within global supply chains, both in terms of intensity and depth of cross-industry foreign linkages. Thus, any increase in nominal protection for these industries would likely trigger cost-push effects that could propagate widely across regional production networks.

Chen et al. (2017) applied the Leontief inverse derived from the input output table, similarly to Diakantoni and Escaith (2012), to account for indirect input absorption across multiple production layers. Moreover, they adjusted tariffs by incorporating both export supply and import demand elasticities, aiming to capture the incomplete transmission of tariffs in large economies that have influence over world market prices. These refinements enabled a revised ERP model that reflects complex production chains and partial tariff pass-through effects. Their results showed that the conventional ERP tends to overestimate the level of protectionism stemming from import duties and reveals certain associations with industry-specific characteristics. In comparison, the updated ERP model aligned more strongly with macroeconomic indicators, especially in the context of China. Dao and Nguyen (2020) further dissected ERP to calculate the input tariff rate (ITR), which represents the total protection applied to intermediate goods within each sector. By using ITR, they could identify whether ERP protection primarily stems from input or output tariffs. Additionally, they expanded the ERP framework to measure protection at the provincial level in Vietnam. This was accomplished through a weighted calculation based on labor distribution across sectors located within each province. Hence, ERP proves to be a valuable tool for assessing region-specific protection levels and understanding how local tariff structures influence regional development patterns. Notably, the weighted ERP also correlated with provincial wage outcomes, using data from Vietnam's labor force surveys.

Dinh et al. (2020) also examined the extent of support provided to Vietnam's agricultural sector amid trade liberalization. They expanded the ERP framework to incorporate the value-added tax (VAT) alongside tariffs, enabling a broader measurement of protection in each industry. By doing so, their adjusted ERP accounts for the combined effects of tariff and VAT policies. Using the value-added multiplier from the input–output table, they observed that Vietnam's tax system has contributed to greater structural distortion, offering limited support for agriculture while prioritizing protection for manufacturing industries despite the fact that these industries are not currently areas of Vietnam's comparative advantage in terms of value-added contribution. Pathania and Bhattacharjea (2020) analyzed inverted duty structures (IDS) a situation where input tariffs exceed output tariffs alongside ERP, to investigate declining effective protection levels in India. Although IDS were found in several sectors, they did not appear to be linked to reductions in effective protection. The decline in ERP, instead, was attributed to a fall in value-added under free trade conditions, suggesting that certain industries may struggle to remain viable without trade barriers. Nonetheless, the authors emphasized that these outcomes are limited to specific sectors and timeframes, and should not be interpreted as proof that the industries in question are inherently unable to compete at global price levels. Notably, both Dinh et al. (2020) and Pathania and Bhattacharjea (2020) made efforts to incorporate non-tariff measures into ERP assessments but acknowledged that further investigation is needed in this area

Jongwanich and Kohpaiboon (2020) using the ERP to understand impacts of trade protection on Thai manufacturing. However, they develop the idea of ERP to capture two additional concepts. On the one hand, they applied the concept of ERP to capture the protection on the different degree of exports which affected the output tariff protection. The first ERP is water in the tariffs ERP. On the other hand, they develop the ERP to capture the FTA tariff rate which less than MFN rate by using the share of imports from FTA country. For this reason, ERP can additionally capture the protection that accounted for preferential tariff rates.

To sum up, ERP has been developed with two concerning points. First, the coefficient of intermediate inputs used in each sector has capture only direct consumption. Some paper has adjusted it by using Leontief coefficient to capture the indirect effect of consumption (Diakantoni and Escaith , 2012; Chen et al., 2017). Another concerning point is the tariff rate. With the different export shares in each sector, the studies have applied the ERP to capture their different tariffs in each sector (Athukorala, 2006; USAID, 2008; Jongwanich and Kohpaiboon, 2020). Also, some studies which mainly concern tariff rates have modified ERP by including various aspects such as value-added tax, inverted duty structures (IDS) and free trade agreement rate (Dinh et al. ,2020; Pathania and Bhattacharjea, 2020; Jongwanich and Kohpaiboon, 2020).

Table 2.3

Review conclusion for measurement of tariff protection.

Author	Main Idea
Balassa (1965)	- Traditional ERP based on the idea that non-traded inputs could be treated as if they were traded inputs in infinitely elastic supply with zero tariffs.
Corden (1966)	- Traditional ERP based on the idea that value added in non-traded inputs should be aggregated with all other value added. So, non-traded inputs enjoy the same level of protection as primary factors.

Table 2.3

Review conclusion for measurement of tariff protection. (Cont.)

Author	Main Idea
Athukorala (2006)	Export bias index (EBI): $$EBI = \left[1 - \frac{(1+ERP_d)}{(1+ERP_x)}\right] x\ 100$$ - A positive EBI implies an incentive bias against exporting (that is, a bias in favor of import-competing production) and a negative EBI implies an incentive bias in favor of exporting (a bias against domestic sales).
USAID (2008)	- The domestic ERP (ERPd) measures products sold in the domestic market. (affected by tariffs on input and final products) - The export ERP (ERPw) deals with products sold in international markets. (only affected by tariffs on input)
Diakantoni and Escaith (2012)	- Use "Leontief inverse"" to capture indirect consumptions of intermediate inputs in ERP. - Decompose the ERP component to identify the difference in each period.
Chen et al. (2017)	1. Develop ERP to capture incomplete tariff pass-through. 2. Develop ERP to capture the iterative use of inputs. 3. Develop ERP to capture both incomplete pass-through and the iterated use of inputs.
Dao and Nguyen (2020)	- Develop ERP to capture the net effects of trade protection in each industry that located in the different provinces by weighted with share of labor in each industry in the different province.
Dinh et al. (2020)	- Add the value-added coefficient of each industry measured as a weighted average of tariffs and VAT rates.
Pathania and Bhattacharjea (2020)	- Use the idea of inverted duty structure (IDS) to identify the reason of effective protection rate changing.
Jongwanich and Kohpaiboon (2020)	1. Develop ERP to capture the different share of exports. 2. Develop ERP to capture the different levels of protection from trade agreements. 3. Develop ERP to capture both different shares of exports and different levels of protection from trade agreement.

Note. Author' compilation

2.3.1.2 Gains from Tariff Reductions

To measure the gain from trade liberalization, firms' productivity always has been used to identify the gain. Amiti and Konnings (2007) estimate the effects of reducing input tariffs on firm productivity, separating importing firms from other firms. They estimated the gains of productivity from tariff reduction on both final and intermediate goods by using Indonesian manufacturing census data from 1991 to 2001. They use two estimation steps to calculate the total factor productivity (TFP) growth. First, they follow the Olley and Pakes (1996) methodology to estimate the production function because this method can take into account the simultaneity between input choices and productivity shocks and also avoided the coefficients overestimated problem in ordinary least square (OLS) methods. Then, they use the coefficient from Olley-Pakes methodology to estimate the plant-level TFP. Aiming to assign the most relevant input tariff to each industry, they calculated input tariff by weighing output tariff with cost shares of industry in each sector by using census data. The results show that the reduction of output tariff can increase productivity from inducing tougher import competition and the reduction of input tariff can raise productivity via learning, variety, and quality effects. However, the productivity gains from reducing input tariffs are much higher than those from reducing output tariffs. In addition, the importers enjoyed the same productivity gains in both concentrated and competitive industries while only firms in competitive industries gained from reducing output tariffs.

Topalova and Khandelwal (2011) study about the change in tariff and firm productivity in India manufacturing sector over 1987-2001. They use the method in Levinsohn and Petrin (2003) to construct TFP in firm level which uses a firm's raw material inputs as a proxy for the unobservable productivity shocks to correct for the simultaneity in the firm's production function. They also create a productivity index in order to compare the estimated TFP across industries. This study also further uses ERP to capture trade liberalization along with output tariff. The results show that both output tariff and input tariff reduction can increase firm productivity. Since the gains from input tariff reduction are higher than output tariff reduction, it indicates that an important way through which trade reforms induce productivity improvements is through the intermediate inputs channel. When using the ERP instead of nominal tariff, the result still shows the significant positive effect from protection reduction on firm productivity. They also found that industrial policies can amplify the impact of firm productivity from trade liberalization.

Ahmed et al (2016) examines the impact of trade liberalization on industrial productivity in Pakistan manufacturing industries over the period 1980-2006. To find the TFP, this paper used two-stages estimation following the Levinsohn and Petrin methodology to compute firm productivity. Since Pakistan initiate trade reform around 1990 and join WTO agreement in 1995, they estimate both pre-liberalization period (1980-1995) and post-liberalization period (1996-2006) to compare between each period. By using ERP and excise duty on imports as a proxy for trade liberalization, they found that both reduction in tariff and excise duty can increase TFP in both periods. However, the increase in TFP from excise duty is quite small in both periods. They also found that the effect of trade liberalization as proxy by ERP have relatively large impact on TFP in the post-liberalization period than pre-liberalization period.

Jongwanich and Kohpaiboon (2017) examine the effect of trade protection on firm productivity in Thai manufacturing sector using trans-log production function of the firm. By using OLS estimation, the tariff-exemption by BOI privileges has increased firm productivity. By using ERP as the representation of tariff protection, the results suggest that firms under higher cross-border protection have lower productivity, or the protection can hinder the process of productivity improvement. Interestingly, the negative effect of protection on productivity is higher for export firms. When separating the protection into output tariff and input tariff, they found that the decrease in output tariff only increases productivity in exporting firms. On the other hand, the decrease in input tariff will decrease non-importing firm productivity but increase importing firm productivity. The higher imported intermediate input shows greater benefit from trade liberalization on firm productivity. The significant result supports the crucial role of trade liberalization in productivity improvement. Firms, either domestic or foreign, engaging in global market participation tend to be more productive than those strictly operating in local markets. Hence, the lowering input tariffs while leaving output tariffs untouched may well significantly obstruct overall productivity improvement.

Ahn et al. (2019) estimates the impact of trade liberalization on productivity in 18 manufacturing and non-manufacturing sectors across 18 high income countries over the period 1991–2012. They construct a new tariff rate which is weighted by MFN rate, non-MFN rate and trade agreement rate. Then, they calculate the effective output rate and effective input rate by using the linkage share between each sector and import share. For TFP, they use the total factor productivity at the industry level from the EU KLEMS World KLEMS databases which provide TFP in annual measurement. The results suggest that only the reduction in input tariff can increase firm productivity whereas output tariff will not affect firm productivity. When they consider tariff with FDI, they found that input tariff reductions have a larger impact on TFP when FDI barriers are low. At the same time, the result of output tariff shows the inconsistent effect since it turns to be significant when applied with FDI. However, it shows that the estimated TFP gain from output tariff reduction is greater when FDI barriers are lower which means the presence of foreign firms amplifies the productivity gain from trade liberalization. When they applied ERP to represent tariff protection, the result still tells the same story which only input tariff reduction can increase firm productivity.

Elawa and Ezzat (2019) estimate the relationship between market trade liberalization and firm productivity in 127 manufacturing sectors in 26 countries from 1990-2013 by merging the UNIDO Industrial Statistics Database with the UNIDO Industrial Demand-Supply Balance Database. The UNIDO Industrial Demand-Supply Balance Database contains highly disaggregated data on the manufacturing sector for the period 1990 to 2015 and includes trade data. Then, they estimate sectoral total factor productivity (TFP) by Levinsohn and Petrin approach. They found that firms become more productive when they are engaged in international trade. The reduction in tariffs and the higher import penetration will increase the firm productivity. In addition, the sector size does not matter for the impact of trade openness on TFP productivity. The result did not show the different effect of TFP in medium and large sectors in the periods of trade liberalization. However, the benefit of trade liberalization is larger in the developed countries than the developing countries. This result may be caused by the different levels of productivity between these two groups.

Fiorini et al. (2019) determine the impact of a reduction in input tariffs on the productivity of Ethiopian large and medium manufacturing firms covering the period 1998-2009. To construct TFP, they apply the approach by Levinsohn and Petrin approach to correct for simultaneity bias. In addition, they apply the approach suggested by Eslava et al. (2004) and Smeets and Warzynski (2013) to calculate a firm-level price index to eliminate the output price bias. Also, they applied the approach developed by De Loecker et al. (2016) to address input price bias. They found that input tariff reduction did not affect the firm's productivity. However, when interacting with proxy of infrastructure variable such as roads, they found that tariff reduction is associated with a larger increase in productivity in firms located in towns with better roads. Without quality roads, there is no evidence that a reduction in the input tariff is associated with gains in total factor productivity for Ethiopian firms. This result implied that the trade 37ndustrializ such as road have affected the relation among these two factors in Ethiopian. On the other hand, while using revenue-based total factor productivity (TFPR), they found that a reduction in the input tariff is associated with an increase in TFPR, driven by the reduction in marginal cost for firms.

Defever et al. (2020) investigates the role of wholesalers in the relationship between trade liberalization and firm productivity in China manufacturing over the period 2000– 2006. This study used Olley and Pakes approach to calculate TFP. They found that both input and output tariff reductions can improve firm productivity. The largest effect of input tariff reduction has been shown for direct importers. The role of wholesalers also affects productivity gain. However, wholesaling of imported inputs only matters for the productivity response to input tariff cuts in indirect. Indirect importer firms did not import their input by themselves. Hence, they face higher input cost when the wholesaling share is relatively low. Meanwhile, the role of wholesalers did not affect direct importers since they can import by themselves.

Esaku and Krugell (2020) analyze the impact of trade liberalization on firm productivity growth in 6 Kenyan manufacturing sectors over periods 1992-1999. This study used Levinsohn and Petrin approach to derive a firm-level productivity. They used ordinary least squares (OLS), fixed effects (FE), and quantile regression (QR) in the estimation method. Also, they further divide the data into two, pre-liberalization (period from 1992-1995) and post-liberalization (period from 1996-1999). They found that import tariffs reduction will improve firm productivity in both pre-liberalization and post-liberalization periods. However, the effect of improvement in pre-liberalization is larger than post-liberalization periods. Interestingly, even in overall tariffs reduction will improve firm productivity, the result shows us that the effect of import tariff reduction has concentrated for those around 25th and 50th quantiles. They also investigated the effect on firm productivity growth. The result shows that reducing import tariffs significantly raises firm-level productivity growth, between the ranges of 6% and 8.2%. The result is also consistent when Ackerberg, Caves and Frazer (ACF) approach are applied to calculate TFP. However, they find that using ACF method seems to give more statistically significant estimates of productivity at the industry level than the LP method

Jongwanich and Kohpaiboon (2020) revisit the effects of industrial policy on firm productivity by using Thai manufacturing. This paper applies two definitions to measure firm productivity which is value added per worker and TFP. This study used LP approaches to calculate the TFP. This paper uses both nominal tariff protection, input and output tariffs separately, and ERP. Also, they construct ERP in 3 alternative ways to capture the export share and trade agreement. The results from both methods are consistent with each other. When using nominal tariffs as a proxy for trade protection, the result shows that only cutting input tariffs was able to stimulate firm productivity. While using ERP as proxy, the result shows that decreasing in trade protection can increase firm productivity. However, free trade agreement (FTA) which grant more trade liberalization fail to improve firm productivity. They argued that sectors which are subject to high tariffs are also often on the sensitive list in FTA negotiations. Therefore, FTA will not improve firm productivity as expected.

Cirera et al. (2021) estimate the effect of trade liberalization on firm productivity in Brazilian industrial sectors during 2000–2007. To estimate TFP, this study used Wooldridge (2009) method to estimate firm productivity. They found that the effect of decreasing output tariffs will increase export firm productivity more than non-exporting firm productivity. The intense competition in the domestic market forces both types of firms to increase efficiency. The reason for the higher productivity in export firms came from less reduction in domestic share and larger resources for investment to improve productivity when compared to non-exporting firms. On the other hand, the effect of input tariff reduction did not differ between importing firms and non-importing firms. The reason came from the more market competition, technology embodied in imported input, spillover effect and benefit from wholesalers. They also found that switching from non-exporting to exporting firms and switching from non-importing to importing firms can increase firm productivity. However, they did not find the additional benefit for the firms that are two-way traders (firms that simultaneously export goods and import inputs). In addition, their result suggests to us that the effect of output tariff reduction on firm productivity has related to the real effective exchange rate (REER). In contrast, the effect of input tariff reduction on firm productivity almost unaffected from REER.

However, the impacts of trade liberalization are ambiguous. When the reduction in input tariff shows consistent benefits to firm productivity, the reduction in output tariff does not show the same direction. Some studies show that the reduction in output tariff can increase firm productivity (Amiti and Konnings, 2007; Topalova and Khandelwa, 2011; Jongwanich and Kohpaiboon, 2017; Defever et al., 2020; Cirera et al., 2021). However, some studies show that reduction in output tariff cannot increase firm productivity (Ahn et al., 2019; Jongwanich and Kohpaiboon, 2020). The benefit of tariff reduction also related to others economic indicator. Without infrastructure, the reduction in input tariff did not affect firm productivity in Ethiopian (Fiorini et al., 2019). Foreign direct investment (FDI) can amplify the benefit from tariff reduction to firm productivity (Ahn et al., 2019). Type of firm and level of firm productivity also important to consideration (Jongwanich and Kohpaiboon, 2017; Defever et al., 2020; Esaku and Krugell, 2020; Cirera et al., 2021). Only few studies have used effective rate of protection (ERP) in firm productivity studies (Ahmed et al., 2016; Jongwanich and Kohpaiboon, 2017; Jongwanich and Kohpaiboon, 2020). In summary, input tariff reduction can improve firm productivity by lowering the cost of intermediate product. On the other hand, lowering the output tariff can improve productivity by increasing market competition in the domestic market. Hence, domestic firms have to improve their performance to compete with importing products from abroad.

Table 2.4

Preview finding of tariff liberalization on firm productivity

Author	TFP Measure	Trade protection indices	Country	Main Finding
Amiti and Konnings (2007)	Olley and Pakes (1996)	- Tariff	Indonesia (1991-2001)	- Input tariff reduction can increase firm productivity more than reduction in output tariff.
Topalova and Khandelwal (2011)	Levinsohn and Petrin (2003)	- Tariff and ERP	India (1987-2001)	- The productivity gains from input tariff reduction are higher than output tariff reduction.
Ahmed et al (2016)	Levinsohn and Petrin (2003)	- Tariff, ERP and excise duty	Pakistan (1980-2006)	- Both reduction in tariff and excise duty can increase firm productivity. - Productivity Gain from tariff and excise duty reductions are relatively larger in post-liberalization period.
Jongwanich and Kohpaiboon (2017)	Trans-log production function	- Tariff and ERP	Thailand 1996, 2006, 2011	- Decreasing in output tariff only increases firm productivity in exporting firms. - Decreasing in input tariff decreases non-importing firm productivity but increases importing firm productivity.
Ahn et al. (2019)	EU KLEMS World KLEMS databases	- Tariff and ERP	18 high income countries (1991-2012)	- Only input tariff reduction can increase firm productivity. - Input tariff reductions have a larger impact on firm productivity when barriers on FDI have lessened.
Elawa and Ezzat (2019)	Levinsohn and Petrin (2003)	- Tariff	26 Countries (1990-2013)	- Firms which engaged in international trade have higher productivity. - The benefit of trade liberalization is larger in the developed countries than the developing countries.
Fiorini et al. (2019)	Levinsohn and Petrin (2003)	- Tariff	Ethiopia (1998-2009)	- Input tariff reduction did not affect to the firm productivity without trade facility such as quality roads. - Productivity gains have founded only in revenue-based total factor productivity (TFPR).

Table 2.4

Preview finding of tariff liberalization on firm productivity (Cont.)

Author	TFP Measure	Trade protection indices	Country	Main Finding
Defever et al. (2020)	Olley and Pakes (1996)	- Tariff	China (2000-2006)	- Both input tariff and output tariff reduction can improve firm productivity. - Direct importers show the largest productivity gains from input tariff reduction. - The wholesaling of imported inputs matters for firm productivity in indirectly importer.
Esaku and Krugell (2020)	- Levinsohn and Petrin (2003) - Ackerberg et al. (2015)	- Tariff	Kenya (1992-1999)	- The productivity gain from import tariffs reduction relatively larger in pre-liberalization period when compare to post-liberalization periods. - The effect of import tariff reduction has concentrated around 25th and 50th quantiles of firm productivity. - Using ACF method gives more statistically significant estimator at industry level than using LP method.
Jongwanich and Kohpaiboon (2020)	Levinsohn and Petrin (2003)	- Tariff and ERP	Thailand 1996, 2006, 2011, 2016	- Input tariff reduction stimulates firm productivity but reduction in output tariffs is powerless to improve firm productivity. - Free trade agreements (FTAs) which grant more trade liberalization fail to improve firm productivity.
Cirera et al. (2021)	Wooldridge (2009)	- Tariff	Brazil (2000-2007)	- Productivity gains from output tariff reduction have greater in exporting firm than non-exporting firm. - The effect of input tariff reduction did not difference between importing firms and non-importing firms.

Note. Author' compilation

2.3.2 Non-Tariff Measures

To measure the NTMs, two methods have been widely used to indicate trade protection from NTMs. First, we use an indicator to measure a number of regulations or intensity of regulations. According to De Melo and Nicita (2018), they review five descriptive indicators to measure NTMs. First, the coverage ratio (CR) measures the percentage of NTMs on import volume. Second, the frequency index (FI) measures the percentage of NTMs on imported products. Third, the prevalence score (PS) measures the average number of NTMs on imported products. These three indicators are commonly used to calculate overall trade and suited to illustrate the incidence of NTMs on specific groups of products. Fourth, the regulatory intensity (RI) is used to measure regulatory intensity across countries. This indicator tells us whether a policy is equally applied to all products or targets only in some groups of products. The last one is regulatory distance (RD). It is used to measure the percentage of product combinations that are not equal across countries. The different indicators have been used for different purposes. However, the most popular indicators are the coverage ratio (CR), the frequency index (FI) and the prevalence score (PS).

Second, NTMs can be quantified as ad-valorem equivalent (AVEs). We found two broad approaches that have been used. First, the qualification based on price gap between imported prices affected by NTMs and NTMs-free imported prices. The advantage of price-based approach comes directly from quantifying price effect. However, it requires a detailed price which is uncommonly available in dataset. Second, the qualification based on quantity, called quantity-based approach. This approach is quantified by using trade data which are available and more accessible than price data.

Cadot and Gourdon (2016) estimate the AVEs for NTMs by using price-based approach to measure the AVEs in 65 countries around 2009-2012. The interpretation is based on gravity equation. The NTMs focused on this paper is sanitary and phytosanitary measures (SPS) and technical barriers to trade (TBT). They found that NTMs accounted for around 8.8 % in terms of prices. The largest effect came from TBT which accounted for around 5% following by 2.8% from SPS. They also find the relationship between regional trade agreements and the price effect from NTMs. They found that trade integration can reduce AVEs of SPS and TBT measures by about 25%. They also separate integration into 5 clauses by instrument. Their result suggests that an alternative and more sensible route to improve regulations is to encourage regional cooperation through mutual recognition of regulations.

Cadot and Ing (2017) quantified the NTMs by using price-based approach and gravity-like model to quantify the AVE of NTMs in 85 countries over the period 2013-2015. They particularly focused on technical measures classification of NTMs. On the one hand, they proxy NTMs in agricultural sector by using sanitary and phytosanitary measures (SPS). On the other hand, they use technical barriers to trade (TBT) as a proxy for NTMs in the manufacturing sector. The result tells us that the AVEs for TBT measures on manufactured sector have less dispersion within ASEAN, compared to the AVEs for SPS measures on agricultural sector. The AVEs for TBT measures on manufactured products only accounted for around 3% to 5% while the AVES for SPS show dispersion effect of NTMs within the range 4% to 16%. For Thailand, they show that AVEs for SPS measure in agricultural sector increased prices around 11.7 %. At the same time, AVEs for TBT measure in manufactured sector increased prices around 4.5 %.

Cadot et al. (2018) interpret the AVEs of NTMs by using both price-based approach and quantity-based approach on 86 countries over period 2011-2018. This study focused on 4 types of NTMs which are sanitary and phytosanitary measures (SPS), technical barriers to trade (TBT), border control measures (PSI), and quantity restrictions (QRs). For the price-based approach, they use OLS to estimate the result because price data is no zero observation. However, in quantity-based approach, they used PPML which can deal with zero-trade observations. In both approaches, they use the gravity idea to estimate the impacts. Combined these two approaches, they can use the result from price-based approach to identify the large set of ad valorem tariffs (AVEs) and use the result from quantity-based approach to identify the information of affected to trade volume. They found that the variability of AVEs for SPS measures in the agri-food sector is higher than that of TBT measures in manufacturing. Even the AVEs of technical measures can be accounted as compliance costs, higher AVEs do not necessarily reflect more severe distortions to economic welfare. It may imply that producers substantial must alter design of their products or upgrade the quality which would help improve social welfare from the unregulated market equilibrium. The origin-composition effect is one reason why they have different average AVEs, even though they apply the same regulations. The country importing more highly sensitive products will have a mechanically higher average AVE for SPS measures than a country that imports fewer sensitive products. For the volume effects, it can show either positive or negative depending on the relative strength of compliance-cost versus demand-enhancing effects. Thus, we cannot treat the positive volume effect from NTMs as a bias because it shows that market-creating effects outweigh compliance-cost effects. The result suggests that the technical measure can create demand-enhancing effect even if they raise prices. In contrast, non-technical measures raise prices while reducing volumes. Therefore, these results implied that some business receives benefits from trade NTMs even when the price raised.

Ghodsi et al. (2016) uses quantity-based approach to estimate ad valorem equivalents of NTMs by applied gravity approach on 100 WTO countries over the period 2002-2011. They estimate AVEs of NTMs by using 10 classifications from MAST. In the modelling, they use two variables for NTMs for control the other effect away from their interesting NTMs type. Therefore, they can separate report AVEs for each NTMs from their result. On average, the most three NTMs that affected the price are antidumping (ADP), safeguard (SG) and specific trade concerns on technical barriers to trade (STC_{TBT}) which all occur to counter the imposed NTMs from trading countries. Interestingly, all of the effects from NTMs except quantitative restrictions (QRS) and specific trade concerns on sanitary and phytosanitary measure (STC_{TBT}) have larger effect than tariff. Also, they found that richer countries apply more NTMs than poorer countries, but they only observe smaller effects of NTMs for richer countries compared to poorer countries.

Bratt (2017) estimates the effect of NTMs on trade by using quantity-based approach by applied gravity idea. They pointed out that using ordinary least squares (OLS) can be biased in the presence of heteroskedasticity and zero trade flows. Therefore, they instead use Poisson pseudo-maximum likelihood (PPML) method which can treat the problem better than OLS. They also include the comparative advantage in their modelling to capture the relatively factor endowment. The result from 81 countries around 2000-2003 suggests that low-income countries impose more trade-restrictive type in NTMs than middle-income and high-income countries. The AVEs of NTMs in low-income countries are also higher than in the other two groups.

Even low-income countries do not face many NTMs in relative terms, the ones they do impose tend to be particularly trade restrictive. At the same time, low-income exporters seem to be more adversely affected by NTMs than middle-income and high-income exporters. Because it is easier for higher income countries to meet standards and regulations that are imposed by other countries. Then, the estimated AVEs for high-income importers are lower than low-income importers.

Ronen (2017) studies about the relationships between NTMs and tariff in 61 countries from all continents in 2001-2003. They use quantity-based approaches to estimate an AVEs of NTMs and then use the result of AVEs to find the relationships between tariff and non-tariff measures. They found that the highest AVEs of NTMs are the middle-income countries, followed by the high-income countries. In addition, they found that tariffs have a statistically significant and negative correlation with the import policy to impose NTMs. The decrease in the tariff rate leads to an increase in the AVE of NTMs in low-income countries and middle-income countries. Therefore, they argued that the countries which agreed to lower tariffs during the Uruguay Round negotiations should subsequently replace some of this liberalization with a stringent NTMs regime. Their result also suggests that the decrease in tariffs of 1% has led to a 4.7% higher AVE of NTMs. They also compare the results between the agricultural and non-agricultural sectors. The result shows that the 1% tariff reduction in non-agricultural sectors has raised the restrictiveness of NTMs greater than agricultural by around 5.7%. Additionally, they found that the scale of substitutability diminishes gradually the more developed a country is. The result pointed out that higher income countries are less likely to compensate for tariff elimination by growing the restrictiveness of NTMs to substitute the cost from tariff elimination.

Niu et al. (2018) estimate the AVEs of NTMs in 97 countries over the period 1997-2015 by using a quantity-based approach. They separate the effect of agricultural domestic support and compare it with the core NTMs. They also decompose the effect on NTMs into country specific factors and tariff line specific factors in their modelling approach. Since they use the nonlinear least square methods, they can apply the exponential functions to capture the effect of NTMs and agricultural domestic support in their model. They found that the frequency or incidence of core NTMs was greater for agricultural products than for manufacturing goods. They found that the most frequently used NTMs are technical measures in agricultural sector. However, less than 25% of products in these industries are affected by technical measures, price control measures and quantity control measures. The result shows that average AVE of NTMs protection rose from 20% in 1997 to 57% in 2015 when tariff rate has fallen from 12% to 5% at the same time. The share of NTMs in overall protection, tariff plus NTMs, has risen from 70% in 1997 to 90% in 2015. In general, the AVEs are higher for agricultural products than for manufacturing products. In contrast with tariff rate declining, overall protection from NTMs is higher in all regions, except for Sub-Saharan Africa. Especially after 2006, NTMs protection rose sharply across all regions. NTMs in high income countries rose more sharply than middle- and low-income countries. They argued that the evolution of tariffs fails completely to reflect the changing stance of trade policy in this period.

Nguyen et al. (2020) argued that the traditional method to compute the AVEs of NTMs may be biased and create misleading interpretation. They proved the idea by using a quantity-based approach to quantify the coefficient of NTMs in 115 importing countries from 2009 to 2018. They pointed out that the exponential function in AVE calculating is non-linear so the calculation as in traditional is biased. To avoid this bias, we should apply Jensen's inequality. Their results show that ignoring Jensen's inequality may affected trade volume. When applied Jensen's inequality is switched the positive trade effect to negative. For this reason, the bias is significant and tends to underestimate the restrictive effect of non-tariff measures.

Dolabella (2020) uses the quantity-based approach to estimate the AVEs of NTMs in 64 countries between 2001 and 2015. By using gravity model, they include export share, import share of trading partner in world market. Also, they control preferential trade agreements and WTO member in their modelling. In the interpretation, they drop the extreme value to reduce the influence of outlier which under the 1% percentile and above the 99% percentile of the entire distribution. Their results show that TBT measures seem to be more restrictive than SPS measures. Imposed TBT measures associated with a reduction of 1% to 2% in trade volume. However, imposing SPS measures had a positive effect on trade of around 0.8% but the distribution of SPS effects is relatively around zero compared to TBT. Their result suggests that NTMs have larger effect on trade volume in lower income countries in both import and export sides. They argued that when individual countries want to implement a specific policy affecting a particular product or group of products, taking into account the particularities of the country-product in question is better suited than large number of products and countries.

Sanjuan et al (2021) estimated the AVEs of NTMs in African countries by using quantity-based approach in gravity-based model. The data set contains 92 countries from period 2012-2018. They also use an indirect characteristics approach to account for the possible heterogeneous trade impact by interacting the NTMs variable with sectoral trade shares. Additionally, to compare the effect from intra-African trade to trading partner, they also decompose the effect of intra-Africa trade from AVEs of NTMs. They find the systematic trade restricting effect from both technical and non-technical measures. The result tells us that non-technical measures have more trade-restrictive and costly for bilateral trade than technical measures. However, the AVEs of NTMs for non-technical measures have majority less than 5%. The AVEs result also show that NTMs have greater affected to trade reduction in African partner countries in both import and export when compared to the other trading partners. They argue that the main policy actions address the importance of non-technical measures on the intra-African trade.

Akintola et al. (2021) estimate the effect of NTMs in the Indian Ocean Rim Association which include Australia, Southeast Asia, South Asia, West Asia, Eastern Africa and Southern Africa. This dataset contained 11 IORA countries between 2009 to 2015. They used quantity-based approach in gravity-based models. However, they also include the interaction term between NTM and factor endowments in the calculation for AVEs. This study only considers 4-types of NTMs which are SPS, TBT, QR and SG. Their results show both positive and negative AVE estimates on import value which mean NTMs had both import-facilitating or import-restricting effects. They found that the imposed SPS measures were mostly import-restricting effects, while the TBT measures had an import-facilitating effect across all countries. In addition, the restrictive effect of SPS seems to be higher in the high-income countries of the region than in middle- and low-income countries. Although, AVEs for QR show the greater effect on the average which related to highly imposed measures on manufacturing sectors. The results tell that QR and SG measures have higher AVEs than SPS and TBT even though the latter two are imposed more on agricultural products. This result may suggest that the number of measures do not necessarily translate to strong restrictions.

The empirical results between NTMs and productivity are still ambiguous. Some groups of studies show the negative relationship among NTMs and firm productivity. Goldar et al. (2020) assess the impact of India's trade liberalization during 1998-2010 on manufacturing firms' productivity. This study uses the Levinsohn and Petrin approach to estimate TFP in Indian manufacturing sector. They also estimate TFP in both gross output specification and value-added specification. They found that decreasing in tariff protection can increase firm productivity in both NRP and ERP. The effect of the decrease in tariff protection also consistent across different methods since OLS, 2SLS and 3SLS report the same relationship. In addition, not only tariffs, but relaxing quantitative restrictions can improve firms' productivity as well. However, the effect of quantitative restrictions is sensitive to the modelling. When comparing the effect of input tariff and output tariff, they found that only reduction in output tariff can increase firm productivity. This result contrasts with the finding of previous studies that input tariff will improve firm productivity. Lastly, they found that the greater share of imports can increase firm productivity along with tariff reduction.

Elisabeth et al. (2020) focused on the effect of NTMs in imported intermediate input on labor productivity and firms' profitability in Indonesian manufacturing sector over the period 2010-2015. Labor productivity has been proxied by value-added per labor which is the difference between real output and real intermediate inputs divided by total employment. NTMs have been measured by covered ratio (CR) and frequency index (FI). The result suggests that NTMs has decreased labor productivity and profit in Indonesian both in term of covered ratio and frequency index. Both output tariff and input tariff show the negative effect on labor productivity and profit. Decrease in output tariff increases productivity by increasing market competition. Meanwhile, decrease input tariff will increase productivity by creating higher quality products, market accessibility and variety of imported intermediate inputs. Shepotylo et al. (2022) explore the effect of non-tariff measures (NTMs) on firm productivity in the food-processing industry in Ukraine over 2008-2012. They use frequency index to measure the NTMs on each product at HS 6-digit category. Firm productivity has been calculated from Levinsohn and Petrin (2003), and Ackerberg et al. (2015). They found that 1% increase in input NTMs is associated with 1.2% lower TFP while output NTMs can reduce TFP by 1.5%. They also found that only importers have experienced decreasing productivity while non-importing firms did not. This implies that the negative effect of NTMs has not been spillover to the entire industry. When NTMs are imposed, only most productive firms can generate the profit in Ukraine. Input tariff also shows negative effect to firm productivity as well as NTMs. This result also shows that the effect of productivity depends on the measurement methods since the effect of quantity-based productivity measures is likely to be negative compared to revenue-based productivity.

Some studies show the positive relationship between NTMs and firms' productivity. Ghodsi and Strehrer (2022) also examine both direct and indirect effects of both directly and indirectly trade policy on labor productivity growth in 41 countries from 2002 – 2011. Labor productivity has been calculated from Cobb-Douglas production function. This study used both direct and indirect measures to identify the NTMs effect. Also, they measure NTMs by using both in terms of measure and ad-valorem equivalent. They found that NTMs did not affect labor productivity growth directly. However, NTMs that are imposed on non-services sector can increase labor productivity growth indirectly. Navaretti et al. (2023) explore the effect of tariff and non-tariff measures in 15 EU countries between 2001-2012. This study used labor productivity which provided by CompNet dataset. They consider Technical Barriers to Trade (TBT) as a proxy of NTMs. The result found that an increase of 1% in the tariff is associated with 49 ndustse of 0.019% in the average productivity. Whereas an increase of 1% in the TBT measure is associated with an increase of 0.03% - 0.006% in the average productivity. The positive efficiency effect only occurs in more productive firms, while less productive firms face decreasing in productivity.

However, some studies argue that the relationships between NTMs and firm productivity relies on the type of NTMs. Gupta (2021) inspects the impact of trade policy shocks to firm's Total Factor Productivity (TFP) both in term of tariff, non-tariff and free trade agreement in Indonesian firm over 2008-2012. Levinsohn and Petrin (2003) is used to measure TFP in this study. NTMs indicator has been proxied by the coverage ratio on sanitary and phytosanitary (SPS) and technical barrier to trade

(TBT) measures. They found that an increase in SPS has decreased firm productivity while TBT has increased firm productivity. Tariff also shows the negative impact on firm productivity. Larger firms show greater ability to manage the negative effect from trade policy which imply the heterogenous effect of globalization among firms in Indonesia. Cali et al. (2021) examine the effect of non-tariff measures to productivity and markups in Indonesia during 2008-2015. Indonesian productivity has been measured by Ackerberg et al. (2015). NTMs have been measure by the share of products within an industry. They found that tariffs harm technical productivity through both input tariff and output tariff. However, the negative effect of output tariff has been offset by the positive impact of markups. Indonesian productivity is also insignificantly affected by NTMs both from input and output. This result implies that the quality improvement from NTMs has been counteracted by compliance cost effect.

Some studies show the indirect relationships between NTMs and firm productivity. Liu et al. (2020) estimate the effect of output trade liberalization on firm productivity in Chinese manufacturing sector from 2004 to 2006. This paper used firm productivity from Chinese Manufacturing Firms Survey (CMS) which is an annual survey of manufacturing enterprises in China. Using nominal tariff rate, they found that firm productivity in China has increased when tariff decreases. They also found that the effect of trade liberalization is larger for firms with more training investment. Note that when the applied LP approach and OP approach in TFP calculation, they did not find the effect of firm productivity from output trade liberalization. However, when they drop the firm that related to non-tariff barriers out of sample, they found that output trade liberalization can boost firm productivity in China. Therefore, non-tariff barriers which is a subset of NTMs must be added in consideration when study about the relation between trade liberalization and firm productivity

Instead of using productivity, some studies used other alternative indicators to identify the quality of products and variation of trade partners. Hu et al. (2019) identify the effect of technical barriers to trade as child-resistance policy from EU on China cigarette lighter export performance between 2001-2010. The policy change has been proxied by dummy variable. They found that the quality did not increase in the transition period, but quality increased later. The quality improvement not only improves complying with the requirements but also stimulates to improve in other dimensions. This result implies that quality NTMs Policy can generate the dynamic of improvement in exporting firms. However, China ‘s export has decreased from NTMs policy since exporters have to compete in high-quality product market that was not comparative advantage of Chinese. An increase in quality and a decrease in export volume only occurred in the low-quality firms which have to improve their quality to meet the requirement. NTMs from EU policy also caused low productivity firms to exit EU exporting market while high productivity firms can survive in this market. Ghodsi and Stehrer (2022) assess the impact of TBTs and SPS measures on the quality of traded products in 151 countries between 1995-2011. They found that TBT and SPS measures strongly affect the quality of traded products. The result also shows that a higher quality of traded product has increased in the year that it imposed. The impact on the quality of products from TBT depends on the available at that moment. In contrast, the impact on quality of products from SPS has shown largest effect in imposed year. An additional TBT imposed on a product which traded bilaterally can improve the quality of that product by 0.09%. However, the effect of the newly imposed SPS policy did not show a significant effect on that year. The effect of quality improvement also shows the variability effect between industries. Hu et al. (2021) investigate the impact of NTMs on China’s firm imports over 1978-2012. This study used coverage ratio of NTMs to represent NTMs and separate NTMs into trade policy that NTMs increase the price and public policy that NTMs increase quality. They found that NTMs in China’s trade policy decrease the import volume depends on characteristic of imported product in each industry. Whereas NTMs in public policy induce China import volume especially in high technology intermediate product from both developed economies and developing economies. Both of China’s trade policy and public policy NTMs increase the import varieties of high-tech intermediates but reduce those of low-tech intermediates. NTMs in public policy can upgrade the quality of imported intermediates in all sectors while NTMs in trade policy sometime reduce the quality of product.

To conclude, NTMs can create the barrier to entry for low productivity firms and filter out low quality producers from the market. Also, it can stimulate surviving firms to improve their innovation and technology which leads to higher productivity (Fontagne, et al., 2015). Excessively stringent NTMs can reduce market competition which may be harmful to overall market efficiency (Crivelli and Groeschl, 2016). The different effects of NTMs on firm productivity mainly come from individual performance or firm heterogeneity. In addition, NTMs also enforce product quality standards and safety regulations which force firms to upgrade their technology and production processes. However, poorly design NTMs can increase compliance costs which disproportionately affects smaller firms

Table 2.5

Preview finding on non-tariff measure.

Author	Focusing point	Country	Main Finding
Cadot and Gourdon (2016)	Price-based approach	65 Countries (2009-2012)	- Trade integration can reduce AVEs of SPS and TBT measures around 25%.
Cadot and Ing (2017)	Price-based approach	85 Countries (2013-2015)	- SPS measures show dispersion effect of NTMs with the wide range of effect when compare to TBT measures.
Cadot et al. (2018)	Price-based approach & Quantity-based approach	86 Countries (2011-2018)	- The origin-composition effect can explain the different effect in AVEs. - The volume effect can show either positive or negative depending on the relative strength of compliance-cost versus demand-enhancing effects. - While technical measure can create the demand-enhancing effect, non-technical measures cannot increase trade volumes.
Ghodsi et al. (2016)	Quantity-based approach	100 WTO countries (2002-2011)	- NTMs policies often use to counteract NTMs that imposed from trading country. - Only 2 out of 10 NTMs have shown larger effect to trade than tariff. - The richer countries apply more NTMs than poorer countries. However, they only observe smaller effects of NTMs for richer countries when compared to poorer countries.

Table 2.5

Preview finding on non-tariff measure (Cont.)

Author	Focusing point	Country	Main Finding
Bratt (2017)	Quantity-based approach	81 Countries (2000-2003)	- Low-income countries impose more trade-restrictive type in NTMs than others country groups - AVEs in high-income importers are lower than low-income importers.
Ronen (2017)	Quantity-based approach	61 Countries (2001-2003)	- The highest AVEs of NTMs has shown in middle-income countries. - The countries which agreed to lower tariffs during the Uruguay Round negotiations have replaced with stringent NTMs policies. - However, higher income countries have less likely to compensates for tariff elimination by growing NTMs policies.
Niu et al. (2018)	Quantity-based approach	97 Countries (1997-2015)	-The average AVEs of NTMs was rose from 20% in 1997 to 57% in 2015 when tariff rate has fallen from 12% to 5% at the same time. - The share of NTMs in overall protection, tariff plus NTMs, has raised from 70% in 1997 to 90% in 2015. - NTMs in high income countries rose more sharply than middle- and low-income countries. - Only tariffs cannot completely represent the protection policy in this era.
Nguyen et al. (2020)	Quantity-based approach	115 Countries (2009-2018)	- The exponential function in AVEs calculation is non-linear, so, the calculation as in traditional was biased. - Ignoring Jensen's inequality may affect to the relation on trade volume.
Dolabella (2020)	Quantity-based approach	64 Countries (2001-2015)	- TBT measures have more restrictive than SPS measures. - NTMs have more affected to trade volume in lower income countries in both import and export sides. - Country and product characteristic are important in AVEs calculation.

Table 2.5

Preview finding on non-tariff measure (Cont.)

Author	Focusing point	Country	Main Finding
Sanjuan et al (2021)	Quantity-based approach	92 Countries (2012-2018)	- Non-technical measures have more restrictive and costly to trade than technical measures. - NTMs have larger effect in Intra-African trade partners than trade with other countries
Akintola et al. (2021)	Quantity-based approach	11 Countries (2009-2015)	- While SPS measure are the most import-restricting effect to trade, TBT measures has import-facilitating effect to trade. - The restrictive effects of SPS from high-income countries are larger than middle- and low-income countries. - Numbers of measures do not always show the restriction level.
Goldar et al. (2020)	TFP measure by Levinsohn and Petrin (2003)	India (1998-2010)	- Decreasing tariff protection can increase firm productivity. - Relaxing quantitative restrictions (QR) can improve firm productivity. - While output tariff reduction can increase firm productivity, input tariff reduction did not increase firm productivity.
Elisabeth et al. (2020)	TFP measure by Labor productivity	Indonesia (2010-2015)	- NTMs has decreased labor productivity and firm profit in Indonesian. - While decreasing output tariff only increases firm productivity by stimulated market competition, input tariff reductions increase firm productivity by creating higher quality product, market accessibility and variety of imported intermediate inputs.
Shepotylo et al. (2022)	TFP measure by- Levinsohn and Petrin (2003), - Ackerberg et al. (2015)	Ukraine (2008-2012)	- Imposing NTMs in output can decrease firm productivity larger than NTMs in input - The negative effect of NTMs has not been spillover to the entire industry since it only limited to importer.

Table 2.5

Preview finding on non-tariff measure (Cont.)

Author	Focusing point	Country	Main Finding
Ghodsi and Strehrer (2016)	TFP measure by Labor productivity	41 countries (2002-2011)	- NTMs did not directly affected to labor productivity growth. However, NTMs that imposed on non-services sector can increase labor productivity growth indirectly
Navaretti et al. (2023)	TFP measure by Labor productivity	15 EU Countries (2001-2012)	- While decreasing tariff only reduced small size firms, decreasing in TBT can also increase number of large firms in market. - Whereas increasing in tariff decreased firm productivity, increasing in TBT measures increase firm productivity.
Gupta (2021)	TFP measure by Levinsohn and Petrin (2003)	Indonesia (2008-2012)	- While imposed SPS has decreased firm productivity, imposed TBT has increased firm productivity. - Larger firms have greater ability to mitigate the negative effect of trade policy when compare to smaller firms
Cali et al. (2021)	TFP measure by Ackerberg et al. (2015)	Indonesia (2008-2015)	- input tariff and output tariff reduction can increase firm productivity. - However, input and output NTMs reduction cannot increase Indonesian firm productivity.
Liu et al. (2020)	TFP measure by- Chinese Manufacturing Firms Survey - Levinsohn and Petrin (2003) - Olley and Pakes (1996)	China (2004-2006)	- Firm productivity in China has increased when tariff decrease. - However, NTB has played an important in relation between tariff and firm productivity.

Table 2.5

Preview finding on non-tariff measure (Cont.)

Author	Focusing point	Country	Main Finding
Hu et al. (2019)	- Quality improvement	China cigarette lighter (2001-2010)	- NTMs policy that require higher quality product did not suddenly increase product quality in the transition period, but quality will increase later on. - NTMs policy did not improve quality only imposed product; it also improves other product quality. - NTMs only reduce trade volume in low-quality firms which quality of product did not meet the requirement.
Ghodsi and Stehrer (2022)	- Quality of traded products	151 Countries (1995-2011)	- The impact on quality of products from TBT depend on the available at that moment. In contrast, the impact on quality of products from SPS has shown largest effect in imposed year.
Hu et al. (2021)	- Intensive margin - Extensive margin	China (1978-2012)	- While imposing NTMs in China trade policy decrease the import volume, imposing NTMs in public policy induce import volume especially in high technology product. - NTMs in both trade policy and public policy can increase variability of imported high-tech products but decrease variability of imported low-tech products. - Whereas NTMs in public policy can upgrade quality of imported intermediates in all sector, NTMs in trade policy sometime reduce the quality of product.

Note. Author’ compilation

2.3.3 Free Trade Agreement

Even though free trade agreements have been studied for a long time, recent study find the different results of FTA on trade. On the one hand, FTA can increase trade between each other. Agung et al. (2019) estimate the effect of ASEAN-Korea free trade agreement (AKFTA) on Indonesia import using gravity model. This study used Indonesia import data from 10 countries in AKFTA between 2007-2016. They found that tariff elimination from AKFTA agreement increased Indonesia import by 34 percent. Also, Ramaswamy et al. (2021) evaluates the performance of Free Trade Agreements (FTAs) by analyzing the determinants of trade flows between 31 Asian economies during 2007–2014 using gravity model. In the estimation, they used Pseudo-Poisson Maximum Likelihood (PPML) estimation methods to avoid the inconsistent and inefficient estimates from the OLS. This study estimates five free trade agreements: AFTA, APTA, Gulf Cooperation Council (GCC), SAFTA and CISFTA. They found that all five-trade agreements can increase the trade volume.

Harada and Nishitateno (2021) measure trade creation effects of free trade agreements from wine trade in East Asia, particularly in Japan, China and South Korea. They used gravity equation with the Poisson pseudo-maximum likelihood technique to estimate wine import from 27 trading partners between 1990 to 2016. They found that a 1 percentage point reduction in preferential tariff rates led to an increase in wine import volumes by 4.2%. Meanwhile, interestingly, a 1 percentage point reduction in MFN tariff rates only led to an increase in the wine import volumes by 0.6 % but was statistically insignificant. They also found that wine imports were smaller when non-tariff measures were imposed. The estimated trade creation effects of tariff reductions under FTAs are statistically significant larger than those of MFN tariff reductions. This may show that bilateral trade agreements may be more efficientives than multilateral trade agreements. Dadakas et al. (2020) examine the trade policy in United Arab Emirates (UAE) over the period 2002–2016. The estimation covers 32 exporting countries and 211 trading partners by using gravity equation. They found that FTA can stimulate export volume when both trading countries have trade agreements. However, the magnitude of the effect is different depending on estimation technique. They also argue that, for UAE, recently FTAs do not appear to have had a positive impact on UAE’s export value. UAE should focus to expand the trade to large markets by using FTA and also needs to re-examine implementation methods, incentives and terms of using FTA.

On the other hand, some studies also find inconclusive result. Abbas (2018) explores the effect of free trade agreements (FTAs) on international trade flow of Pakistan. The estimation used gravity equation by covering 47 trading partners from 1980 to 2016. In estimation, they consider 6 FTA partners with Pakistan: USA, China, Indonesia, Malaysia, Sri Lanka and Mauritius and South Asian FTA. They found that only FTA with China and Indonesia did not have an impact on Pakistan exports. On the other hand, FTA with USA did not affect Pakistan imports. Interestingly, regional trade agreement such as SAFTA has decreased both imports and exports of Pakistan. The results from this study request more focused in FTA effect as mentioned in Spaghetti bowl phenomenon. Karkanis and Fotopoulou (2021) identify trade integration and structure effects on bilateral trade between China and trading partners. The estimation using gravity equation with OLS and PPML by covered 196 Chinese trading partners over the period 1995 – 2018. They found the inconsistent effect of FTA on Chinese merchandise imports. It shown both positive and negative effects from FTA on Chinese import volume. However, it may occur from omitted variable, for example domestic policy, since China has shown rapidly development among estimation periods.

Some studies explain the effect of FTA by using trade creation, trade diversion and volatility. Timsina and Culas (2020) estimates the agricultural trade creation and export diversion effects of Australia's free trade agreements (FTAs). The estimation includes 24 Australia trade partners comprising both FTA and non-FTA members covering 22 years from 1996 to 2017 by using Poisson pseudo-maximum-likelihood (PPML) estimation. All ten FTA with Australia has been included in the estimation model. The result also suggests that PPML has also provided more robust results compared to OLS. Three largest trade creations in Australia were FTAs with China, United states and Korea. In pooled estimation, only FTAs with Thailand, Singapore and New Zealand did not show trade creation. The reason is that FTAs with Singapore and Thailand has been dominated by the ASEAN-Australia-New Zealand that was formed later. For FTA with New Zealand, FTA cannot increase trade volume only at the initiate state of FTA. However, overall, FTA in Australia has shown trade creation in both aggregate and disaggregate levels. Also, each FTA has shown different effect between industry sectors. Hence, these results show an important evidence for spaghetti bowl effect that the more FTA signed has generate complicated impact in FTA analysis. Jagdambe and Kannan (2020) analyze the trade creation and trade diversion effects of agricultural sectors in countries which participate in either SAFTA, AIFTA, NAFTA, MERCOSUR and EU. This study estimates 50 countries over the period 2005 – 2014 by using gravity equations with OLS and PPML. They found that members in AIFTA have benefited from both trade creation and trade diversion effects, with respect to both OLS and PPML estimations. However, the magnitude of the effects depends on estimation method. The EU and MERCOSUR FTA also generated trade creation among their members but did not generate trade diversion. For other FTAs, they also found inconsistent results when compared to the result from both methods.

Linarello (2018) examines the effect of a reduction of foreign tariffs from FTA on the productivity of supplier industries of Chilean exporters. They especially focus on the period of three Chilean important FTA with E.U., United States, and Republic of Korea that went into force between 2003-2004. They found that tariffs fall on average by 5.2 percent after entry into force of the FTAs. This study used methodology proposed by Eslava et al. (2004) and Wooldridge (2009) to estimate firm productivity. By using 2001 to 2007 firm data, they found that productivity increases for Chilean firms came from both directly and indirectly effect of FTA. However, the increase in productivity from the indirect effect is higher than the direct effect. Both the comparative advantage and disadvantage sectors have shown higher productivity, but larger for the comparative advantage sector. Industries that produce more differentiated products have shown higher productivity gain from tariff reduction when compared to the lower differentiated product industries. It also shows a spillover effect to non-exporting firms since productivity of non-exporting firms has increased. An increasing demand from FTA implemented induces firms to increase machinery capital stock accumulation. In Chilean industry, they found that the reallocation of resource plays an important role to improve firm productivity. Jamil et al. (2022) analyze the impact of Pakistan-China Free Trade Agreement on Pakistan textile manufacturers. To estimate productivity, they use three methodologies to estimate: De Loecker et al. (2016), Blundell and Bond (2000) and Gandhi et al. (2020). The estimation used OLS and fixed effect estimations over the period 2000 to 2010. They found that the tariff reduction from FTA can increase both productivity and quality of Pakistan textile. Reductions in tariffs of between 7.5 and 10.5 percentage points (depending on the segment) resulted in an aggregate increase of 3 to 8.7 percent in the productivity of Pakistani textiles. Also, product quality increased around 1-2 percent since FTA implemented. The reason is that the quality improvement only occurred in the high productivity group. The low productivity group shows lower quality of product with respect to quantile regression estimation. They also found that both exporter and non-exporter experienced increases in productivity when China's tariff has decreased. However, the exporter has got greater benefit from FTA. They found most non-exporters show the negative elasticity of productivity with respect to quality which opposite to the exporters. The lower productivity gain from the FTA came from a lack of investment and upgrading, especially in physical capital. They also found the spillover effect within 5km or 10 km to non-exporter which can explain the passive positive effect of FTA.

For Thailand, Kohpaiboon and Jongwanich (2022) examines the effects of trade policy on firms' productivity in Thailand. They estimate the total factor productivity by using Levinsohn and Petrin (2003). By using the preferential rate from FTA to construct ERP, they found that FTA cannot improve firm productivity in Thai manufacturing sector. This implies that FTA-led trade liberalization policy fails to add substantial competitive pressure and induce firms to improve productivity. The reason came from the structure of preferential commitment often reluctant to offer in tariff commitment. Then, high tariff protection sector still has been protected even Thailand joining many FTAs. This result consistent with Jongwanich and Kohpaiboon (2020).

The results from previous studies still show various effects of FTA in different countries (see table 2.6). The reason may come from an increasing trend of signing FTA and having many overlapping FTA, which creates spaghetti bowl phenomenon and make hard to analyze the effect of the individual FTA.

Table 2.6

Preview finding on FTA and trade.

Author	Country/ Year	Main Finding
Agung et al. (2019)	11 countries in AKFTA (2007-2016)	- Tariff eliminations from AKFTA agreement increase Indonesia Import around 34%.
Ramaswamy et al. (2021)	31 Asian countries (2007-2014)	- All five FTAs in Asian economies (AFTA, APTA, Gulf Cooperation Council (GCC), SAFTA and CISFTA) can enhance an economy to increase the trade volume.
Harada and Nishitateno (2021)	27 trading partners with Japan, China and South Korea (1990-2016)	- 1 percentage point reduction in preferential tariff rates led to an increase in wine import volumes by 4.2%. - Bilateral trade agreement may have more efficiency than multilateral trade agreement (MFN).
Dadakas et al. (2020)	211 countries (2002-2016)	- FTA can stimulate export volume when both trading countries have trade agreement. - UAE should focus to expand the trade to large markets by using FTA and also needs to re-examine implementation methods, incentives and terms of using FTA.
Abbas (2018)	47 Pakistan trading partners (1980 – 2016)	- Almost all FTAs can increase trade volume both in import and export term. - Regional trade agreement as SAFTA has decreased Pakistan's import and export volume.
Karkanis and Fotopoulou (2021)	196 Chinese trading partners (1995-2018)	- Effect of FTA on Chinese merchandise import have ambiguous depending on the controlled variable.
Timsina and Culas (2020)	24 Australia trade partners (1996-2017)	- Bilateral FTA with Thailand and Singapore has been dominated by ASEAN-Australia-New Zealand that formed later.

Table 2.6

Preview finding on FTA and trade (Cont.)

Author	Country/ Year	Main Finding
Jagdambe and Kannan (2020)	50 countries (2005-2014)	- Members of AIFTA have got benefit from both trade creation and trade diversion effect. - EU and MERCOSUR generate trade creation among their members but did not generate trade diversion.
Linarello (2018)	Chilean exporter to E.U., United States, and Republic of Korea (2001-2007)	- FTA can increase firm productivity both directly and indirectly which reflected spillover effect from FTA. - Both of comparative advantage and disadvantage sector have shown higher productivity, with the larger effect in comparative advantage sector.
Jamil et al. (2022)	Pakistan (2000-2010)	- Tariff reductions from FTA can increase firm productivity and product quality in Pakistan textile. - FTAs also have spillover effect within Pakistan textile sector.
Kohpaiboon and Jongwanich (2022)	Thai Manufacturing	- FTAs fail to add substantial competitive pressure and induce firms to improve productivity in Thailand. - The structure of preferential commitment often reluctant to offer in tariff commitment.

Note. Author' compilation

CHAPTER 3
RESEARCH METHODOLOGY AND DATA

As discussed in the previous chapter, trade liberalization can be implemented through both tariff (unilateral or PTAs/FTAs) and non-tariff measures. This chapter will discuss the measurement method to compute policy indicators in both tariff and non-tariff measures and also free trade agreements. In addition, since trade liberalization/protection could affect firms' productivity, measures of total factor productivity are proposed in this chapter. The last section provides methods to determine the impacts of trade liberalization on trade performance and firms' productivity.

3.1 Measurements of Trade Policy and Productivity

3.1.1 Tariff Protection

This study computes both nominal rate of protection (NRP) and effective rate of protection (ERP) to reflect trade protection in Thailand. ERP is modified to capture the effective rate of protection in various aspects. First, we measure ERP by following with Balassa (1965) and Corden (1966) which is traditional ERP measurement. [1]

Traditional ERP:

$$ERP_{jt} = \frac{T_{jt} - \sum_{i=1}^{n} a_{ijt} T_{ijt}}{1 - \sum_{i=1}^{n} a_{ijt}} \tag{3.1}$$

where T_{jt} is average tariff on finished product in sector j at time t

T_{ijt} is average tariff on product from sector I which has been used as intermediate input to produce product in sector j at time t

[1] Diakantoni and Escaith (2012) adjusted ERP formula in order to capture the indirect consumptions of intermediate inputs. However, with data limitation, this study cannot calculate ERP following this methodology.

a_{ijt} is share of intermediate product form sector I which been used to produce product in sector j at time t

We use the production share from Input-Output table (IO table), which collects data based on International Standard Industrial Classification (ISIC). The most detailed sector in IO table contains 180 sectors in the Thai economy. On the other hand, tariff has collected on Harmonised System (HS) Classification which contained around 5,000 products at 6-digit level. Therefore, we have to convert these two classifications by applying concordance between HS code and TSIC 4-digit from the United Nations Statistics Division (UNSD).

Then, to observe the effect of input tariff and output tariff separately, we conduct input tariff rate (ITR) and output tariff rate (OTR) following Amiti and Konning (2007). While output tariff rate (OTR) is the average of MFN tariff rate in each sector, input tariff rate (ITR) is calculated as follows:

Input tariff rate: $$ITR_{ijt} = \sum_{i=1}^{n} a_{ijt} * T_{it} \quad (3.2)$$

where ITR_{ijt} is input tariff rate of product I from country j at time t

T_{it} is average tariff on finished product in sector I at time t

a_{ijt} is share of intermediate product form sector I which been used to produce product in sector j at time t

3.1.2 Free Trade Agreements (FTAs)

Since impacts of tariffs are included in the FTA, the true impacts of FTA might not properly be revealed. This study introduces FTAs as a separated variable to capture impacts of free trade agreement through FTAs. We discussed two measures to capture the impact of FTA, namely tariff margin and utilization. As we mentioned above Thailand has 14 FTAs in effect at the moment and each FTA has their own tariff schedule which commits different preferential tariff rates. Then, we conduct tariff margins on each FTA at 6-digit HS code by comparing it with applied tariff rate. However, with the lack of information about export tariff commitment, we only conduct the tariff margins in the import side.

Tariff Margin: $$Margin_{ijt} = T_{ijt,MFN} - PT_{ijt} \tag{3.3}$$

Where PT_{ijt} is preferential tariff rate of product I from country j at time t

Second, we conduct the utilization rate of each in-effect FTA to represent the amount of import value that has been used under each FTA. The FTA utilization rate (UR) has been calculated as the share of imports under FTAs on the total imports. It is noteworthy that the utilization rate is combined with the preferential tariff rate to conduct the Tariff associated with FTAs (T_{ijt}*) by following formula:

Tariff associated with FTA: $$T_{ijt}^{*} = \left(1 - \sum_{f=1}^{n} UR_f\right)T_{ijt} + \left(\sum_{f=1}^{n} UR_f\right)PT_{ijt} \tag{3.4}$$

where T_{ijt}^{*} is tariff associated with FTAs of product I from country j at time t

UR_f is utilization rate from free trade agreement calculated as the share of imports under FTAs on the total imports

PT_{ijt} is preferential tariff rate of product I from country j at time t

T_{ijt} is average tariff on product in product I from country j at time t

Then, we can conduct the alternative ERP as shown in Jongwanich and Kohpaiboon (2020), which aims to capture the rate of partial trade liberalization induced by FTAs signed. However, instead of using the import share of FTA partner and tariffs facing by exporters, we use utilization rate and preferential tariffs. Thus, we employ tariff associated with FTAs (T_{ijt}*) to represent the average tariff on finished product in calculating the alternative ERP (See equation 3.5). Note that concordance between HS code and TSIC 4-digit from the United Nations Statistics Division (UNSD) is utilized to convert T_{ijt}* using 6-digit Harmonised System (HS) Classification to T_{ij}* (average tariff on finished product in sector j at time t) for 180 sectors according to the Thai I-O table.

FTA ERP: $$ERP_{jt}^{*} = \frac{T_{jt}^{*} - \sum_{i=1}^{n} a_{ijt} T_{it}^{*}}{1 - \sum_{i=1}^{n} a_{ijt}} \qquad (3.5)$$

In conclusion, this study conducts ERP in 2 different aspects which contain traditional ERP (equation 3.1) and ERP concerning preferential tariffs under the free trade agreements (equation 3.5).

3.1.3 Non-Tariff Measures (NTMs)

Since we know that NTMs can capture both indicator and ad-valorem equivalent (AVEs), this study has used both ideas to analyze the protection level from NTMs. First, we measure NTMs by using descriptive indicators which gathered in De Melo and Nicita (2018). The first group of indicators are the coverage ratio (CR) and the frequency index (FI). These two indicators are commonly used and mostly calculated on overall trade. They can represent the percentage of trade which is affected by NTMs (CR) and the percentage of imported products which NTMs is applied (FI). Even though these two indicators have been provided by World Integrated Trade Solution (WITS), it is only available for some strict format, sector and particular year. Hence, we construct the indicator during 2012 – 2020 at 6-digit HS. The formula can be expressed in equations 3.6 - 3.7.

$$CR_{ij} = \frac{\sum_{i=1}^{hs} NTM_{ij} X_{ij}}{\sum_{i=1}^{hs} X_{ij}} \ x\ 100 \qquad (3.6)$$

$$FI_{ij} = \frac{\sum_{i=1}^{hs} NTM_{ij} D_{ij}}{\sum_{i=1}^{hs} D_{ij}} \ x\ 100 \qquad (3.7)$$

Where NTM_{ij} is dummy variable which is equal to 1 if Thailand imposed non-tariff measures on importer product I from country j and zero otherwise

X_{ij} is the value of imported product I from country j

D_{ij} is dummy variable which is equal to 1 if Thailand import product I from country j

The other group of indicators are more sophisticated than the former. We quantify NTMs as ad-valorem equivalent (AVEs) by using quantity-based approach since price data is unavailable in Thailand. The ad-valorem equivalent approach evaluates based on gravity equation. These pioneers are from Tinbergen (1962) which use the theory of gravitation to approximate bilateral trade flows between any two countries. The equation mainly uses the size of economies and distance between them to explain bilateral trade flow. It generally formulates in multiplicated form.

$$X_{ij} = GS_i M_j \phi_{ij} \tag{3.8}$$

Where X_{ij}	is	the export volume from country I to country j
G	is	the constant effect
S_i	is	the importer-specific factors
M_j	is	the exporter-specific factors
ϕ_{ij}	is	the ease of exporter I to access of market j (reflect cost of trade)

Natural logarithms are applied to obtain a log-linear equation. The gravity model based on Cadot and Ing (2019) is then employed as in equation (3.9) to determine AVEs.

$$\text{Ln}\, q_{ijt} = \beta_0 + \beta_1 T^*_{ijt} + \beta_2 NTM_{ijt} + \beta_3 G_{ijt} + \delta_i + \delta_{s(k)} + \varepsilon_{ijk} \tag{3.9}$$

Where q_{ijk}	is	import volume of product I from country j to Thailand at time t
T^*_{ijt}	is	weighted average of the tariff rate associated with FTA rate from equation 3.4 in product i
NTM_{ijt}	is	dummy variable of non-tariff measure in product I that impose by Thailand on country j at time t
G_{ij}	is	gravity variable which is distance, GDP and population of country j and language variable

δ_i is exporter fixed effect
$\delta_{s(k)}$ is sector fixed which using 4-digit level in ISIC

The estimation method to quantify ad-valorem equivalent of non-tariff measure is Poisson Psuedo Maximum Likelihood (PPML). The reason is that trade volumes have many zero values, and these zero values should not be neglect. For this reason, PPML method provides us with more efficiency estimators than ordinary least square (OLS), according to Head and Mayer (2014). After that, we use the coefficient from equation 3.9 to calculate the ad-valorem equivalent of non-tariff measure. To convert the coefficient, we use equation 3.10:

$$AVE_{NTM} = e^{\beta_2} - 1 \tag{3.10}$$

3.1.4 Firm Productivity

In this study, we calculate total factor productivity (TFP) by following Ackerberg et al. (2015) methodology, called ACF. The reason is that ACF method shown fairly stable than the methods in Levinsohn and Petrin (2003). The ACF method has slight adaptation from LP methodologies as it essentially relies on the same moment conditions[1]. The main difference between ACF and LP is that they invert "conditional" rather than "unconditional (or less conditional)" input demand functions to controlling unobserved productivity. This method involves two stages. Consider a simple Cobb-Douglas production function in logs

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \varepsilon_{it} = \widetilde{\phi_t}(k_{it}, l_{it}, m_{it}) + \varepsilon_{it} \tag{3.11}$$

Where y_{it} is log of output at sector I at time t
k_{it} is log of capital at sector I at time t
l_{it} is log of labor input at sector I at time t

[1] We did not include Olley and Pakes methods in this study because problem in OP is outdated and has been used as the fundamental to develop in LP and ACF method.

m_{it}	is	intermediated input at sector I at time t
ω_{it}	is	productivity shock at sector I at time t that are potentially observed or predictable by firms when they make input decisions.
ε_{it}	is	shock to production or productivity at sector I at time t that are not observable (or predictable) by firms before making their input decisions

First stage is selecting investment factors that minimizes the shock to production or productivity between actual output and set of inputs (the best case is no shock). Thus, the first stage moment condition is:

$$E[\varepsilon_{it}|I_{it}] = E\left[y_{it} - \widetilde{\phi_t}(k_{it}, l_{it}, m_{it})\middle|I_{it}\right] = 0 \quad (3.12)$$

The second stage is the conditional expectation for investment at previous period. Hence, the decision at period t-1 is expected to select the investment level which minimizes the shock to production and prediction error. Then, the second stage moment condition is:

$$E[\xi_{it} + \varepsilon_{it}|I_{it-1}] =$$
$$E\left[y_{it} - \beta_0 + \beta_k k_{it} + \beta_l l_{it} - g(\tilde{\phi}_{t-1}(k_{it-1}, l_{it-1}, m_{it-1}) - \beta_0 + \beta_k k_{it-1} + \beta_l l_{it-1}\middle|I_{it-1}\right] = 0 \quad (3.13)$$

where $\xi_{it} = \omega_{it} - E[\omega_{it}|I_{it-1}]$ which is the prediction error from period t-1

However, unlike LP, this method does not permit estimation of β_l in the first stage. They produce an estimation $\widehat{\widetilde{\phi_t}}(k_{it}, l_{it}, m_{it})$ of $\widetilde{\phi_t}(k_{it}, l_{it}, m_{it})$ in the first stage instead. Then, they propose estimating β_l along with other production function parameters in the second stage.

Note that this study employs ACF as the main method to determine TFP due to its superiority than others. However, TFP calculated by LP is also used as an alternative in the study for a sensitivity analysis. In addition, the value-added per worker (VA) is included to measure firms' productivity as argued by the previous studies (see for example Gandhi et al., 2020), even though gross output is a more appropriate approach in detailed measures of productivity, the value-added measure cannot be ignored in the productivity analysis with labor and capital.

3.2 Modelling

The empirical model in this study has been separated into 2 parts. First, we estimate the effect of trade policy on trade performance, emphasizing on imports. Then, we explore the effect of trade policy on firm productivity.

3.2.1 Trade Equation

We explore the effect of trade policy on import performance in Thailand by focusing on tariff, non-tariff measures and free trade agreements. For tariff, we use both nominal tariff protection and effective tariff protection while there are four alternatives for non-tariff measure: number of NTM, coverage ratio (CR), the frequency index (FI) and ad-valorem equivalents (AVEs).

The effect of FTAs has been proxied by three aspects: dummy variable, utilization rate and tariff margin. However, as we explain above, we also combined the effect of FTAs into tariff variables, both of nominal tariff and effective tariff protection. Hence, our empirical model has been summarized in equation 3.14:

$$M_{ijt} = \beta_0 + \beta_1 T_{ijt} + \beta_2 NTM_{ijt} + \beta_3 FTA_{ijt} + \beta_4 G_{jt} + \varepsilon_{ijt} \qquad (3.14)$$

Where M_{ijt} is total import volume of product I from country j at time t[1]

[1] This study did not include Trade in Value-Added (TiVA) indicators as alternative independent variable since the author does not only examines impacts of trade policy on import volume, but also on those of trade policies on firm's productivity. In terms of productivity, three measures are applied, including value added per worker, total factor productivity (TFP) using the estimation methods of Levinsohn and Petrin

T_{ijt} is tariff rate that Thailand imposes on product I of country j at time t, which measures by three measures:

(1) MFN_{ijt} is nominal rate of protection of product I of country j at time t

(2) ERP_{ijt} is effective rate of protection of product I of country j at time t, which is measured by two alternatives which are ERP_{ijt} (traditional effective rate of protection) and ERP_{ijt}^{*} (ERP concerning preferential tariffs under the free trade agreements)

(3) OTR_{it} is output tariff rate of product I of country j at time t

(4) ITR_{it} is input tariff rate of product I of country j at time t

FTA_{ijt} is free trade agreements between Thailand and country j of product I at time t which are measures by two measures:

(1) UR_{ijt} is FTA utilization rate of product I between Thailand and country j in effect at time t.

(2) $Margin_{ij}$ is FTA tariff margin of product I between Thailand and country j in effect at time t.

$NTM_{ijt}$is non-tariff measures that Thailand imposed on product I of country j at time t which are measures by four alternatives:

(1) $\#NTM_{ijt}$ is number of NTMs in product I of country j at time t

(2) CR_{ijt} is coverage ratio of product I of country j at time t.

(3) FI_{ijt} is frequency index of NTMs that Thailand imposed on product I of country j at time t.

(LP) (2003) and Ackerberg et al. (ACF) (2015). Thus, to a certain extent, the impacts of trade policies on value added could be capture when firms' productivity is examined.

(4) AVE_{ijt} is ad-valorem equivalents of NTMs that Thailand imposed on product I of country j at time t

G_{jt} is the basic variables in the gravity model, including distance between Thailand and the country j, GDP of country j, Thailand's GDP of country j at time t.[1]

As impacts of trade protection/liberalization on import performance vary among sub-sectors, this study disaggregates total imports into three sub-categories, composing of finished ($IMFinish_{ijt}$), capital ($IMCap_{ijt}$) and raw material ($IMRaw_{ijt}$) imports. Broad Economic Categories (BEC) rev.5 is applied to disaggregate imports into three categories and equation 3.15 is modified as follows:

$$\begin{aligned} \ln IMFinish_{ijt} &= \beta_0 + \beta_1 T_{ijt} + \beta_2 NTM_{ijt} + \beta_3 FTA_{ijt} + \beta_4 G_{jt} + \varepsilon_{ijt} \\ \ln IMCapi_{ijt} &= \beta_0 + \beta_1 T_{ijt} + \beta_2 NTM_{ijt} + \beta_3 FTA_{ijt} + \beta_4 G_{jt} + \varepsilon_{ijt} \\ \ln IM_{Rawijt} &= \beta_0 + \beta_1 T_{ijt} + \beta_2 NTM_{ijt} + \beta_3 FTA_{ijt} + \beta_4 G_{jt} + \varepsilon_{ijt} \end{aligned} \tag{3.15}$$

Table 3.1

Variable and expectation in trade equation

Explanation	Variable	Expectation
Tariff - Tariff rate	MFN/ERP (ERP and ERP*) /OTR/ITR	+/-
Non-tariff measure - NTMs indicator	#NTM/ CR / FI / AVEs	+/-
Free trade agreement - Utilization - Margin	UR Margin	+ +
Gravity variable	Distance/GDP/language	-/+/?

Note. Author's compilation

[1] Note that we employed Poisson pseudo-likelihood regression with multiple levels of fixed effects which is country fixed effects, year fixed effect, product fixed effects, and the country-year pair fixed effects. Therefore, the gravity variable distance, GDP and population and language variable has been dropped from interpretation results

The estimation used Poisson Pseudo Maximum Likelihood (PPML) following Santos Silva and Tenreyro (2006). Since zero trade flows caused bias and inconsistent estimators in OLS, PPML can avoid the biased estimators from heteroskedasticity and more versatile for trade analysis with many zero trade flows. In addition, we use PPMLHDFE (Poisson Pseudo-Maximum Likelihood with High-Dimensional Fixed Effects) estimation that allows the high-dimensional fixed effects which important to control time-varying factors in the large dataset. However, employing PPMLHDFE while controlling country fixed effects, year fixed effects, product fixed effects, and the country-year pair fixed effects, the gravity variable distance, GDP and population and language variable would have been dropped from interpretation results. Note that the Covid-19 dummy variable has been dropped as other gravity variable from the controlling properties in PPMLHDFE.

The Interpretation result Is reported In term of the Incidence rate ratio (IRR). When IRR > 1, the result shows that the independent variable has a positive effect on the dependent variable by (β-1) x 100 percent. For example, if β = 1.15, it means that when the independent variable increases by 1 unit, the dependent variable's expected value increases by 15%. On the other hand, IRR < 1, the result shows that the independent variable has a negative effect on the dependent variable. For example, if β = 0.90, it means that when the independent variable increases by 1 unit, the dependent variable's expected value decreases by 10%. The independent variable has no effect on the dependent variable when β = 1.

3.2.2 Productivity Equation

To explore firm productivity, this study uses the traditional equation for determining the firm's productivity which contains firm-specific factors, industry-specific factors and trade policy factors following Jongwanich and Kohpaiboon (2020), Fiorini et al. (2021) and Mo et al. (2021). By controlling firm-specific and industry-specific factors, this helps us to get a more precise estimation of the effect of trade policy on firm productivity.

The first group of controlling variables are the share of exports and imports at the firm and industry level. As we discussed in Chapter 2, we know that firms have to improve their productivity to compete in the world market and imported products can create a spillover effect to firm production. Hence, we control the share of exports and imports for both firm-specific factors and industry-specific factors. Theoretically, these two factors will increase firm productivity. Then, we expected the positive effect from these two factors.

For firm-specific factors, we control the research and development (R&D) factor as it potentially enhances firms' productivity (Krugman et al, 1985; Audretsch and Belitski, 2020; Jongwanich and Kohpaiboon, 2020, Zhou and Dahal, 2024). In addition, we include the proportion of skill and unskilled labor in the equation, instead of total workers, because skill labor can generate higher productivity than unskilled labor as shown in the previous studies (Paderson et al. 2022; Rossi, 2022; Hendricks and Schoellman, 2023; Abbritti and Consolo, 2024). These two variables are included to represent the firm-specific factors.

For industry-specific factors, the control variables are industrial intermediate imports, industrial exports and market competition effect. On one hand, importing intermediate inputs can improve efficiency by cost efficiency, input variety, high product quality and technological pass-through (Amiti and Konning, 2007; Defever et al. 2020; Pane and Patunru, 2023). On the other hand, exporting output could improve firm productivity through self-selection and learning by exporting (Delgado et al., 2002; Wagner, 2007; Alguacil et al., 2022; Casagrande et al., 2024). Also, a higher competition level in the industry can pressure firms, especially domestic firms, to improve their productivity (Nickell, 1996; Hay and Lui, 1997; Mayer et al.,2021; Loncan, 2023). Hence, the Hirschman Herfindahl index (HHI) is included in the model to represent the market competition level in each industry. The index is calculated using the following equation:

$$HHI_j = \sum_{i=1}^{n} (S_{ij})^2 \tag{3.16}$$

Where S_{ij} is the market share of firms I in industry j. While n is the number of firms in country j.

In addition, we also added Covid-19 dummy variable which equal to 1 after 2019 to represent the effect of covid-19 incident.[1] For trade policy factors, we use both tariff and non-tariff measure variables as in trade performance equation. For tariff variable, we use both nominal rate of protection and effective rate of protection. In addition, we include non-tariff measure variables to explore the effect of NTMs on the firm's productivity. The non-tariff measure variables contain three indicators, including TBT, SPS, and Inspect.

All in all, equation 3.17 is employed to investigate the relationship between trade policy and firms' productivity. The conclusion and expectation have been shown in table 3.2.

$$TFP_{ijt} = \alpha_0 + \alpha_1 XI_{jt} + \alpha_2 MI_{jt} + \alpha_3 RDI_{jt} + \alpha_4 Skill_{ijt} + \alpha_5 HHI_{jt} + \alpha_6 Covid_t + \alpha_7 T_{jt} + \alpha_8 NTM_{jt} + \alpha_9 FTA_{jt} + \varepsilon_{ijt} \tag{3.17}$$

where TFP_{ijt} is total factor productivity of firm I in industry j at time t

XI_{ijt} is average share of industry exported product in industry j at time t

MI_{ijt} is average share of industry imported intermediate input in industry j at time t

RDI_{jt} is average share of research and development expenditure on total expenditure in industry j at time t

$Skill_{ijt}$ is share of skill labor on total labor input of firm I in industry j at time t

HHI_{jt} is Hirschman Herfindahl index in industry j at time t

[1] It is noteworthy that since industrial census has been published by 5- year periods, Industrial and Business Census (1997, 2002, 2007, 2012, 2017, 2022), the covid dummy variable is included in the productivity model only in 2022. Therefore, we cannot use other variables such as mobility index as alternative variable to evaluate the effect of covid-19.

$Covid_t$ is COVID-19 dummy variable which equal to 1 after 2019 and equal to 0 otherwise.

T_{ijt} is tariff rate that Thailand imposes on product I of country j at time t, which measures by four measures:

(1) MFN_{ijt} is nominal rate of protection of product I of country j at time t

(2) ERP_{ijt} is effective rate of protection of product I of country j at time t, which is measured by two alternatives which are ERP_{ijt} (traditional effective rate of protection) and ERP^{*}_{ijt} (ERP concerning preferential tariffs under the free trade agreements)

(3) OTR_{it} is output tariff rate of product I of country j at time t

(4) ITR_{it} is input tariff rate of product I of country j at time t

FTA_{jt} is free trade agreements on Thailand in industry j at time t which are measures by two measures:

(1) UR_{jt} is FTA utilization rate of industry j at time t.

(2) $Margin_{jt}$ is FTA tariff margin of industry j at time t.

NTM_{ijt} is non-tariff measures that Thailand imposed on product I of country j at time t which are measures by two alternatives:

(1) $\#NTM_{ijt}$ is number of NTMs in product I of country j at time t which contain SPS, TBT and Inspect

(2) PCA is principal component analysis of non-tariff measures by using both covariance matrix and correlation matrix

In the estimation technique, tariff and non-tariffs variable have been interacted with covid-19 variable to measure the effect of tariff and non-tariffs variable after covid-19 incident. Also, we observe the effect of tariff and non-tariff variable on important section which show explicitly change in TFP between 2007 – 2021.

Table 3.2

Variable and expectation in productivity equation

Explanation	Variable	Expectation
Firm-specific factors		
Share of exported product	XF	+
Share of imported intermediate input	MF	+
Share of research and development expenditure	RD	+
Share of skill labor	Skill	+
Industry-specific factors		
Share of industry exported product	XI	+
Share of industry imported intermediate input	MI	+
Market concentration ratio	HHI	+
COVID-19	Covid	+/-
Trade policy factors		
Tariff protection		
- Tariff rate	MFN/ERP /OTR/ITR	+/-
Free trade agreement		
- Utilization	UR	+
- Margin	Margin	+
Non-tariff measure		
- NTMs indicator	SPS/ TBT/ Inspect	+/-
- Principal component analysis	PCA(corr)/ PCA(cov)	

Note. Author's compilation

For productivity equation, we employ panel data regression to estimate equation (16) and also applied fixed effects to control time-varying factors in the estimation.

3.3 Data

Concerning ERP, we retrieve applied tariff rate from Tariff Analysis Online (TAO) which provides tariff rates since 1999. The preferential tariff rates and import utilization are retrieved from Thai customs department, Ministry of Finance. For non-tariff measure, we retrieve NTMs data from the Integrated Trade Intelligence Portal (I-TIP) which provides us the NTMs data since 1960. The gravity variables to find

AVEs of NTMs are retrieved from Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) database.

Total factor productivity (TFP) has been calculated from Thai Industrial Census in 2017 and 2022. The share of exports, share of imported intermediated inputs, research and development (R&D) and skill/unskilled labor are calculated from Thai Industrial Census. This study analyzes the data in the period 2012 – 2021.

CHAPTER 4
TRADE POLICY AND TRADE PERFORMANCE IN THAILAND

This chapter provides an overview of Thailand trade policy and its effect on import. Firstly, we present an overview of trade policy in Thailand from 2007 to 2021. First, we examine tariff protection and free trade agreements (FTAs) in terms of tariff margins and utilization rates. Then, we discuss non-tariff policies, focusing on coverage, frequency, and ad-valorem equivalents (AVEs). Lastly, we examine the impact of tariffs, the inclusion of technical NTMs and FTAs on import volume.

4.1 Tariff, FTAs and NTMs: First Look

MFN tariff rates in Thailand have declined over the past few decades, following tariff reforms in the early 1990s and 2000s. The average tariff rate in Thailand decreased from 10.6% in 2007 to 9.2% in 2021. At the sectoral level, we calculate the nominal rate of protection (NRP) and the effective rate of protection (ERP) to represent the level of protection in each sector. The results show that NRP decreased across all sectors from 2007 to 2021 (Table 4.1). According to the NRP, the three most protected sectors are food manufacturing, construction, and agriculture. For ERP, the three most protected sectors are food manufacturing, construction, and textiles. Additionally, the ERP in the food manufacturing and textile industries has increased, which contrasts with the decrease in NRP. This may reflect the lower adjustments to tariffs on finished products compared to raw materials.

Table 4.1

NRP and ERP in Thailand over the periods 2007 – 2021.

16 Sector	NRP		ERP	
	2007	2021	2007	2021
Agriculture	21.5%	19.2%	30.9%	29.1%
Mining and Quarrying	1.1%	0.8%	-0.1%	-0.2%
Food Manufacturing	30.4%	28.4%	44.8%	48.3%
Textile Industry	16.4%	15.7%	37.8%	41.1%
Sawmills and Wood Products	13.6%	12.1%	34.0%	28.6%
Paper Industries and Printing	4.2%	4.0%	9.8%	9.9%
Rubber, Chemical and Petroleum Industries	7.3%	6.4%	19.5%	16.4%
Non-metallic Products	11.9%	10.7%	32.8%	29.7%
Metal, Metal Products and Machinery	8.5%	7.2%	20.1%	16.5%
Other Manufacturing	11.2%	8.6%	21.5%	18.9%
Public Utilities	0.0%	0.0%	-1.8%	-1.4%
Construction	26.3%	21.7%	52.9%	45.4%
Services	2.5%	2.5%	0.0%	-0.7%

Note. Author's calculates by using data from Thai customs department and NESDC.

Since 2000, the number of in-effect free trade agreements (FTAs) has gradually increased from just the ASEAN Free Trade Agreement (AFTA) in 2000 to 15 FTAs in 2024. However, the additional 14 FTAs cover only 10 more countries, largely due to the overlapping nature of bilateral and multilateral agreements within ASEAN (Figure 4.1). China, Indonesia, and Vietnam are the three largest users of FTAs, with utilization rates of 43.2%, 37.4%, and 31.8%, respectively (Table 4.2). We found that countries with both bilateral and multilateral agreements tend to use bilateral agreements more frequently than multilateral ones. This is because bilateral agreements with Australia, New Zealand, and Japan provide preferential tariff treatment (PTA) on more products than the multilateral agreements within ASEAN.

Despite the large number of PTAs provided by each FTA, we found that FTA utilization in Thailand has not reached its full potential. By calculating FTA usage as the proportion of PTA utilization across all imported products at the HS-6 digit level, we found that only one-quarter of the FTAs were used in 2021. Only China utilized PTAs for more than half of its imports. This limited usage is attributed to other tax privileges in Thailand, such as Free Zones, Bonded Warehouses, Duty Drawback schemes, and the Board of Investment (BOI) incentives, which provide alternative benefits for import and investment activities.

Table 4.2

Tariff margins, Number of PTA and FTA utilization in 2021

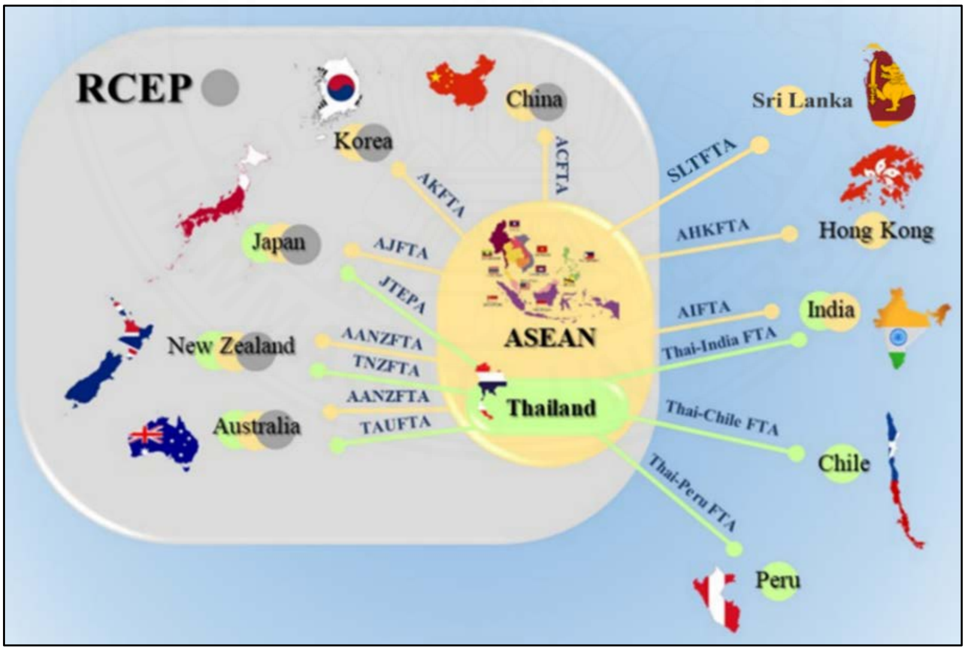
Country	Margin	Number of PTA	Utilization (Overall)
AFTA			
Brunei	9.2%	5,387	0.0%
Cambodia	9.2%	5,387	18.6%
Indonesia	9.2%	5,387	37.4%
Laos	9.2%	5,387	19.5%
Malaysia	9.2%	5,387	23.2%
Myanmar	9.2%	5,387	14.5%
Philippines	9.2%	5,387	13.5%
Singapore	9.2%	5,387	7.3%
Vietnam	9.2%	5,387	31.8%
Australia			
- ASEAN – Australia – New Zealand	8.8%	5,336	4.7%
- Thai – Australia	9.2%	5,387	13.7%
New Zealand			
- ASEAN – Australia – New Zealand	8.8%	5,336	5.6%
- Thai – New Zealand	9.2%	5,387	14.6%
Japan			
- ASEAN – Japan	8.6%	5,209	1.7%
- Thai – Japan	8.9%	5,375	16.1%
India			
- ASEAN – India	7.5%	4,835	18.1%
- Thai – India	5.6%	113	0.1%
ASEAN – China	8.4%	5,337	43.2%
ASEAN – Korea	8.6%	5,289	19.9%
ASEAN – Hong Kong	5.2%	5,215	0.3%
Chile	9.1%	5,387	16.8%
Peru	6.6%	3,947	7.1%

Note. Author’s calculates from Thai customs department

As mentioned earlier, FTA utilization varies among countries. To evaluate tariff protection, especially in the 18 countries under consideration, we need to account for the effect of FTAs. We calculate T* to represent the combination of preferential tariff agreements (PTA) and utilization in tariff protection. The calculation shows that when China complies with FTAs, its tariff rate decreases from 9.2% to 4.8%. Similarly, in Indonesia and Vietnam, tariff rates reduce from 9.2% to 6.9% and 7.1%, respectively. In terms of the effective rate of protection (ERP*), the reduction effect is twice as large as that of the nominal rate of protection (NRP*). The FTA privileges granted by China effectively reduce Thailand's protection by about 10.3% on average when FTA privileges are included in our analysis, followed by Indonesia and Vietnam at 9.1% and 6.8%, respectively (Table 4.3). These results demonstrate that utilizing FTAs can significantly reduce import costs from each country.

Figure 4.1

Signed and in effect FTAs in Thailand in 2024



Note. Thailand had 14 FTAs in effect until 2022; then, RCEP came into effect in 2022. The latest FTA is the Sri Lanka-Thailand Free Trade Agreement, which was signed in 2024. Author's compilation from Asia regional integration center, ADB.

Table 4.3

NRP & ERP calculation from Tariff associated with utilization FTA in 2021

16 Sector	NRP	NRP (Indonesia)	NRP (Vietnam)	NRP (China)	ERP	ERP (Indonesia)	ERP (Vietnam)	ERP (China)
001	19.2%	16.0%	16.4%	13.1%	29.1%	24.3%	24.9%	20.5%
002	0.8%	0.4%	0.7%	0.2%	-0.2%	-0.4%	-0.2%	-0.5%
003	28.4%	23.3%	20.3%	18.6%	48.3%	36.7%	30.9%	39.1%
004	15.7%	10.6%	11.5%	5.3%	41.1%	26.3%	29.5%	11.9%
005	12.1%	5.0%	6.8%	1.2%	28.6%	11.4%	15.9%	2.5%
006	4.0%	2.5%	2.9%	3.7%	9.9%	6.0%	6.7%	9.4%
007	6.4%	4.4%	4.9%	3.2%	16.4%	10.6%	11.7%	7.1%
008	10.7%	7.1%	6.1%	5.1%	29.7%	18.5%	15.3%	12.7%
009	7.2%	5.3%	5.7%	3.9%	16.5%	11.8%	12.8%	8.7%
010	8.6%	5.6%	6.1%	4.0%	18.9%	11.6%	12.6%	8.3%
011	0.0%	0.0%	0.0%	0.0%	-1.4%	-1.2%	-1.2%	-1.1%
012	21.7%	1.7%	14.7%	16.1%	45.4%	0.4%	31.0%	34.4%
015	2.5%	0.2%	0.0%	0.3%	-0.7%	-3.4%	-4.3%	-2.4%
016	24.5%	23.9%	23.5%	18.1%	64.0%	66.2%	64.6%	50.5%
Average	11.6%	7.6%	8.5%	6.6%	24.7%	15.6%	17.9%	14.4%

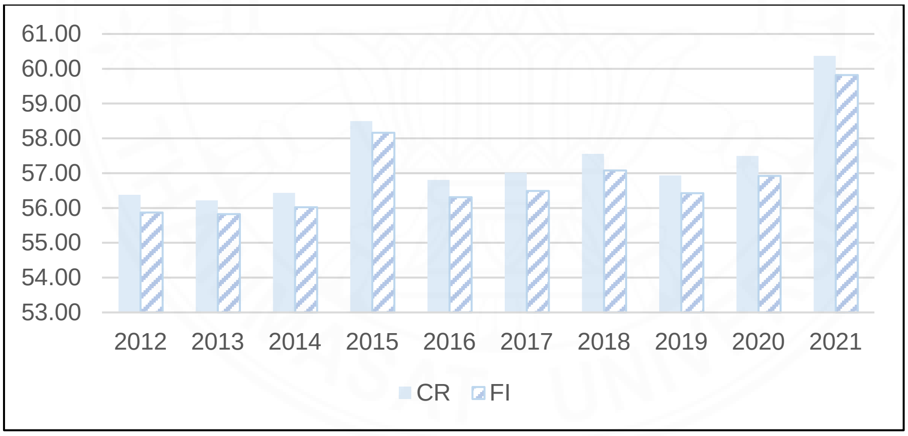
Note. While the average MFN rate is 9.2%, the average T* rates for China, Vietnam, and Indonesia are 4.8%, 7.1%, and 6.9%, respectively. Trade Industry and Transportation and Communication industry are not applicable. Author’s calculation from Thai customs department, NESDB and UNCOMTRADE

4.2 Non-Tariff Protection

Between 2012 and 2021, Thailand imposed non-tariff measures (NTMs) on both agricultural and manufacturing products. Over this period, NTMs showed an increasing trend in both coverage ratio (CR) and frequency index (FI). On average, NTMs covered approximately 55% to 60% of all products between 2012 and 2021. These two indicators are nearly equal, with the frequency index (FI) being slightly lower than the coverage ratio (CR) throughout the period (Figure 4.2). This suggests that NTMs are relatively evenly distributed across products, regardless of their import value. NTMs policies are imposed more heavily on products from least developed countries (LDCs), where both the coverage ratio and frequency index are highest, followed by developing countries and then developed countries.

Figure 4.2

Coverage ratio and frequency index of NTMs in 2012 -2021



Note. CR is coverage ratio; FI is frequency index. Author's calculations from I-TIP data.

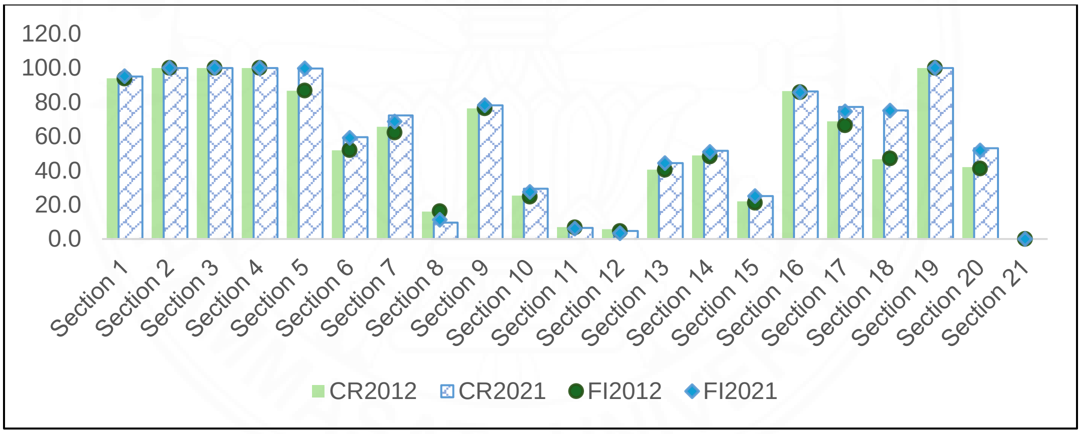
At the sectoral level, the analysis of the coverage ratio and frequency index reveals that four sectors, i.e., vegetable products (Section 2), fats and oils (Section 3), prepared food and beverages (Section 4), and arms and ammunition (Section 19), have been fully covered by NTMs policies[1](Figure 4.3). The sector for optical, measuring,

[1] The definition of 21 sections is following from Harmonized System (HS) nomenclature.

and medical or surgical instruments (Section 18) shows the largest increase in protection, with coverage rising by 30%, from 46.6% in 2012 to 75.2% in 2021. This increase may be attributed to the Medical Device Act BE 2019, which aimed to protect medical or surgical instruments (Chapter 90) during the COVID-19 pandemic. The second largest increase in NTMs coverage occurred in the mineral products sector (Section 5), which rose from 86.7% in 2012 to 99.7% in 2021. This change was driven by the Excise Act B.E. 2017, which specifically affected ores, slag, and ash in Chapter 26. In conclusion, the two largest changes in NTMs policies over the past decade stemmed from the Medical Device Act in 2021 and the Excise Act in 2017. However, neither of these policies shows any discrimination in terms of country coverage, meaning they do not specifically target any particular group of countries.

Figure 4.3

Coverage ratio of NTMs by section in Thailand in 2012 and 2021

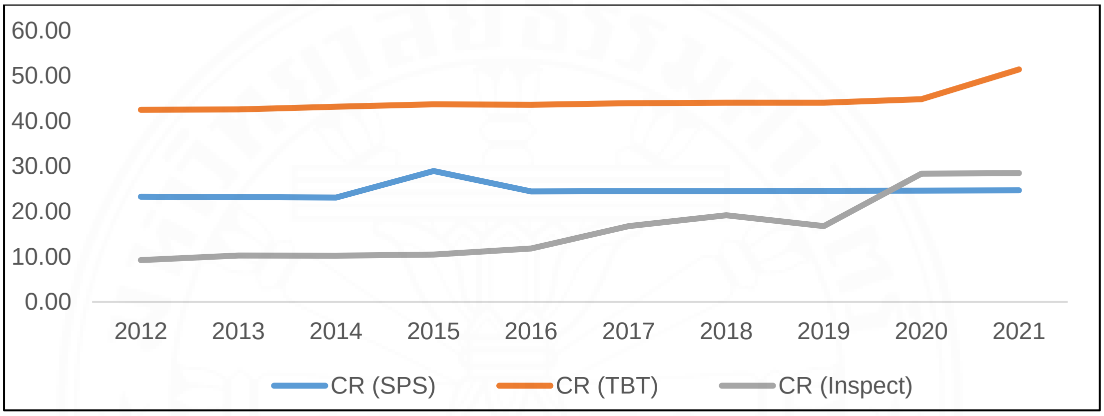


Note. Section 1-21 following from WCO HS Nomenclature. Author's calculations from I-TIP data

As mentioned earlier, the two key policies during this period are the Medical Device Act B.E. 2019 and the Excise Act B.E. 2017. The key difference between these two policies lies in the type of NTMs implementation. The Excise Act of 2017 relied on pre-shipment inspections and other formalities (Inspect) to control imported products. In contrast, the Medical Device Act B.E. 2019 utilized technical barriers to trade (TBT) to regulate imported products. Another short-term policy that impacted the coverage ratio was the control on imported thermoplastics in 2015, which applied to all products in Chapter 39 for a year. However, this policy was repealed at the beginning of 2016. As a result, the sanitary and phytosanitary (SPS) coverage ratio for Chapter 39 in 2015 reached 100%. Apart from these three significant policies, no major changes in the NTMs pattern were observed (Figure 4.4). Overall, Thailand has primarily relied on three types of NTMs to control imported products: SPS, TBT, and Inspect.

Figure 4.4

Coverage ratio of technical NTMs by type in Thailand in 2012 – 2021

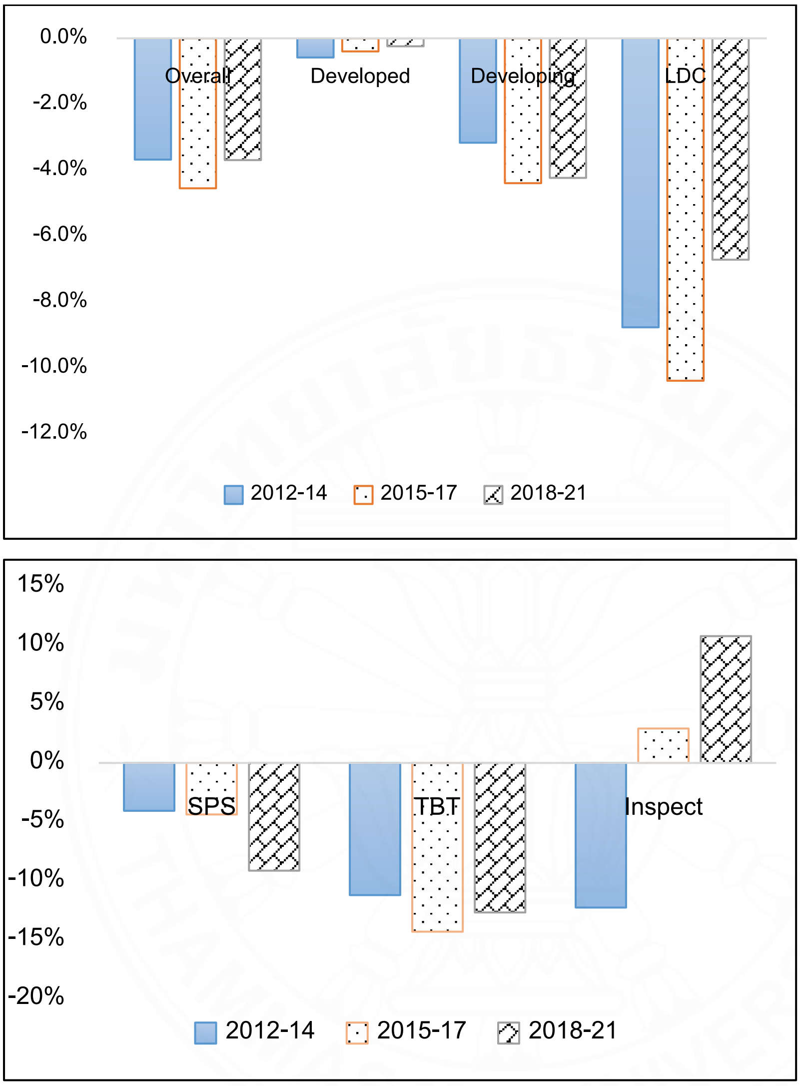


Note. CR (SPS) is the coverage ratio of sanitary and phytosanitary; CR (TBT) is the coverage ratio of technical barrier to trade; CR (Inspec) is the coverage ratio of pre-shipment inspections and other formalities. Author's calculations from I-TIP data

The ad-valorem equivalents (AVEs) of technical NTMs were calculated using equations (9) and (10) . The results show that, on average, NTMs accounted for 4% of the tariff rate between 2012 and 2021 (Figure 4.5). The negative effects of NTMs are more pronounced in lower-income countries. The AVE of NTMs in developed countries is only about 0.5%, while it is 4% in developing countries and 8% in least-developed countries (LDCs). These results suggest that higher-income countries tend to manage non-tariff policies more effectively than lower-income countries. Furthermore, the results show that each type of NTMs has had a distinct impact. SPS and TBT compliance costs have intensified over the years. The compliance cost for SPS increased from 4% in 2012-2014 to 9% in 2018-2021. Similarly, the compliance cost for TBT rose from 11% in 2012-2014 to 13% in 2018-2021. In contrast, the compliance cost for pre-shipment inspection and other formalities (Inspect) declined over the period under consideration.

Figure 4.5

Ad-valorem equivalent of NTMs in Thailand between 2012 – 2021



Note. SPS is sanitary and phytosanitary, TBT is technical barriers to trade, Inspect is pre-shipment inspection and other formalities. Author's calculations from I-TIP data.

4.3 Effects on Imports

As mentioned in Chapter 3, this study first examines the impact of tariffs and FTAs, followed by the inclusion of technical NTMs in the analysis. Four types of tariff rates are considered: MFN, ITR, OTR (equivalent to NRP as discussed above), and ERP. Two measures of FTAs are also included: tariff margins and FTA utilization. The results are presented in Table 5. The findings show that the MFN rate may not effectively represent the impact of tariffs on import volume, especially compared to other measures of the tariff rate, such as ERP. A 1% increase in the MFN rate is associated with a 5.7% to 6.6% increase in import volume. In contrast, an increase in ERP tends to decrease import volume by 0.7% to 0.9%, depending on the model specification. When input tariffs (ITR) and output tariffs (OTR) are considered separately, the coefficient for ITR is statistically insignificant, suggesting that a reduction in input tariffs, despite the negative coefficient, does not significantly reduce imports. On the other hand, output tariffs show a stronger and statistically significant effect, particularly when controlling for the effect of free trade agreements (Table 4.4). The insignificance of ITR could be attributed to the aggregation of all imported products, which may mask the effects on intermediate products. As previous studies (e.g., Amiti and Konings, 2007) have shown, the significant effects of tariffs on intermediate products are more apparent when imports are disaggregated. This effect is confirmed in the results shown in Table 4.7. The free trade agreement variable demonstrates a clear positive impact on stimulating import volume in Thailand. We found that a 1% increase in FTA utilization rate positively influences import volume by 1.1%, while a 1% increase in tariff margins resulted in an approximate 2% increase in import volume.

Table 4.4

Results of separately effect of tariff and FTA

VARIABLES	(1)	(2)	(3)	(1)	(2)	(3)
Import						
MFN	1.057**			1.066**		
	(0.0271)			(0.0338)		
ERP		0.993			0.991**	
		(0.00455)			(0.00440)	
OTR			0.947**			0.936**
			(0.0245)			(0.0272)
ITR			0.957			0.986
			(0.0733)			(0.0680)
Utilization	1.011***	1.011***	1.011***			
	(0.00101)	(0.00104)	(0.00103)			
Tariff margin				1.007	1.019**	1.020**
				(0.00656)	(0.00805)	(0.00824)
Constant	2.036e+07***	3.193e+07***	4.971e+07***	1.973e+07***	3.142e+07***	4.682e+07***
	(3.349e+06)	(2.171e+06)	(1.611e+07)	(3.682e+06)	(2.268e+06)	(1.538e+07)
Observations	368,491	368,228	368,228	881,712	881,372	881,372

Note. Estimation results were obtained using the PPML method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered by exporter-year pairs, and product are shown in brackets. The results are reported in terms of the incident rate ratios (IRR), which is calculated by exponentiating the Poisson regression coefficient. The ratios, which are less than 1 and statistically significant, show that policy measures could negatively influence import structure. In all specifications, we control for country fixed effects, year fixed effects, product fixed effects, and the country-year pair fixed effects. Large constant value reflects the absorption of baseline means which is trade value. Author’s estimations.

According to the explicit effect of utilization and tariff margin, we then use T* in which output tariff is adjusted by preferential tariff from each FTA. Results are reported in Table 4.5. The results show that tariff variable T*, ERP*and OTR* show a significant negative relationship with import volume and amplified the positive impacts of trade liberalization on import volume. Increasing 1% in tariff, in term of T*, decreases import volume by 5.1%, while increasing 1% in ERP* and OTR* lowers import volume by 3.6% and 11.2% respectively. These results imply that FTA policy in Thailand could stimulate international trade between countries. On one hand, the result from T*, ERP*and OTR* becomes statistically significant in explaining import volume so that ignoring other forms of trade liberalization in investigating the impacts of tariff measures could yield biased results. On the other hand, input tariffs becoming statistically insignificant might be due to the relatively low level of input tariff in the country. Additionally, as mentioned earlier, aggregating all imported products together could contribute to this insignificance.

Table 4.5

Results of combining the effect of tariff and FTA

VARIABLES	(1)	(2)	(4)
Dependent: Import			
T*	0.949***		
	(0.00734)		
ERP*		0.964***	
		(0.00696)	
OTR*			0.888***
			(0.0200)
ITR*			0.936
			(0.0408)
Constant	2.699e+07***	3.175e+07***	5.005e+07***
	(696,380)	(2.181e+06)	(9.289e+06)
Observations	9,658,336	9,654,720	9,654,720

Note. Estimation results were obtained using the PPML method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered by exporter-year pairs, and product are shown in brackets. The results are reported in terms of the incident rate ratios (IRR), which is calculated by exponentiating the Poisson regression coefficient. The ratios, which are less than 1 and statistically significant, show that policy measures could negatively influence import structure. In all specifications, we control for country fixed effects, year fixed effect, product fixed effects, and the country-year pair fixed effects. Large constant value reflects the absorption of baseline means which is trade value. Author’s estimations.

Technical NTMs, including TBT, SPS, and Inspect, are included in the analysis along with tariffs adjusted by the impacts of FTAs. Alternatively, principal component analysis (PCA) is applied to incorporate all three types of technical NTMs. The results are presented in Table 4.6. The findings indicate that NTMs policies, particularly TBT, enhance confidence in the quality of imported products, thereby stimulating import demand in Thailand. Imposing additional TBT can significantly increase import volume by 1.7%. In contrast, SPS and Inspect have an insignificant effect on import volume, despite their positive coefficients. The insignificance of SPS and pre-shipment inspections may stem from the fact that SPS measures are primarily imposed on agriculture and food imports, which are likely to be more protected than manufacturing products, while TBT measures are more commonly applied to manufacturing products. Previous studies, such as Jongwanich (2009) and Jouanjean et al. (2015), have identified potential negative impacts of SPS on agriculture and food products. These results remain consistent when we replace the tariff measures with ERP*, OTR*, and ITR* in the analysis, and also when applying PCA. Overall, the positive impact of technical NTMs, especially TBT, aligns with findings in many previous studies (e.g., Cadot et al., 2018; Akintola et al., 2021).

Table 4.6

Results of combining the effect of tariff, FTA and NTMs by using PCA

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Dependent: Import						
T*	0.949***	0.949***	0.949***	0.949***	0.949***	0.949***
	(0.00730)	(0.00732)	(0.00734)	(0.00727)	(0.00733)	(0.00729)
SPS	1.014			1.013		
	(0.0106)			(0.0105)		
TBT		1.017**		1.018**		
		(0.00788)		(0.00833)		
Inspect			1.016	0.959		
			(0.0671)	(0.0693)		
PCA (correlation)					1.088*	
					(0.0516)	
PCA (covariance)						1.018
						(0.0112)
Constant	2.593e+07***	2.519e+07***	2.679e+07***	2.467e+07***	2.667e+07***	2.532e+07***
	(1.064e+06)	(1.089e+06)	(989,404)	(1.405e+06)	(740,163)	(1.278e+06)
Observations	9,658,336	9,658,336	9,658,336	9,658,336	9,658,336	9,658,336

Note. PCA (covariance) is principal-component factors analysis using covariance; PCA (correlation) is principal-component factors analysis using correlation. Estimation results were obtained using the PPML method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered by exporter-year pairs, and product are shown in brackets. The results are reported in terms of the incident rate ratios (IRR), which is calculated by exponentiating the Poisson regression coefficient. The ratios, which are less than 1 and statistically significant, show that policy measures could negatively influence import structure. In all specifications, we control for country fixed effects, year fixed effects, product fixed effects, and the country-year pair fixed effects. Large constant value reflects the absorption of baseline means which is trade value. Author's estimations.

Tariffs and NTMs policies show different effects on each type of product. We categorize imported products into three types: capital, intermediate, and finished products. The results show that intermediate products are the most sensitive to changes in tariff rates. A 1% increase in the tariff rate (in terms of T*) decreases the import volume of intermediate products by 6%. For finished products and capital products, a 1% increase in the tariff rate (in terms of T*) decreases import volume by 4.7% and 4%, respectively (Table 4.7). These results imply that tariff policy in Thailand, including both standard tariffs and preferential tariffs from FTAs, can significantly influence imported products, particularly intermediate products.. Intermediate products are also the only category that shows a significant effect when technical NTMs are considered. While TBT plays a dominant role in this positive effect, controlling the quality of intermediate manufacturing products helps stimulate their import volume, which, in turn, could enhance overall production quality.

Table 4.7

Interpretation result by group of products.

VARIABLES	capital product		intermediate product.		Finished product.	
	(1)	(2)	(1)	(2)	(1)	(2)
Import						
T*	0.960***		0.940***		0.953***	
	(0.00752)		(0.0159)		(0.00711)	
ERP*		0.963***		0.955***		0.969***
		(0.0132)		(0.0101)		(0.00609)
PCA	1.367	1.351	1.075	1.111*	1.040	1.069
(correlation)	(0.401)	(0.380)	(0.0645)	(0.0648)	(0.0639)	(0.0662)
Constant	2.256e+07***	2.858e+07***	3.661e+07***	4.718e+07***	1.790e+07***	1.777e+07***
	(975,905)	(4.661e+06)	(1.767e+06)	(4.554e+06)	(1.640e+06)	(1.837e+06)
Observations	1,287,687	1,287,687	6,071,400	6,067,800	2,810,385	2,808,580

Note. PCA (correlation) is principal-component factors analysis using correlation. Estimation results were obtained using the PPML method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered by exporter-year pairs, and product are shown in brackets. The results are reported in terms of the incident rate ratios (IRR), which is calculated by exponentiating the Poisson regression coefficient. The ratios, which are less than 1 and statistically significant, show that policy measures could negatively influence import structure. In all specifications, we control for country fixed effects, year fixed effects, product fixed effects, and the country-year pair fixed effects. Large constant value reflects the absorption of baseline means which is trade value. Author’s estimations.

When imports from developed and developing countries are considered separately, the results reveal a positive and significant impact of NTMs only for imports from developed countries (Table 4.8). This suggests that NTMs policies in Thailand may establish higher product standards, leading to higher compliance costs for exporters from LDCs (Least Developed Countries) and developing countries compared to those from developed countries. Specifically, technical NTMs tend to increase imports from developed countries by 14.1%. In contrast, the implementation of NTMs policies does not significantly affect imports from developing countries or LDCs. However, the relationship between NTMs policies and imports from these two groups of countries differs. While the NTMs coefficient shows a positive relationship with imports from developing countries, it has a negative relationship with imports from LDCs. This may indicate that the compliance costs are higher for LDCs than for developing countries. Tariff policies also show the most significant effect on imports from LDCs, followed by those from developing countries. A 1% increase in tariffs (adjusted by preferential tariffs, i.e., T*) reduces imports from LDCs by 9.3%, and from developing countries by 7.3%. In contrast, the effect on imports from developed countries is much smaller, decreasing by only 1.3%, and is statistically insignificant. These results suggest that imports from LDCs and developing countries are more price-sensitive, while the higher quality of imports from developed countries results in a relatively lower impact from tariffs imposed by Thailand. The results obtained using ERP* and ITR* measures are consistent with those from T*.

Table 4.8

Interpretation result by country groups

VARIABLES	Overall	Developed countries	Developing Countries	Least Developed countries
Import				
T^*	0.949***	0.987	0.927***	0.907***
	(0.00733)	(0.0110)	(0.0119)	(0.0194)
PCA	1.088*	1.141**	1.045	0.718
(correlation)	(0.0516)	(0.0648)	(0.0652)	(0.270)
Constant	2.667e+07***	2.086e+07***	4.499e+07***	1.227e+08***
	(740,163)	(1.124e+06)	(1.670e+06)	(2.593e+07)
Observations	9,658,336	2,608,092	4,884,064	1,311,052

Note. PCA (correlation) is principal-component factors analysis using correlation. Estimation results were obtained using the PPML method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered by exporter-year pairs, and product are shown in brackets. The results are reported in terms of the incident rate ratios (IRR), which is calculated by exponentiating the Poisson regression coefficient. The ratios, which are less than 1 and statistically significant, show that policy measures could negatively influence import structure. In all specifications, we control for country fixed effects, year fixed effects, product fixed effects, and the country-year pair fixed effects. Large constant value reflects the absorption of baseline means which is trade value. Author's estimations.

4.4 Conclusions

This study examines the effects of tariffs, non-tariff measures, and free trade agreements on import volume in Thailand. The study shows that tariff protection in Thailand decreased significantly between 2012 and 2021, but the level of protection in certain sectors, especially for finished products, increased during this period. The effective rate of protection (ERP) is nearly twice as high as the nominal rate of protection (NRP) across all sectors. Although Thailand engaged in 14 free trade agreements during this period, effectively reducing tariff margins under these agreements, the average utilization rate remains below 25%. Interestingly, in countries that have both bilateral and multilateral agreements, the utilization rate for bilateral agreements is significantly higher than for multilateral agreements. China, Vietnam, and Indonesia are the top three countries benefiting from preferential tariff rates to reduce tariff protection in Thailand. Non-tariff measures (NTMs) in Thailand have increased substantially since 2012, covering around 60% of all products. Sanitary and phytosanitary (SPS) measures, along with technical barriers to trade (TBT), are the two primary policy tools in the country. The relatively even distribution of NTMs across both high- and low-value imported products is evident based on coverage ratio and frequency index.

The estimation results show that the nominal tariff rate does not accurately represent the actual tariff protection in the country, while the effective rate of protection (ERP) reveals a greater impact on import volume. Preferential tariff rates under free trade agreements also play an important role in amplifying the positive impacts of trade liberalization on import volume, although the utilization rate remains relatively low. The results further indicate that non-tariff measures (NTMs) enhance confidence in the quality of imported products, stimulating demand for imports in Thailand, especially with regard to technical barriers to trade (TBT). The insignificance of sanitary and phytosanitary (SPS) measures and pre-shipment inspection (Inspect) could be due to the fact that SPS measures are primarily applied to agricultural and food, which are typically more protected than manufacturing products, while TBT measures are more commonly required for manufacturing products.

Additionally, tariffs and NTMs policies show different effects on various product categories. Intermediate products are the most sensitive to changes in tariff rates, followed by finished products and capital goods, respectively. In country-specific analysis, the positive and significant impact of NTMs is observed only in developed countries. This suggests that NTMs policies, which raise product standards, are likely to impose higher compliance costs on exporters from LDCs and developing countries compared to those from developed countries. Regarding tariff measures, their negative and significant impact on imported products from LDCs and developing countries reflects the price sensitivity of these products, while the relatively higher quality of imports from developed countries leads to insignificant effects of tariffs imposed by Thailand.

CHAPTER 5
TRADE POLICY AND FIRM'S PERFORMANCE

This chapter provides the analysis of trade policy on Thai firm performance from 2007 to 2012 using industry census data retrieved from the Office of the National Economic and Social Development Council (NESDB). We first examine and discuss how to measure the firm's productivity using three different methods. Then, we analyze the effect of trade policy on firms' performance in Thailand.

5.1 Firm Performance

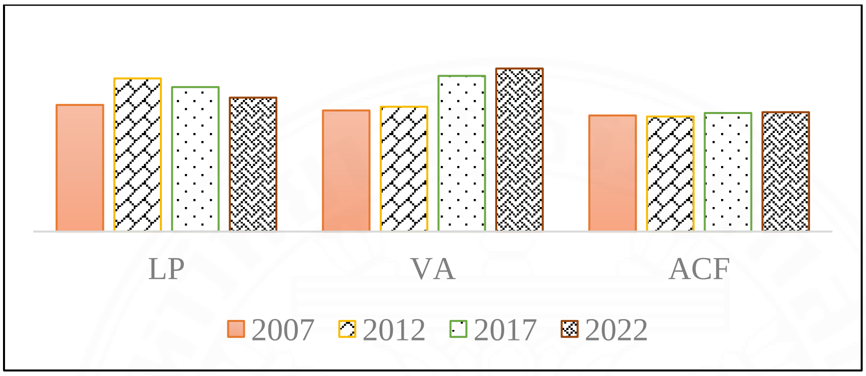
According to the industry census data, we obtain data from 3,743 firms which continuously collected between 2007 and 2022 (collected every 5 years). We then calculate the firm's productivity in terms of total factor productivity (TFP) using the estimation methods of Levinsohn and Petrin (LP) (2003) and Ackerberg et al. (ACF) (2015). In addition, we also calculate the value added per worker (VA) as the representative of TFP.[1] Figure 5.1 depicts the TFP calculation in log form which is calculated using LP, ACF and VA. The results show an increase in TFP from 2007 to 2012 for all three methods, but a different picture after 2012 is evident. For example, TFP calculated by ACF method shows a decreasing trend in 2012 before increasing in 2017 and 2022. At the same time, TFP calculated by VA method shows a stable productivity level between 2007 and 2012 before increasing in 2017 and 2022. While the former two methods show an Increase between 2012 and 2022, TFP calculated by LP method increases between 2007 and 2012 and then displays a decreasing trend until 2022. In other words, the result from VA aligns with that from the ACF estimation while the result from LP estimation method deviates from other two results. The

[1] Even though gross output is a more appropriate approach in detailed measures of productivity, the value-added measure cannot be ignored in the productivity analysis with labor and capital (see Gandhi et al., 2020).

disadvantage of LP method as mentioned in Chapter 3, helps explain such findings. Below the results of ACF method and VA are explained separately in detail. Results from the LP method are reported in Appendix B for the sake of comparison.

Figure 5.1

TFP calculation by ACF, value added (VA) and LP



Note. Author's calculation from Thai Industrial and Business Census provided by National Statistical Office

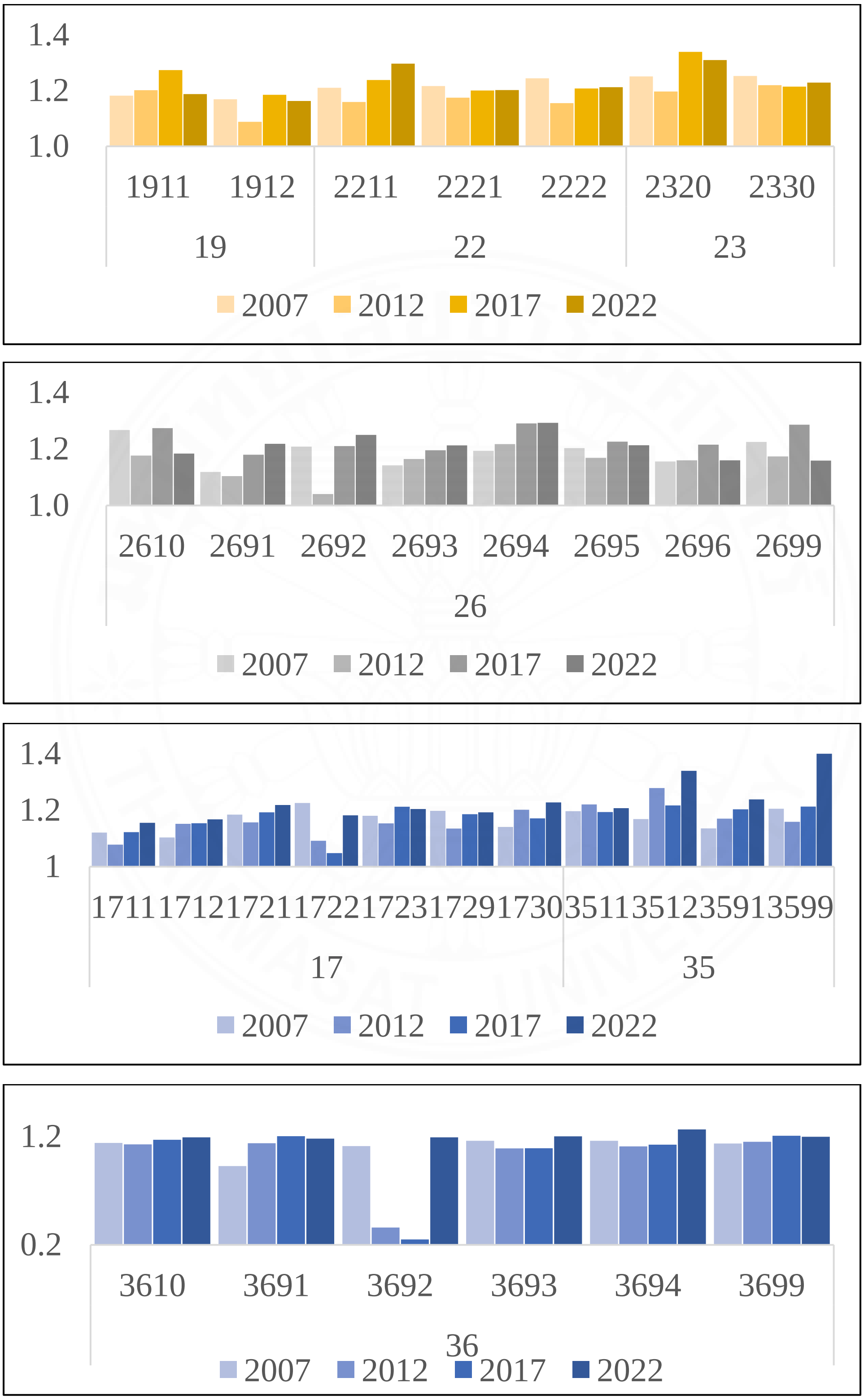
Concerning the ACF estimation, the source of decrease in productivity during 2007-2012 come from the flooding in Thailand in 2011, low investment in infrastructure and slow growth in FDI. These results imply that previous industrial policies fail to improve firm productivity in Thailand during this period (Jongwanich and Kohpaiboon, 2020). At a sectoral level, the sources of decrease in productivity during the period 2007-2012 arise from the tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (division 19), the publishing, printing and reproduction of recorded media (division 22) and the manufacture of coke, refined petroleum products and nuclear fuel (division 23). While the decrease in the tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (division 19) purely come from the manufacture of luggage, handbags and the like, saddlery and harness (division 1912), all sub-division in the publishing, printing and reproduction of recorded media (division 22) and the manufacture of coke, refined petroleum products and nuclear fuel (division 23) show a decrease in productivity. Precisely, the main source of decrease in the publishing, printing and reproduction of recorded media (division 22) comes from service activities related to printing (division 2222) and the main source of decrease the manufacture of coke, refined petroleum products and nuclear fuel (division 23) comes from the manufacture of refined petroleum products (division 2320).

Subsequently, productivity increases during 2017-2022, with a noticeable adjustment in 2012-2017. Interestingly, the main source of productivity increase during 2012-2017 comes from the publishing, printing and reproduction of recorded media (division 22) and the manufacture of coke, refined petroleum products and nuclear fuel (division 23). The service activities' productivity increase, related to printing (division 2222) , is a main driver for productivity improvement in the publishing, printing and reproduction of recorded media (division 22). The manufacture of refined petroleum products (division 2320) is the main driving source of productivity in the manufacture of coke, refined petroleum products and nuclear fuel (division 23). Another source of productivity increases during this period is from the manufacture of other non-metallic mineral products (division 26) in which the manufacture of refractory ceramic products (sub-division 2692) is the key sub-sector driving force.

During the period 2017-2022, productivity also continuously increases but at a lower rate and the driven divisions are different from the previous period. The reason comes from COVID-19 incident in 2019 which affects the global supply chain and slowdown the productivity growth in Thailand. The main source of productivity increases in this period comes from the manufacture of textiles (division 17), the manufacture of other transport equipment (division 35) and the manufacture of furniture (division 36). For the manufacture of textiles (division 17), the largest increase in productivity comes from the manufacture of carpets and rugs (sub-division 1722). While the manufacture of musical instruments (sub-division 3692) is the main sub-division driving the productivity improvement in the manufacture of furniture (division 36), in the manufacture of other transport equipment (division 35), the source of productivity increases comes from the building and repairing of pleasure and sporting boats (sub-division 3512) and the manufacture of other transport equipment (sub-division 3599). Overall, in TFP estimation using ACF methodology, we find that only 3 out of 22 divisions show a decrease in productivity when comparing those in 2022 with 2007.

Figure 5.2

The main driven source in each period of productivity estimates from ACF



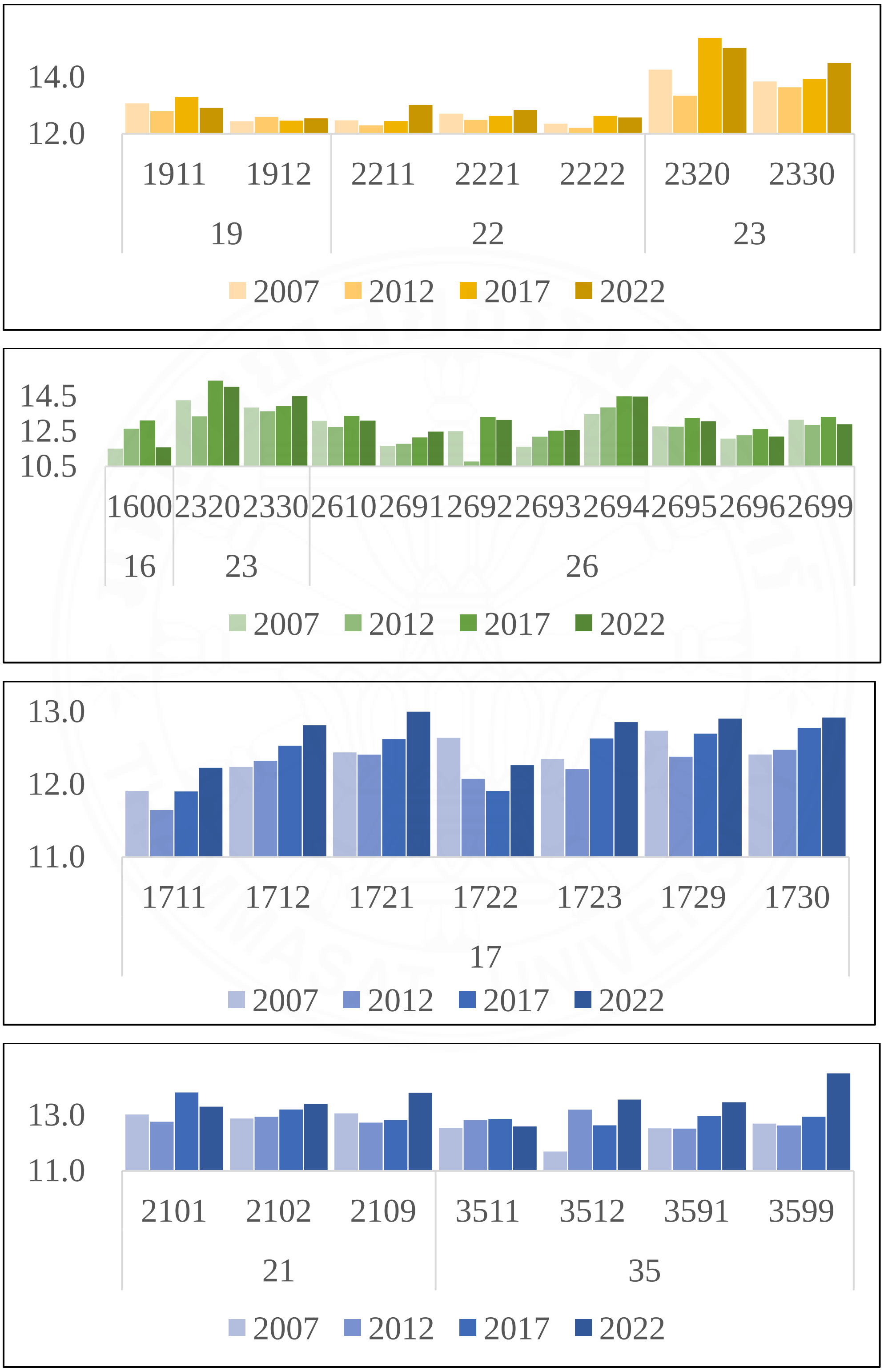
Note. Code of industry following Thailand Standard Industrial Classification (TSIC). Author's calculation from Thai Industrial and Business Census provided by National Statistical Office

The result of VA method consistent with the result revealed in the ACF method. The source of decrease in productivity comes from the tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (division 19), the publishing, printing and reproduction of recorded media (division 22) and the manufacture of coke, refined petroleum products and nuclear fuel (division 23). However, the main source of productivity reduction in tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (division 19) when VA method is applied, comes from the Tanning and dressing of leather (sub-division 1911).

However, TFP does not decline during 2012-2017, partly due to the productivity increase in the manufacture of tobacco products (division 16). Productivity continuously increases during the period 2012-2017. The other main source of productivity increases during this period comes from the manufacture of coke, refined petroleum products and nuclear fuel (division 23) and manufacture of other non-metallic mineral products (division 26). The result shows the main sub-division driving TFP changes as in ACF estimation which are the manufacture of refined petroleum products (division 2320) and the manufacture of refractory ceramic products (sub-division 2692), respectively. Even during the period 2017-2022, the results resemble those observed by using the ACF estimation. The main source of productivity increases during this period are the manufacture of textiles (division 17), the manufacture of paper and paper products (division 21) and the manufacture of other transport equipment (division 35). While the sub-division contributing to productivity improvements for the manufacture of other transport equipment (division 35) remains the same as in ACF results, the sub-division driving the manufacture of textiles' productivity changes (division 17) is the manufacture of made-up textile articles, except apparel (sub-division 1721). For the manufacture of paper and paper products (division 21), the manufacture of other articles of paper and paperboard (sub-division 2109) plays the main role to drive the productivity increases in this division.

Figure 5.3

The main driven source in each period of productivity estimates from VA



Note. Code of industry following Thailand Standard Industrial Classification (TSIC). Author's calculation from Thai Industrial and Business Census provided by National Statistical Office

All in all, the TFP only shows a steady increase during the period 2007-2022. This result is also consistent with the result when we weight output with sectoral price data. The result of sectoral price weighted was shown in Appendix C

5.2 Empirical Result

According to the different results in TFP estimation, we use the TFP result from ACF and VA methods as the dependent variable to explore the effect of trade policy on firm productivity. The equation used in this section is the following equation (16) as we mentioned in chapter 3. Note that all variables are in logarithm formula. The study period covers the data from 2012 to 2022. The results when the LP method is employed are reported in Appendix B.

Initially, we use both fixed effect and random effect in the estimation method. Nevertheless, the Hausman test suggests that fixed effect is more appropriated. Therefore, we show only fixed-effect model in this chapter. Also, we report only the results of ACF since the results from ACF and VA are similar (see Appendix D). The results from LP are higher and significantly compared to ACF. We first explore the effect of tariff and FTA variables which are utilization rates and tariff margins. Then, we combine them to represent tariff protection and add NTMs variables. Results are reported in table 5.1.

In terms of tariff protection, while effective rate of protection (ERP) and output tariff rate (OTR) do not affect firm productivity, tariff rates represented by MFN and input tariff rate (ITR) show a significant effect on firm productivity. An increase in MFN of 1 % decreased firm productivity by 0.025% on average, whereas an increase in ITR by 1% decreased firm productivity by 0.052% - 0.064% on average. The larger effect of ITR compared to MFN and the insignificant effect of OTR suggest that the input tariff rate should be prioritized in policy discussions when revising the tariff rates in the HS nomenclature. The importance of input tariff on productivity and insignificant effect from output tariff are aligns with Amitit and Kongnings (2007), Bas et al. (2016), Ahn et al. (2019) and Jongwanich and Kohpaiboon (2020). These results confirm that lowering intermediate input cost by reducing input tariff rate can stimulate firm productivity in Thailand. Free trade agreements also have an impressive effect on firm productivity. Regarding impacts of FTAs, an increase of 1% in FTA utilization can raise firm productivity by 0.034% to 0.052%, depending on the model specifications. This result is consistent with Linarello (2018) and Jamil et al. (2022) that tariff reduction from FTA can directly improve firm productivity. However, the result implies that researchers should carefully use the tariff margin with tariff rate since these two variables are closely related.

Interestingly, ERP turns out to be insignificant in improving firms' productivity. This result differs from Jongwanich and Kohpaiboon (2020), where ERP tends to play a role in influencing firms' productivity in Thailand. The differences in the results could be due to sample extension, including the new census in 2022. The number of firms under the panel-data decline substantially, probably due to the COVID-19, which causes a significant reduction in the sample sizes. The Covid-19 dummy variable, which equals to one for the last industrial census published in 2022 and zero otherwise cannot capture changes in impacts of tariffs on firms' productivity before and after the COVID-19. To clearly examine such possible impacts, the slope dummy variables between the COVID-19 and different kinds of tariffs are introduced in the model.[1] The results are reported in Table 5.2.

[1] Note that when we exclude the census 2022 from dataset, we found that an decreasing in tariff in all 4 terms can increase firm productivity in Thailand which consistent with Jongwanich and Kohpaiboon (2020). This result confirms us that sample extension from new census in 2022 affected to estimation result in Thailand.

Table 5.1

Results of separate effect of tariff and FTA on TFP by ACF method

VARIABLES	ACF					
XI	-0.003	-0.010*	-0.001	-0.002	-0.008	-0.001
	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)
MI	-0.006	-0.005	-0.008	0.003	0.003	-0.002
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.005)
RDI	0.007	0.009*	0.005	0.009*	0.011*	0.006
	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)
Skill	0.004*	0.004**	0.004*	0.004*	0.005**	0.003*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
HHI	-0.003	-0.003	-0.002	0.008*	-0.006	-0.001
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)
Covid-19	0.026***	0.033***	0.021***	0.020***	0.034***	0.020***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
MFN	-0.025**			-0.689***		
	(0.012)			(0.086)		
ERP		-0.006			0.006	
		(0.008)			(0.011)	
OTR			-0.014			-0.048
			(0.018)			(0.031)
ITR			-0.052***			-0.064***
			(0.018)			(0.017)
Utilization	0.040***	0.052***	0.034***			
	(0.012)	(0.013)	(0.012)			
Margin				0.710***	-0.018	0.039*
				(0.090)	(0.018)	(0.023)
Constant	1.249***	1.159***	1.311***	1.357***	1.342***	1.436***
	(0.051)	(0.054)	(0.059)	(0.034)	(0.039)	(0.047)
Observations	8,810	8,227	8,810	8,814	8,227	8,814
R-squared	0.015	0.018	0.016	0.024	0.015	0.015
Number of ID	3,443	3,252	3,443	3,447	3,252	3,447

Note. XI is share of export on output in industry; MI is share of import on intermediate input in industry; RDI is share of research and development on expenditure in industry; Skill is share of skilled labor on labor; HHI is Hirschman Herfindahl index in industry; Covid-19 is the dummy variable represent covid-19 which equal to 1 in period 2022; MFN is most flavor nation tariff rate; ERP is effective rate of protection; OTR is output tariff rate; ITR is input tariff rate; Utilization is the FTA utilization and Margin is tariff margin from FTA. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Estimation results were obtained using the Fixed effect regression method. Author's estimations.

Table 5.2 reports the estimation results by ACF and VA estimation. Tariff policies and FTAs show the different effects on firms' productivity after Covid-19 incident. Before Covid-19, an increase in tariff rate in terms of MFN, ERP, OTR and ITR decreased firm productivity. Trade liberalization, both through output and input tariffs, helps stimulate firms' productivity. However, the opposite results are observed after the COVID-19, except input tariffs where the slope dummy between the COVID-19 and ITR is statistically insignificant. After the Covid-19, the overall impacts of tariffs – MFN, ERP and OTR – on firms' productivity tend to be smaller, reflected by the coefficients associated with their slope dummy variables (Table 5.2). Even though the results are plausible since the impacts of the COVID-19 and the lockdown have caused both demand and supply interruption, so that trade policy is likely to play a less important role in influencing productivity during periods. However, due to data limitations, in this the Covid-19 variable is only one year observation. Thus, this study cannot fully confirm whether the lower impact of tariff rate in stimulating productivity was mainly attributed to the COVID-19 incidence. The finding of this result, however, could be a reference point for future research.

Table 5.2

Results of separately effect of tariff and FTA on TFP

VARIABLES		ACF			VA	
XI	-0.002	-0.010*	0.000	-0.026	-0.099*	0.002
	(0.005)	(0.006)	(0.005)	(0.048)	(0.051)	(0.048)
MI	-0.006	-0.007	-0.008	-0.041	-0.040	-0.062
	(0.006)	(0.006)	(0.006)	(0.051)	(0.052)	(0.052)
RDI	0.004	0.010*	0.003	-0.062	-0.020	-0.083*
	(0.005)	(0.006)	(0.005)	(0.047)	(0.049)	(0.048)
Skill	0.004*	0.004**	0.003*	0.049***	0.059***	0.048***
	(0.002)	(0.002)	(0.002)	(0.018)	(0.019)	(0.018)
HHI	-0.003	-0.006	-0.002	-0.067*	-0.096**	-0.052
	(0.004)	(0.005)	(0.005)	(0.040)	(0.042)	(0.041)
Covid-19	-0.013	0.009	-0.025	0.152	0.392**	-0.002
	(0.021)	(0.020)	(0.020)	(0.191)	(0.174)	(0.181)
MFN	-0.049***			-0.431***		
	(0.014)			(0.123)		
ERP		-0.022**			-0.197**	
		(0.009)			(0.084)	
OTR			-0.058***			-0.457**
			(0.021)			(0.190)
ITR			-0.039*			-0.510***
			(0.020)			(0.184)
Utilization	0.035***	0.054***	0.031**	0.436***	0.567***	0.375***
	(0.013)	(0.014)	(0.013)	(0.114)	(0.121)	(0.117)
Covid-19 x MFN	0.014***			0.117***		
	(0.004)			(0.035)		
Covid-19 x ERP		0.015***			0.123***	
		(0.004)			(0.036)	
Covid-19 x OTR			0.017***			0.112**
			(0.006)			(0.051)
Covid-19 x ITR			-0.002			0.004
			(0.004)			(0.040)
Covid-19 x Util	0.001	-0.008	0.001	-0.068	-0.155***	-0.038
	(0.007)	(0.007)	(0.007)	(0.067)	(0.058)	(0.062)
Constant	1.319***	1.196***	1.403***	12.164***	11.180***	13.090***
	(0.058)	(0.057)	(0.066)	(0.520)	(0.506)	(0.599)
Observations	8,810	8,227	8,810	8,683	8,112	8,683
R-squared	0.019	0.021	0.020	0.030	0.033	0.032
Number of ID	3,443	3,252	3,443	3,437	3,246	3,437

Note. XI is share of export on output in industry; MI is share of import on intermediate input in industry; RDI is share of research and development on expenditure in industry; Skill is share of skilled labor on labor; HHI is Hirschman Herfindahl index in industry; Covid-19 is the dummy variable represent covid-19 which equal to 1 in period 2022; MFN is most flavor nation tariff rate; ERP is effective rate of protection; OTR is output tariff rate; ITR is input tariff rate; Utilization is the FTA utilization and Margin is tariff margin from FTA. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Estimation results were obtained using the Fixed effect regression method. Author's estimations.

When sectoral analysis is considered[1], the impact of tariff on productivity tends to decline in all industries (Table 5.3). Especially, the results show that the impacts of tariffs tend to decline substantially in the manufacture of textiles (division 17), the manufacture of coke, refined petroleum products and nuclear fuel (division 23) and manufacture of other non-metallic mineral products (division 26) where COVID-19 and global uncertainty have caused a significantly sectoral slowdown in this sector (see Appendix E). However, as mentioned earlier, the results should be interpreted with caution since observations included as panel-data analysis are relatively small after the latest census published in 2022 is included in the analysis.

Table 5.3

Result of sectoral analysis of tariff on TFP before and after COVID-19

VARIABLES	ACF			
XI	-0.002	-0.001	-0.007	-0.006
	(0.005)	(0.005)	(0.006)	(0.006)
MI	-0.006	-0.009	0.005	-0.002
	(0.006)	(0.007)	(0.007)	(0.007)
RDI	0.007	0.009	0.015**	0.022***
	(0.005)	(0.006)	(0.006)	(0.006)
Skill	0.003*	0.003*	0.004*	0.004*
	(0.002)	(0.002)	(0.002)	(0.002)
HHI	-0.003	-0.004	-0.006	-0.005
	(0.004)	(0.005)	(0.005)	(0.005)
Covid-19	-0.016	-0.011	-0.015	-0.015
	(0.022)	(0.024)	(0.021)	(0.023)
MFN	-0.051***	-0.054***		
	(0.016)	(0.016)		
ERP			-0.019*	-0.028***
			(0.010)	(0.011)

[1] Sectoral analysis following the analysis in section 5.1 which show the explicit result from division 17, division 19, division 21, division 23, division 26, division 31, division 34, division 35 and vision 36. Division 22 has been dropped from the analysis because lacking information about import and export from this industry

Table 5.3

Result of sectoral analysis of tariff on TFP before and after COVID-19 (Cont.)

VARIABLES	ACF			
Utilization	0.033**	0.034**	0.055***	0.049***
	(0.014)	(0.014)	(0.016)	(0.016)
Covid-19 x MFN	0.015***	0.016***		
	(0.004)	(0.005)		
Covid-19 x ERP			0.017***	0.022***
			(0.005)	(0.005)
Covid-19 x Util	0.001	-0.002	-0.006	-0.010
	(0.008)	(0.008)	(0.007)	(0.008)
MFN x Ind19	-0.789*	-0.797*		
	(0.444)	(0.447)		
MFN x Ind23	0.214	-4.279***		
	(0.565)	(1.438)		
MFN x Ind31	0.050	0.028		
	(0.161)	(0.168)		
MFN x Ind34	0.198	0.178		
	(0.655)	(0.663)		
MFN x Ind17	-1.866***	-1.519**		
	(0.611)	(0.691)		
MFN x Ind35	-2.398	-1.123		
	(7.068)	(7.282)		
MFN x Ind36	0.007	0.016		
	(0.025)	(0.026)		
MFN x Ind21	-0.118	-0.077		
	(0.088)	(0.096)		
MFN x Ind26	-0.622***	-0.671***		
	(0.166)	(0.191)		
Covid-19 x MFN x Ind19		-0.001		
		(0.006)		
Covid-19 x MFN x Ind23		0.638***		
		(0.185)		
Covid-19 x MFN x Ind31		-0.004		
		(0.010)		
Covid-19 x MFN x Ind34		-0.000		
		(0.005)		

Table 5.3

Result of sectoral analysis of tariff on TFP before and after COVID-19 (Cont.)

VARIABLES	ACF		
Covid-19 x MFN x Ind17	0.008		
	(0.007)		
Covid-19 x MFN x Ind35	-0.007		
	(0.009)		
Covid-19 x MFN x Ind36	0.004		
	(0.005)		
Covid-19 x MFN x Ind21	0.010		
	(0.009)		
Covid-19 x MFN x Ind26	-0.002		
	(0.006)		
ERP x Ind19		-0.022	-0.174
		(0.301)	(0.365)
ERP x Ind23		-4.235***	-4.475***
		(1.372)	(1.382)
ERP x Ind31		0.014	0.006
		(0.119)	(0.120)
ERP x Ind34		0.039	-0.136
		(0.242)	(0.352)
ERP x Ind17		0.266**	0.250**
		(0.109)	(0.112)
ERP x Ind35		-0.011	-0.417
		(0.299)	(0.393)
ERP x Ind36		-0.032	-0.011
		(0.027)	(0.030)
ERP x Ind21		-0.118	-0.126
		(0.096)	(0.097)
ERP x Ind26		-0.460***	-0.841***
		(0.109)	(0.162)
Covid-19 x ERP x Ind19			0.003
			(0.006)
Covid-19 x ERP x Ind23			0.041**
			(0.020)
Covid-19 x ERP x Ind31			0.005
			(0.008)

Table 5.3

Result of sectoral analysis of tariff on TFP before and after COVID-19 (Cont.)

VARIABLES	ACF			
Covid-19 x ERP x Ind34				-0.003
				(0.005)
Covid-19 x ERP x Ind17				0.011**
				(0.004)
Covid-19 x ERP x Ind35				-0.014
				(0.010)
Covid-19 x ERP x Ind36				0.003
				(0.004)
Covid-19 x ERP x Ind21				0.008
				(0.005)
Covid-19 x ERP x Ind26				-0.016***
				(0.005)
Constant	1.827***	1.756***	1.398***	1.641***
	(0.299)	(0.318)	(0.105)	(0.130)
Observations	8,810	8,810	8,227	8,227
R-squared	0.024	0.027	0.027	0.032
Number of ID	3,443	3,443	3,252	3,252

Note. PCA (covariance) is principal-component factors analysis using covariance; PCA (correlation) is principal-component factors analysis using correlation; other factors and estimation methods see table 5.2. Note2: Ind19 is the tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (division19); Ind 23 is the manufacture of coke, refined petroleum products and nuclear fuel (division 23); Ind31 is the manufacture of electrical machinery and apparatus n.e.c. ;Ind34 is the manufacture of motor vehicles, trailers and simi-trailers ; Ind17 is the manufacture of textiles (division 17); Ind 35 is the manufacture of other transport equipment (division 35); Ind 36 is the manufacture of furniture (division 36); Ind 21 is the manufacture of paper and paper products (division 21) and Ind26 is the manufacture of other non-metallic mineral products (division 26). Author's estimations.

FTA utilization reports the same result as shown in the tariff policies. An increase in FTA utilization increases productivity before Covid-19, but it negatively affects firms' productivity after Covid-19 incident. Notably, LP estimation methods show different results from ACF and VA, however, the results are inconsistency between model specifications (See Appendix B).

In sum, the results show an importance of tariff policy both in terms of input tariff and trade agreement on firm productivity in Thailand. To avoid the correlation between tariff and tariff margin, we then use T* in which output tariff is adjusted by preferential tariff from each FTA. The results are reported in Table 5.4. The result is consistent with the result shown in table 5.2 in which an increase in tariff rate in terms of MFN, ERP, OTR and ITR decreases firm productivity before Covid-19 but their impact on productivity declined after Covid-19. However, the result becomes more robust since the (robust) standard errors decrease and the effect of input tariff rate on firms' productivity is amplified.

For industry variables, human capital is important to improve firms' productivity as reflected by a positive coefficient of skilled labor. Greater market concentration represented by an increase in HHI decreases firms' productivity. This implies that competition is important to enhance firms' productivity in Thailand. Surprisingly, the results show that the share of imports and share of exports do not have a significant effect in influencing firms' productivity. This result may come from the lack of information in the Thailand Census because only 20 percent of firms in this dataset report import and export share. While research and development show the influential effect to firms' productivity using ACF, it becomes insignificant when VA is considered. This result may come from a focus of R&D expenditures, which is likely to be R&D enhancing capital efficiency, instead of labor-productivity improvements.

Table 5.4

Results of combining the effect of tariff and FTA on TFP by ACF and VA method

VARIABLES		ACF			VA	
XI	-0.003	-0.005	0.001	-0.034	-0.072	0.004
	(0.005)	(0.006)	(0.005)	(0.048)	(0.049)	(0.048)
MI	-0.001	-0.001	-0.003	0.031	0.040	-0.005
	(0.005)	(0.005)	(0.005)	(0.047)	(0.047)	(0.048)
RDI	0.005	0.011**	0.003	-0.054	-0.008	-0.081*
	(0.005)	(0.006)	(0.005)	(0.047)	(0.049)	(0.048)
Skill	0.004*	0.005**	0.003*	0.048***	0.057***	0.047**
	(0.002)	(0.002)	(0.002)	(0.018)	(0.019)	(0.018)
HHI	-0.005	-0.007	-0.003	-0.075*	-0.102**	-0.055
	(0.004)	(0.005)	(0.004)	(0.040)	(0.041)	(0.040)
Covid-19	-0.013	-0.013	-0.026**	-0.053	0.005	-0.128
	(0.010)	(0.011)	(0.011)	(0.086)	(0.101)	(0.099)
MFN*	-0.050***			-0.498***		
	(0.012)			(0.109)		
ERP*		-0.026***			-0.211***	
		(0.008)			(0.074)	
OTR*			-0.055***			-0.419**
			(0.020)			(0.178)
ITR*			-0.050***			-0.679***
			(0.019)			(0.173)
Covid-19 x MFN*	0.016***			0.116***		
	(0.003)			(0.029)		
Covid-19 x ERP*		0.014***			0.091***	
		(0.003)			(0.027)	
Covid-19 x OTR*			0.019***			0.106**
			(0.005)			(0.044)
Covid-19 x ITR*			-0.002			0.006
			(0.004)			(0.040)
Constant	1.432***	1.400***	1.505***	13.748***	13.219***	14.386***
	(0.033)	(0.032)	(0.044)	(0.294)	(0.281)	(0.394)
Observations	8,814	8,274	8,814	8,687	8,158	8,687
R-squared	0.018	0.018	0.020	0.028	0.028	0.032
Number of ID	3,447	3,260	3,447	3,441	3,253	3,441

Note. T* is tariff that combined the actual utilization of FTA by this following equation: $T^{*}_{ijt} = \left(1 - \sum_{f=1}^{n} UR_f\right) T_{ijt} + \left(\sum_{f=1}^{n} UR_f\right) PT_{ijt}$; ERP* is effective rate of protection calculated from T*; OTR* is output tariff rate and ITR* is input tariff rate following as Amiti and Konning (2007) calculated from T*; Distance, Language, Exporter population and Exporter GDP are gravity variables. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Estimation results were obtained using the Fixed effect regression method. Other variables see table 5.1. Author's estimations.

We then add the NTMs variables in the estimation equation and the results are reported in Table 5.5. The result shows a significant positive effect from NTMs policy on firm productivity. The technical barrier to trade (TBT) shows the largest effect when separately estimated, followed by sanitary and phytosanitary (SPS) and pre-shipment inspection and other formalities policy (Inspect). While an increase of 1% in SPS and Inspect increases productivity by 0.011% and 0.008% respectively, an increase of 1% in TBT increases firm productivity by 0.026%. However, when we estimate simultaneously, we find that the most outstanding NTMs policy, to increase firm productivity, is pre-shipment inspection and other formalities policy (Inspect). The result came from the revision of the Excise ACT B.E 2017 which mainly used Inspect policies to control the quality of products in many industries in the period 2017 to 2020. Therefore, after COVID-19, Inspect policies do not show the significant effect on firms' productivity.

Alternatively, as in chapter 4, we apply the principal component (PCA) analysis to include all three measures of technical NTMs to reduce overlapping elements of variables. We find that NTMs policy, as technical measure, can increase firm productivity in Thailand. An increase of 1% in the NTMs policy can increase firm productivity by 0.009% - 0.033%. However, after Covid-19, technical NTMs significantly increases firm productivity in terms of PCA analysis. The reason for the increase could come from the Medical Device Act B.E. 2019 which increases TBT policies in 2021 to control imported products. These significant positive effects of NTMs to improve firm's productivity are align with Ghodsi and Strehrer (2016), Navaretti et al. (2023), Goldar et al. (2020) and Gupta (2021). These results confirm that NTMs, which improve the quality of imported products, can stimulate firms to invest in innovation and upgrade their technology. Hencs, technology enhancement and higher quality thresholds can improves firms' productivity in Thailand.

Table 5.5

Results of combining the effect of tariff, FTA and NTMs on TFP by ACF method

VARIABLES	1	2	3	4	5	6
XI	-0.011	-0.011*	-0.003	0.007	-0.010	-0.010*
	(0.008)	(0.006)	(0.011)	(0.012)	(0.011)	(0.006)
MI	-0.011	0.004	-0.010	-0.015	-0.015	0.002
	(0.010)	(0.006)	(0.008)	(0.012)	(0.011)	(0.005)
RDI	0.005	0.006	0.004	0.014	0.010	0.008
	(0.010)	(0.006)	(0.009)	(0.014)	(0.012)	(0.006)
Skill	0.004	0.002	0.005	0.005	0.008**	0.003
	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)	(0.002)
HHI	-0.002	-0.008	-0.006	-0.019	-0.014	-0.007
	(0.008)	(0.005)	(0.009)	(0.014)	(0.010)	(0.005)
Covid-19	0.013	-0.021*	-0.018	-0.026	-0.038	-0.004
	(0.015)	(0.011)	(0.017)	(0.043)	(0.029)	(0.010)
MFN*	-0.053**	-0.049***	-0.028	-0.033	-0.002	-0.040***
	(0.021)	(0.013)	(0.018)	(0.024)	(0.034)	(0.012)
SPS	0.011**			0.048		
	(0.004)			(0.035)		
TBT		0.026***		-0.022		
		(0.007)		(0.034)		
Inspect			0.008***	0.011***		
			(0.003)	(0.003)		
PCA (correlation)					0.033***	
					(0.012)	
PCA (covariance)						0.009**
						(0.004)
Covid-19 x MFN*	0.008	0.017***	0.012***	-0.004	0.005	0.013***
	(0.005)	(0.004)	(0.005)	(0.010)	(0.008)	(0.003)
Covid-19 x SPS	-0.000			0.000		
	(0.002)			(0.004)		
Covid-19 x TBT		-0.002		0.012		
		(0.002)		(0.008)		
Covid-19 x Inspect			-0.001	-0.007		
			(0.003)	(0.006)		
Covid-19 x PCA (correlation)					0.054***	
					(0.016)	
Covid-19 x PCA (covariance)						-0.000
						(0.001)
Constant	1.403***	1.412***	1.397***	1.395***	1.280***	1.404***
	(0.059)	(0.035)	(0.054)	(0.097)	(0.105)	(0.033)
Observations	4,430	7,973	4,952	3,108	2,468	8,324
R-squared	0.022	0.021	0.015	0.029	0.032	0.018
Number of ID	2,038	3,273	2,777	1,598	1,102	3,329

Note. PCA (covariance) is principal-component factors analysis using covariance; PCA (correlation) is principal-component factors analysis using correlation; other factors and estimation methods see table 5.2. Author's estimations.

These results reflect the productivity increase from non-tariff measures (NTMs) implemented in Thailand over the past decade. For example, Cosmetics Act B.E. 2015, This polices request for the issuing of a notification receipt which complies with the rules, procedures and conditions stipulated by the government. This policy also controls the quality of cosmetic products for both domestic manufacturing and importing products. They stipulated prohibited products, e.g., unsafe for use, counterfeit and sub-standard. In addition, they also improve the quality of products by assigning sanitary condition packages, the hazardous ingredient and the impurities that posed a health risk to consumers to be the strictly prohibited products. This policy can both improve the confidence of consumers and set a higher standard of product which can enforce domestic firms to improve their quality of output. Hence, higher quality gives them more chance to entry in foreign market that can increase their productivity.

Another example is, notification of the Ministry of public health (No.412), B.E. 2019 which assigns the cleaning or sanitizing products for food. This policy has been imposed to control cleaning or sanitizing products for food as a specifically controlled food. Policy assigns the quality and standards of cleaning or sanitizing products for food following the international standard, e.g., the Combined Compendium of Food Additive Specifications, FAO JECFA Monographs, Food Chemical Codex Monograph, the Code of Federal Regulations Title 21 of the United States of America. In addition, they also stipulate the quality and standards of products, e.g., the acid-based value, methanol detected, the biodegradability of the surfactant and the concentration of the surfactant. This policy is used to control both domestical manufacturing and importing products.

Medical Devices Act B.E. 2019 is also imposed to control the standard of medical devices for both domestic manufacturing and importing products. This act is used to control at least 20 products under the medical proposals, e.g., surgical gloves, surgical gowns, medical gloves and contact lens. Table 5.6 provides some policy that imposed by Thailand between 2012 – 2021. These policies can both improve the confidence of consumers and set a higher standard of product which can enforce domestic firms to improve their quality of output. Hence, the higher quality of these products gives them more chance to enhance firms' productivity. So far, there is no notification concerning these measures submitted to WTO, possibly reflecting reasonable measures in protecting human, animal and plants outlined according to WTO/GATT provisions

Table 5.6

NTMs policy imposed by Thailand from 2012 to 2021.

Years	Official title	Main policy
2016	Ministry of Industry's ministerial notice for product standard of hot-rolled carbon steel coil, strip, plate and sheet for general structure B.E.2016	Hot-rolled carbon steel coil, strip, plate and sheet for general structure, either domestically produced or imported, is required to meet the specified product-quality requirements, i.e., size, composition, mechanical properties, and physical properties.
	Ministry of Industry's product standard of cold reduced carbon steel coil, strip and sheet of commercial and drawing qualities B.E.2016	Cold reduced carbon steel coil, strip and sheet of commercial and drawing qualities, either domestically produced or imported, is required to meet the specified product-quality requirements, i.e., size, chemical properties, mechanical properties, and physical properties.
2017	Ministry of Agriculture and Cooperatives's notice on quality and standard for raw materials to be used in especially controlled animal feed (No.4) B.E. 2017	Wheat bran to be used in animal feed, either domestically produced or imported, is required to meet the specified product-quality requirements, i.e. humidity and contents of protein, fat, meal and ash.
2018	Ministry of Public Health's miniterial notice on rules, procedures, and conditions for the manufacturing and import of cosmetic product B.E.2018	Either domestic or overseas manufacturer of cosmetic product is required to meet the internationally-recognised quality management system.

Table 5.6

NTMs policy imposed by Thailand from 2012 to 2021 (Cont.)

Years	Official title	Main policy
2019	Herbal product act B.E. 2019	Herbal product, either domestically produced or imported, is required to meet the specified product-quality requirements, e.g. containing active substances in an amount not more or less than as specified in the registered formulation.
	Ministry of Industry's ministerial notice for product standard of melamine-formaldehyde urea-formaldehyde and melamine-urea-formaldehyde utensils for food (safety requirements) B.E.2019	Melamine-formaldehyde urea-formaldehyde and melamine-urea-formaldehyde utensils for food, either domestically produced or imported, is required to meet the specified product-quality requirements, i.e., raw material and chemical properties.
	Ministry of Public Health's notice on implanted silicone breast prosthesis B.E. 2019	Either domestic or overseas manufacturer of implanted silicone breast prosthesis is required to meet the internationally-recognised quality management system.
	Ministry of Public Health's notice on injectable hyaluronic acid for treatment of ageing skin B.E. 2019	Either domestic or overseas manufacturer of injectable hyaluronic acid for treatment of ageing skin is required to meet the internationally-recognised quality management system.
2020	Ministry of Public Health's notice on standards for medical device to be domestically produced or imported B.E. 2020	Covid-19 test kits and related reagents, either domestically produced or imported, is required to meet the specified product quality, safety or performance requirements.
2021	Ministry of Public Health's notice (No.425) B.E. 2021 on hemp seed, hemp oil, protein from hemp and food containing them	Hemp seed, hemp oil, protein from hemp and food containing them, either domestically produced or imported, are required to meet the specified product quality, safety or performance requirements, e.g. composition, color, odor and taste.
	Ministry of Public Health's notice (No.421) B.E. 2021 on oil and fat	Oil and fat, either domestically produced or imported, is required to meet the specified product quality, safety or performance requirements, e.g. composition, color, odor, taste, physical and chemical properties

Note. Author's compilation.

For control variables, the result confirms the importance of skilled labor in determining firms' productivity as reflected by the positive coefficient of skill variable in all model specifications. The share of export output in industry has a significant negative effect on firm productivity. This implies that export share tends to reduce firm productivity in Thailand. However, this result may occur due to the few data of import and export by each firm in the newly published Thai industrial census as mentioned earlier.

5.3 Conclusions

Our findings show that at least two-thirds of firm productivity in Thailand increases during the period 2007-2022. The three divisions that show the greatest increase in productivity are the manufacture of coke, refined petroleum products and nuclear fuel (division 23), the manufacture of other transport equipment (division 35) and the manufacture of furniture (division 36). In contrast, the three divisions that show the least increase in productivity are the publishing, printing and reproduction of recorded media (division 22), the manufacture of office, accounting and computing machinery (division 30) and the manufacture of medical, precision and optical instruments, watches and clocks (division 33). The result from VA tends to align with that from the ACF estimation while the result from LP estimation method tends to deviate from these two results. The disadvantage of LP method, especially the unconditional (or less conditional) input demand function, tends to explain such findings.

Trade liberalization has a significant positive effect on firm productivity. We find that both tariff reduction and free trade agreement can boost firm performance in Thailand, especially tariff on intermediate input. While effective rate of protection and output tariff do not have significant effect, input tariff shows an explicit effect on firm productivity. Before COVID-19, we found that decreasing tariffs in all forms shows a significant effect to stimulate firm productivity. However, after COVID-19, a decrease in tariff will decrease firm productivity. The explicit result appears in the manufacture of textiles (division 17), the manufacture of coke, refined petroleum products and nuclear fuel (division 23) and manufacture of other non-metallic mineral products (division 26). These three industries show a significant decrease in the effect of tariff policy on firms' productivity. To be precise, the positive effect from tariff reduction before COVID-19 has decreased after COVID-19.

Both tariff margin and utilization rate of FTA show significant effects to increase firm productivity before COVID-19, while they do not show explicit effect after COVID-19. When we combine tariff and FTA (represented by T*), we find the explicit effect of tariff policy both before and after COVID-19. The explicit result also shows the same at the sectoral analysis and, especially in the manufacture of textiles (division 17), the manufacture of coke, refined petroleum products and nuclear fuel (division 23) and manufacture of other non-metallic mineral products (division 26).

The non-tariffs measure policy also has a positive significant effect on firm productivity. All technical measures including sanitary and phytosanitary measures (SPS), technical barriers to trade (TBT) and pre-shipment inspection and other formalities (Inspect) can increase firms' productivity in Thailand. These results imply that firms necessary to improve their innovation and technology following with the improvement in quality of imported product from NTMs in Thailand. Hence, NTMs policies can increase firms' productivity in Thailand. However, after COVID-19, technical measures do not show explicit effect on firms' productivity in Thailand. The reason could probably come from the little policy change after COVID-19. For industry variables, improvements in skilled labor and greater market concentration can increase firms' productivity in Thailand. The insignificant effect of the share of imports and share of exports to firms' productivity in this study may come from the lack of firm information since only 20 percent of firms in the new census reported import and export share.

CHAPTER 6
CONCLUSIONS AND IMPLICATIONS

6.1 Conclusions

This study examines the effects of tariff, non-tariff measures and free trade agreements on import volume and firm's productivity in Thailand during the period 2012-2021. We found that tariff protection in Thailand decreased noticeably for intermediated products and increase in some sector for finished products. The effective rate of protection is almost twice as large as the nominal rate of protection for all sectors. Even though Thailand has engaged in 14 free trade agreements during this period, the average utilization rate is lower than 25% of total imports due to various schemes of tariff exemption. Interestingly, in countries that have both bilateral and multilateral agreements, the utilization rate associated with the former is far higher than the latter. Non-tariff measures in Thailand have increased substantially since 2012 and covered around 60% of all products. Sanitary and phytosanitary (SPS) and technical barriers to trade (TBT) are top two NTMs imposed in Thailand. The NTMs between the high and low value of imported products are relatively well distributed based on the calculation of the coverage ratio and the frequency index.

The results show nominal tariff ra"e is'not well represented by the actual tariff protection and effective rate of protection reveals a greater impact on import volume. Preferential tariff rates under free trade agreements also play an important role in helping amplify the positive impacts of trade liberalization on import volume, though utilization rates are relatively low. The results also show that NTMs policies support the confidence in quality of imported products which stimulate the imported demand in Thailand, especially in terms of technical barrier to trade (TBT). Insignificance of SPS and pre-shipment inspection could be due to the fact that SPS measures are mostly imposed on agriculture and food imports, which are likely to be protected more than manufacturing products, while TBT measures are required more for manufacturing products.

Additionally, tariffs and NTMs policies also show different effects on each product of imports. Intermediate products are the most sensitive to changes in tariff rates, followed by finished and capital products, respectively. For country-wise analysis, the positive and significant impact of NTMs is found only in developed countries. This implies that the NTMs policy, which has created a higher standard of products, is likely to generate a higher compliance cost for exporters in LDC and developing countries than developed countries. Regarding the tariff measure, its negative and significant impacts on imported products from LDC and developing countries reflect the products' price sensitivity while the relatively high quality of imported products from developed countries results in insignificant impacts of imported tariffs imposed.

Firms' productivity in Thailand, at least two-thirds, shows an increase during the period 2007 -2022. Firms' productivity is highly sensitive to the estimation methodology used. The result from VA tends to be aligned with that from the ACF estimation, while the result from LP estimation method tends to deviate from these two results. The disadvantage of the LP method, especially the unconditional (or less conditional) input demand function that has been adopted in ACF estimation, tends to explain such findings.

The estimation results show a significant positive effect of trade liberalization on firm productivity. However, after COVID-19, trade liberalization cannot improve a firm's productivity. While reducing tariff policy, in terms of MFN, ERP, and output tariff, only help domestic firms to improve their productivity before COVID-19, reducing intermediate input tariff can improve firms' productivity even after COVID-19. Additionally, we find the explicit result appears in the manufacture of textiles (division 17), the manufacture of coke, refined petroleum products and nuclear fuel (division 23) and manufacture of other non-metallic mineral products (division 26). Free trade agreements show a stimulating effect on firms' productivity both in terms of tariff margin and FTA utilization. In line with tariff policy, FTA also harms domestic firms' productivity after COVID-19. In sum, even though domestic firms enjoyed trade liberalization before COVID-19, such liberalization has become less crucial in stimulating firms' productivity after the crisis. It is noteworthy that the results should be interpreted with caution since observations included as panel-data analysis are relatively small when the latest census published in 2022 is included in the analysis.

Non-tariff measure policies can also improve firms' productivity in Thailand. All technical measures including sanitary and phytosanitary measures (SPS), technical barriers to trade (TBT) and pre-shipment inspection and other formalities (Inspect) can stimulate firms' productivity in Thailand. This result implies that NTMs, which increase the quality of imported products, can subsequently incentivize domestic firms to improve their innovation and technology which enhances their productivity. However, the effect is not significant after COVID-19. The reason could come from the little change in NTM policy in Thailand after 2020 and the period of this study only cover between 2012- 2021. In conclusion, we find that trade liberalization policies and NTMs policies in Thailand can help domestic firms to boost their productivity, especially before COVID-19.

6.2 Policy Implications

Three policy implications can be drawn from this study. While effective rate of protection is important in assessing the impacts of trade liberalization on imports, focusing solely on reducing input tariffs while leaving output tariffs unchanged may not yield favorable results. Lowering input tariffs can boost firms' productivity by providing access to previously unavailable or higher-quality inputs. However, it may reduce firms' incentives to improve productivity due to the increased level of effective protection. Hence, policymakers should decrease output tariff simultaneously because it also strengthens firm productivity. Therefore, both input and output tariffs must be jointly taken into consideration in ensuring that trade is liberalized. However, domestic firms request some protection to recover from Covid-19 incident.

Second, as FTA negotiations are expected to further drive trade liberalization, tariff cuts under the FTA should be implemented comprehensively, with minimal exceptions. The utilization rate of FTA should be prioritized in policy discussion since it can boost both import and firm productivity (Melitz and Trefler, 2012; Hu and Liu, 2014; Moreno et al, 2023). The government should provide information and support to encourage domestic firms to utilize the benefits of FTA privileges. For example, the government should support information to domestic firms about FTA privileges, especially the information which related to rules of the origins (RoOs) since it is one of the NTM policies related to FTA. Especially, policy makers should remove produce specific rules (PSR), which is often more strictly related to the general rules, in FTA to remove the barrier to utilize the trade agreement (Cheong, 2014). In addition, the government should provide information concerning preferential tariffs and if possible, the tariff margins across in-effect FTAs to domestic firms. This information would assist them to efficiently compare costs and benefits from utilizing FTAs, especially costs concerning RoOs. The government should occasionally conduct public hearings with domestic firms to collect feedback and identify problems related to the utilization of existing FTAs. This information could then be used to renegotiate with FTA partners during upgrading meetings, as well as in negotiations with potential new FTA partners.

Third, regarding non-tariff measures (NTMs), while they help improve product quality and safety, enhancing transparency, promoting harmonization, and preventing arbitrary safety standards are crucial for better market performance. These measures can help reduce transaction costs and trade friction. Improving these aspects is expected to lead to higher-quality imported products, as more efficient producers will be able to expand their exports to the country. Therefore, the government should encourage domestic firms to strengthen their supply-side capacity, including technological upgrading, to compete with foreign products, which can comply with NTMs imposed by Thailand. Along with such encouragement, the Thai authorities should impose, or exercise NTMs basing on scientific background to ensure transparency and avoid the imposition old arbitrary food safety standards.[1]

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[1] Note that in the case of sub-standard Chinese products, non-tariff measures (NTMs) can serve as an effective tool to protect against such imports. The effectiveness of NTMs in addressing this concern depends not only on the frequency of investigations but also on the commitment and diligence of the relevant authorities.

6.3 Limitations and Future Research

This study mainly uses firm level data from Thailand industrial and business census which collected by National Statistical Office to conduct total factor productivity (TFP). This dataset is not only collected every 5 years but also has loose firms' information when the dataset has been extended. As a result, this study is unable to examine the impact of the COVID-19 pandemic effectively, given that the most recent available census data is from 2022. Therefore, we would leave the findings from this study as the reference point and foundation for future research.

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APPENDICES

APPENDIX A

STATISTICAL SUMMARY

Table A.1

Summary of data in trade performance

VARIABLES	N	MEAN	SD	MIN	MAX
MFN	10,774,000	9.53	12.6	0	83
ERP	10,770,000	17.92	33.68	-159.82	355.28
OTR	10,770,000	9.55	10.39	0	66.33
ITR	10,770,000	4.04	4.4	0.03	28.66
Utilization	368,549	20.13	35.86	0	100
Margin	899,838	8.88	12.07	0	83
SPS	10,774,000	7.02	16.75	0	133
TBT	10,774,000	3.23	6.22	0	65
Inspect	10,774,000	0.19	0.55	0	6
PCA(corr)	10,774,000	0	1.3	-0.75	12.1
PCA(cov)	10,774,000	7.56	17.15	0	141.52

Note. Author’s estimations.

Table A.2

Summary of data in firm performance

VARIABLES	N	MEAN	SD	MIN	MAX
ACF	11,219.00	1.33	0.13	-1.16	2.08
VA	11,049.00	12.92	1.36	5.43	20.12
LP	11,229.00	12.24	1.8	-5.01	21.4
XI	10,809.00	-2.12	1.01	-3.78	0
MI	10,912.00	-2.09	0.93	-3.85	0
RDI	10,815.00	-1.98	0.93	-3.89	0
Skill	10,096.00	-0.66	0.87	-6.64	0
HHI	11,229.00	-2.25	0.82	-3.99	0
MFN	10,523.00	2.36	0.94	-2.01	4.09
ERP	9,814.00	3.26	0.96	-2.58	4.66
OTR	10,587.00	2.35	0.82	-0.79	4.09
ITR	10,587.00	1.27	0.85	-1.28	3.05
Utilization	10,572.00	3.09	0.61	-0.73	4.21
Margin	10,523.00	2.3	0.93	-2.01	3.98
SPS	5,223.00	0.66	3.35	-6.97	4.31
TBT	9,478.00	0.3	1.8	-3.91	3
Inspect	5,818.00	-2.52	2.36	-11.13	1.35
PCA(corr)	3,049.00	0.58	0.99	-4.31	1.81
PCA(cov)	9,941.00	-0.32	2.85	-11.55	4.34

Note. Author’s estimations.

Table A.3

Correlation table of data in trade performance

	MFN	ERP	OTR	ITR	Utilization	Margin	SPS	TBT	Inspect	PCA(corr)	PCA(cov)
MFN	1										
ERP	0.68	1									
OTR	0.81	0.85	1								
ITR	0.4	0.14	0.51	1							
Utilization	0.2	0.12	0.18	0.12	1						
Margin	0.95	0.66	0.78	0.38	0.22	1					
SPS	0.31	0.04	0.37	0.65	0.18	0.3	1				
TBT	0.2	-0.01	0.19	0.39	0.11	0.18	0.58	1			
Inspect	-0.04	-0.09	-0.04	-0.02	0	-0.04	0.11	0.38	1		
PCA(corr)	0.24	-0.01	0.25	0.49	0.14	0.22	0.79	0.91	0.55	1	
PCA(cov)	0.31	0.03	0.37	0.65	0.18	0.3	1	0.64	0.14	0.83	1

Note. Author’s estimations.

Table A.4

Correlation table of data in firm performance

	XI	MI	RDI	Skill	HHI	Covid	MFN	ERP	OTR	ITR	Utilization	Margin	SPS	TBT	Inspect	PCA(corr)	PCA(cov)
XI	1																
MI	0.85	1															
RDI	0.64	0.65	1														
Skill	-0.06	-0.04	0.07	1													
HHI	0.31	0.09	0.46	0.03	1												
Covid	0.45	0.39	-0.15	-0.17	0.08	1											
MFN	-0.22	0.03	-0.09	0.03	-0.2	-0.01	1										
ERP	-0.06	0.16	0.02	0.05	-0.08	0.05	0.93	1									
OTR	-0.29	-0.04	-0.12	0.05	-0.17	-0.06	0.95	0.89	1								
ITR	-0.36	-0.14	-0.16	0.01	-0.22	-0.11	0.68	0.53	0.81	1							
Utilization	-0.16	0.02	-0.18	0.01	-0.34	0.16	0.57	0.5	0.64	0.55	1						
Margin	-0.2	0.06	-0.08	0.03	-0.21	0.01	1	0.93	0.94	0.67	0.59	1					
SPS	-0.3	-0.12	-0.26	0.03	-0.3	-0.01	0.56	0.5	0.71	0.73	0.48	0.55	1				
TBT	-0.3	-0.31	-0.5	-0.02	-0.08	0.12	0.29	0.26	0.42	0.58	0.1	0.27	0.52	1			
Inspect	0.12	0.01	-0.27	-0.13	-0.25	0.33	-0.26	-0.33	-0.39	-0.35	-0.24	-0.26	-0.24	0.05	1		
PCA(corr)	-0.25	-0.15	-0.35	-0.02	-0.3	0.06	0.28	0.23	0.42	0.56	0.15	0.27	0.87	0.64	-0.01	1	
PCA(cov)	-0.28	-0.11	-0.29	0.01	-0.28	0.06	0.66	0.59	0.79	0.81	0.47	0.64	0.97	0.64	-0.23	0.85	1

Note. Author’s estimations.

APPENDIX B
RESULTS FROM THE LP METHOD

Table B.1

Results of separately effect of tariff and FTA on TFP by LP method

VARIABLES			LP			
XI	0.019	0.001	0.020	0.024	0.001	0.025
	(0.045)	(0.048)	(0.045)	(0.045)	(0.048)	(0.045)
MI	-0.055	-0.028	-0.057	-0.086**	-0.082*	-0.089**
	(0.048)	(0.049)	(0.048)	(0.044)	(0.045)	(0.045)
RDI	-0.010	-0.002	-0.013	-0.019	-0.024	-0.020
	(0.044)	(0.046)	(0.045)	(0.044)	(0.047)	(0.045)
Skill	-0.041**	-0.028	-0.041**	-0.041**	-0.028	-0.041**
	(0.017)	(0.018)	(0.017)	(0.017)	(0.018)	(0.017)
HHI	-0.028	-0.046	-0.027	-0.010	-0.042	-0.016
	(0.037)	(0.038)	(0.038)	(0.039)	(0.038)	(0.039)
Covid-19	-0.059	-0.027	-0.064	-0.075	-0.049	-0.074
	(0.048)	(0.049)	(0.051)	(0.049)	(0.049)	(0.052)
MFN	0.005			-0.717		
	(0.099)			(0.730)		
ERP	-0.174*	-0.265**	-0.176*			
	(0.103)	(0.111)	(0.104)			
OTR		0.142**			0.219**	
		(0.071)			(0.089)	
ITR			0.001			-0.141
			(0.153)			(0.261)
Utilization			-0.041			-0.001
			(0.150)			(0.148)
Margin				0.738	-0.289*	0.078
				(0.767)	(0.153)	(0.191)
Constant	12.740***	12.539***	12.805***	12.178***	12.007***	12.317***
	(0.429)	(0.452)	(0.496)	(0.285)	(0.327)	(0.399)
Observations	8,818	8,235	8,818	8,822	8,235	8,822
R-squared	0.004	0.005	0.004	0.004	0.005	0.004
Number of ID	3,443	3,252	3,443	3,447	3,252	3,447

Note. XI is share of export on output in industry; MI is share of import on intermediate input in industry; RDI is share of research and development on expenditure in industry; Skill is share of skilled labor on labor; HHI is Hirschman Herfindahl index in industry; Covid-19 is the dummy variable represent covid-19 which equal to 1 in period 2022; MFN is most flavor nation tariff rate; ERP is effective rate of protection; OTR is output tariff rate; ITR is input tariff rate; Utilization is the FTA utilization and Margin is tariff margin from FTA. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Estimation results were obtained using the Fixed effect regression method. Author’s estimations.

Table B.2

Results of separately effect of tariff and FTA on TFP

VARIABLES	1	2	3
XI	0.019	0.002	0.024
	(0.045)	(0.048)	(0.045)
MI	-0.059	-0.032	-0.063
	(0.048)	(0.049)	(0.049)
RDI	-0.012	-0.002	-0.019
	(0.044)	(0.046)	(0.045)
Skill	-0.041**	-0.027	-0.040**
	(0.017)	(0.018)	(0.017)
HHI	-0.032	-0.045	-0.027
	(0.038)	(0.039)	(0.038)
Covid-19	0.076	0.221	0.003
	(0.180)	(0.165)	(0.170)
MFN	0.026		
	(0.115)		
ERP		0.185**	
		(0.080)	
OTR			0.065
			(0.178)
ITR			-0.117
			(0.173)
Utilization	-0.150	-0.230**	-0.171
	(0.107)	(0.114)	(0.110)
Covid-19 x MFN	0.031		
	(0.033)		
Covid-19 x ERP		-0.016	
		(0.035)	
Covid-19 x OTR			-0.022
			(0.048)
Covid-19 x ITR			0.046
			(0.037)
Covid-19 x Util	-0.064	-0.059	-0.024
	(0.063)	(0.055)	(0.058)
Constant	12.592***	12.282***	12.721***
	(0.488)	(0.480)	(0.561)
Observations	8,818	8,235	8,818
R-squared	0.005	0.006	0.005
Number of ID	3,443	3,252	3,443

Note. XI is share of export on output in industry; MI is share of import on intermediate input in industry; RDI is share of research and development on expenditure in industry; Skill is share of skilled labor on labor; HHI is Hirschman Herfindahl index in industry; Covid-19 is the dummy variable represent covid-19 which equal to 1 in period 2022; MFN is most flavor nation tariff rate; ERP is effective rate of protection; OTR is output tariff rate; ITR is input tariff rate; Utilization is the FTA utilization and Margin is tariff margin from FTA. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Estimation results were obtained using the Fixed effect regression method. Author's estimations.

Table B.3

Results of combining the effect of tariff and FTA on TFP by LP method

VARIABLES	LP		
XI	0.022	0.009	0.027
	(0.045)	(0.047)	(0.045)
MI	-0.087**	-0.082*	-0.093**
	(0.044)	(0.044)	(0.045)
RDI	-0.019	-0.010	-0.027
	(0.044)	(0.047)	(0.045)
Skill	-0.041**	-0.032*	-0.041**
	(0.017)	(0.018)	(0.017)
HHI	-0.023	-0.036	-0.018
	(0.037)	(0.038)	(0.038)
Covid-19	-0.078	-0.005	-0.044
	(0.081)	(0.096)	(0.093)
MFN*	-0.006		
	(0.102)		
ERP*		0.124*	
		(0.070)	
OTR*			0.062
			(0.167)
ITR*			-0.110
			(0.162)
Covid-19 x MFN*	0.006		
	(0.027)		
Covid-19 x ERP*		-0.011	
		(0.026)	
Covid-19 x OTR*			-0.037
			(0.042)
Covid-19 x ITR*			0.046
			(0.038)
Constant	12.158***	11.700***	12.131***
	(0.275)	(0.267)	(0.369)
Observations	8,822	8,282	8,822
R-squared	0.004	0.005	0.004
Number of ID	3,447	3,260	3,447

Note. T* is tariff that combined the actual utilization of FTA by this following equation: $T^*_{ijt} = \left(1 - \sum_{f=1}^{n} UR_f\right)T_{ijt} + \left(\sum_{f=1}^{n} UR_f\right)PT_{ijt}$; ERP* is effective rate of protection calculated from T*; OTR* is output tariff rate and ITR* is input tariff rate following as Amiti and Konning (2007) calculated from T*; Distance, Language, Exporter population and Exporter GDP are gravity variables. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Estimation results were obtained using the Fixed effect regression method. Other variables see table B2. Author's estimations.

Table B.4

Results of combining the effect of tariff, FTA and NTMs on TFP by LP method

VARIABLES	LP					
XI	0.047	-0.001	0.169*	0.132	-0.141	0.021
	(0.073)	(0.047)	(0.096)	(0.116)	(0.105)	(0.046)
MI	-0.153*	-0.074	-0.113*	-0.115	-0.202*	-0.075*
	(0.089)	(0.046)	(0.068)	(0.116)	(0.109)	(0.046)
RDI	-0.070	-0.058	-0.034	0.037	0.046	-0.028
	(0.087)	(0.046)	(0.082)	(0.136)	(0.113)	(0.046)
Skill	-0.043*	-0.052***	-0.029	-0.037	-0.022	-0.040**
	(0.025)	(0.017)	(0.027)	(0.032)	(0.034)	(0.017)
HHI	0.036	0.021	0.104	-0.029	-0.004	0.033
	(0.074)	(0.039)	(0.080)	(0.137)	(0.093)	(0.038)
Covid-19	-0.077	-0.102	-0.240	0.290	-0.218	-0.074
	(0.134)	(0.090)	(0.146)	(0.405)	(0.279)	(0.082)
MFN*	0.010	-0.031	0.147	0.100	0.319	-0.011
	(0.191)	(0.109)	(0.160)	(0.228)	(0.322)	(0.102)
SPS	-0.046			0.011		
	(0.040)			(0.331)		
TBT		0.001		-0.570*		
		(0.059)		(0.326)		
Inspect			0.049**	0.067**		
			(0.022)	(0.028)		
PCA (correlation)					0.302***	
					(0.114)	
PCA (covariance)						-0.023
						(0.032)
Covid-19 x MFN*	0.028	0.013	0.009	-0.158	-0.032	0.010
	(0.045)	(0.030)	(0.040)	(0.099)	(0.076)	(0.028)
Covid-19 x SPS	0.003			-0.002		
	(0.015)			(0.035)		
Covid-19 x TBT		0.012		0.059		
		(0.017)		(0.079)		
Covid-19 x Inspect			0.015	0.046		
			(0.025)	(0.058)		
Covid-19 x PCA (correlation)					0.375**	
					(0.155)	
Covid-19 x PCA (covariance)						0.014
						(0.009)

Table B.4

Results of combining the effect of tariff, FTA and NTMs on TFP by LP method (Cont.)

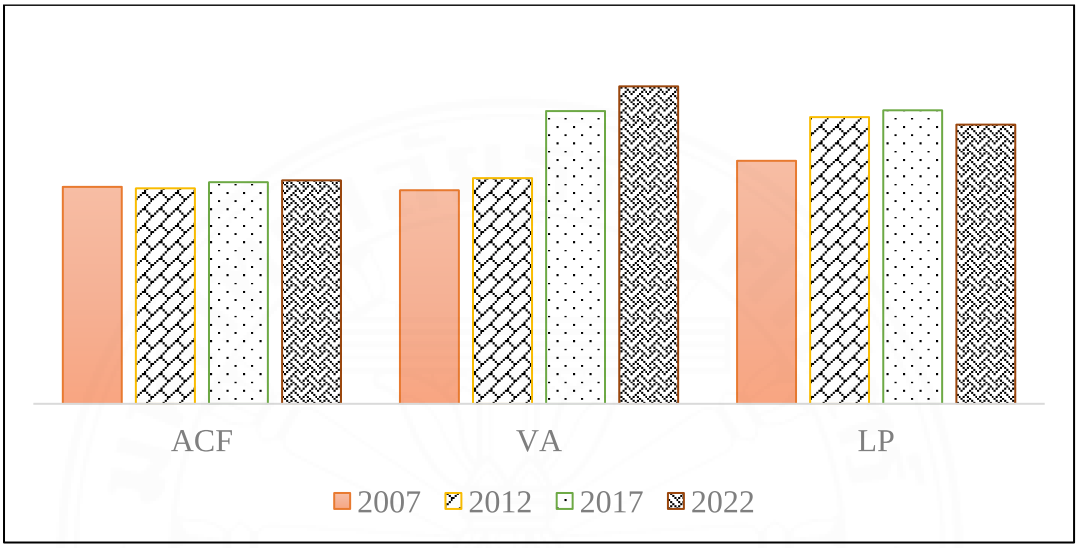
VARIABLES	LP					
Constant	12.104***	12.234***	12.668***	13.162***	10.873***	12.313***
	(0.528)	(0.289)	(0.478)	(0.919)	(1.004)	(0.273)
Observations	4,435	7,977	4,955	3,110	2,468	8,330
R-squared	0.005	0.004	0.009	0.011	0.013	0.004
Number of ID	2,040	3,273	2,777	1,598	1,102	3,329

Note. PCA (covariance) is principal-component factors analysis using covariance; PCA (correlation) is principal-component factors analysis using correlation; other factors and estimation methods see table B3. Author's estimations

APPENDIX C
TFP CALCULATION WEIGHTED BY PPI

Figure C.1

TFP calculation by ACF, value added (VA) and LP



Note. Author's estimations.

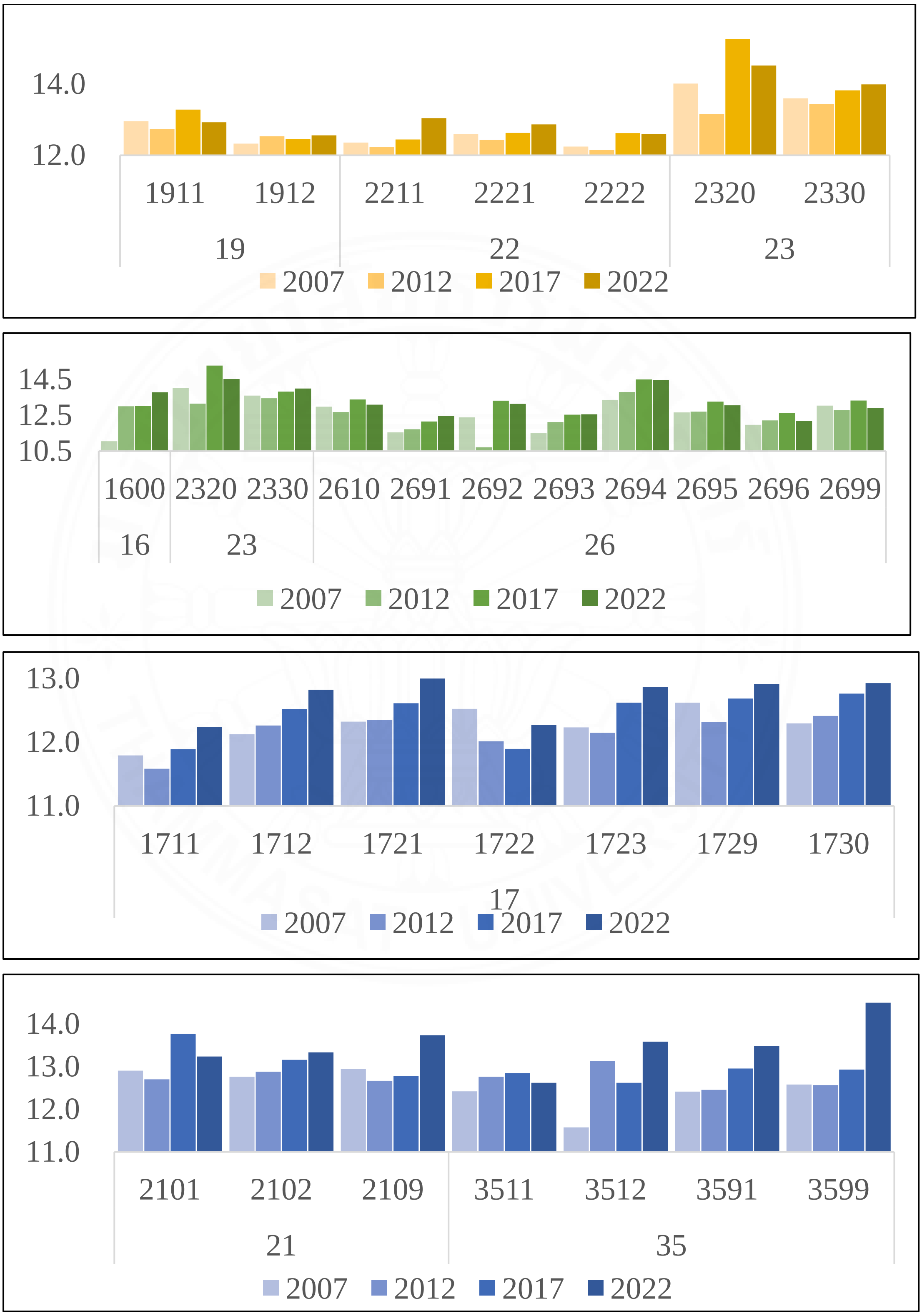
Figure C.2

The main driven source in each period of productivity estimates from ACF

Note. Code of industry following Thailand Standard Industrial Classification (TSIC). Author's estimations.

Figure C.3

The main driven source in each period of productivity estimates from VA



Note. Code of industry following Thailand Standard Industrial Classification (TSIC). Author’s estimations.

APPENDIX D
ESTIMATION RESULTS FROM VA METHODS

Table D.1

Results of separately effect of tariff and FTA on TFP by VA method

VARIABLES	VA					
XI	-0.029	-0.105**	-0.007	-0.024	-0.089*	-0.008
	(0.048)	(0.051)	(0.048)	(0.047)	(0.051)	(0.048)
MI	-0.036	-0.022	-0.057	0.061	0.058	0.007
	(0.051)	(0.051)	(0.051)	(0.046)	(0.048)	(0.048)
RDI	-0.042	-0.026	-0.071	-0.030	-0.011	-0.062
	(0.047)	(0.049)	(0.047)	(0.046)	(0.049)	(0.047)
Skill	0.049***	0.058***	0.048***	0.049***	0.059***	0.047**
	(0.018)	(0.019)	(0.018)	(0.018)	(0.019)	(0.018)
HHI	-0.057	-0.069*	-0.044	0.053	-0.095**	-0.037
	(0.040)	(0.041)	(0.040)	(0.042)	(0.041)	(0.042)
Covid-19	0.222***	0.296***	0.164***	0.165***	0.306***	0.159***
	(0.051)	(0.051)	(0.054)	(0.052)	(0.052)	(0.055)
MFN	-0.313***			-7.393***		
	(0.106)			(0.772)		
ERP	0.447***	0.507***	0.373***			
	(0.109)	(0.117)	(0.111)			
OTR		-0.109			0.005	
		(0.075)			(0.094)	
ITR			-0.228			-0.581**
			(0.164)			(0.279)
Utilization			-0.588***			-0.712***
			(0.160)			(0.158)
Margin				7.581***	-0.163	0.415**
				(0.812)	(0.162)	(0.203)
Constant	11.915***	11.151***	12.678***	13.098***	12.939***	14.047***
	(0.458)	(0.477)	(0.530)	(0.303)	(0.346)	(0.426)
Observations	8,683	8,112	8,683	8,687	8,112	8,687
R-squared	0.027	0.031	0.030	0.040	0.027	0.029
Number of ID	3,437	3,246	3,437	3,441	3,246	3,441

Note. XI is share of export on output in industry; MI is share of import on intermediate input in industry; RDI is share of research and development on expenditure in industry; Skill is share of skilled labor on labor; HHI is Hirschman Herfindahl index in industry; Covid-19 is the dummy variable represent covid-19 which equal to 1 in period 2022; MFN is most flavor nation tariff rate; ERP is effective rate of protection; OTR is output tariff rate; ITR is input tariff rate; Utilization is the FTA utilization and Margin is tariff margin from FTA. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Estimation results were obtained using the Fixed effect regression method. Author’s estimations.

Table D.2

Results of combining the effect of tariff, FTA and NTMs on TFP by LP method

VARIABLES	LP					
XI	-0.051	-0.085	0.023	0.068	-0.103	-0.072
	(0.078)	(0.052)	(0.103)	(0.121)	(0.112)	(0.051)
MI	-0.080	0.078	-0.055	-0.115	-0.135	0.055
	(0.094)	(0.051)	(0.073)	(0.120)	(0.117)	(0.050)
RDI	-0.080	-0.074	-0.097	0.097	0.008	-0.042
	(0.093)	(0.052)	(0.088)	(0.141)	(0.121)	(0.051)
Skill	0.048*	0.045**	0.055*	0.052	0.088**	0.050***
	(0.027)	(0.019)	(0.029)	(0.033)	(0.037)	(0.019)
HHI	0.025	-0.082*	-0.013	-0.124	0.001	-0.094**
	(0.080)	(0.044)	(0.086)	(0.142)	(0.100)	(0.042)
Covid-19	0.013	-0.165*	-0.335**	-0.244	-0.394	-0.021
	(0.143)	(0.100)	(0.157)	(0.417)	(0.299)	(0.090)
MFN*	-0.430**	-0.507***	-0.306*	-0.320	-0.186	-0.443***
	(0.203)	(0.121)	(0.172)	(0.235)	(0.344)	(0.112)
SPS	0.110***			0.491		
	(0.042)			(0.340)		
TBT		0.183***		-0.385		
		(0.065)		(0.338)		
Inspect			0.079***	0.119***		
			(0.024)	(0.028)		
PCA (correlation)					0.333***	
					(0.121)	
PCA (covariance)						0.055
						(0.035)
Covid-19 x MFN*	0.121**	0.149***	0.144***	-0.045	0.062	0.102***
	(0.048)	(0.033)	(0.043)	(0.102)	(0.081)	(0.030)
Covid-19 x SPS	-0.020			-0.036		
	(0.015)			(0.036)		
Covid-19 x TBT		-0.030		0.185**		
		(0.019)		(0.082)		
Covid-19 x Inspect			-0.012	-0.078		
			(0.027)	(0.060)		
Covid-19 x PCA (correlation)					0.488***	
					(0.166)	
Covid-19 x PCA (covariance)						-0.002
						(0.010)

Table D.2

Results of combining the effect of tariff, FTA and NTMs on TFP by LP method (Cont.)

VARIABLES	LP					
Constant	13.499***	13.671***	13.737***	13.908***	13.062***	13.603***
	(0.561)	(0.321)	(0.514)	(0.949)	(1.074)	(0.299)
Observations	4,366	7,864	4,881	3,070	2,435	8,205
R-squared	0.032	0.033	0.020	0.033	0.032	0.029
Number of ID	2,027	3,260	2,753	1,590	1,097	3,322

Note. PCA (covariance) is principal-component factors analysis using covariance; PCA (correlation) is principal-component factors analysis using correlation; other factors and estimation methods see table D1. Author's estimations.

APPENDIX E

ESTIMATION RESULTS SEPARATELY INDUSTRY

Table E.1

Results of separately effect of tariff and FTA on TFP by ACF method

VARIABLES	ACF			
XI	-0.002	-0.001	-0.007	-0.006
	(0.005)	(0.005)	(0.006)	(0.006)
MI	-0.006	-0.009	0.005	-0.002
	(0.006)	(0.007)	(0.007)	(0.007)
RDI	0.007	0.009	0.015**	0.022***
	(0.005)	(0.006)	(0.006)	(0.006)
Skill	0.003*	0.003*	0.004*	0.004*
	(0.002)	(0.002)	(0.002)	(0.002)
HHI	-0.003	-0.004	-0.006	-0.005
	(0.004)	(0.005)	(0.005)	(0.005)
Covid-19	-0.016	-0.011	-0.015	-0.015
	(0.022)	(0.024)	(0.021)	(0.023)
MFN	-0.051***	-0.054***		
	(0.016)	(0.016)		
ERP			-0.019*	-0.028***
			(0.010)	(0.011)
Utilization	0.033**	0.034**	0.055***	0.049***
	(0.014)	(0.014)	(0.016)	(0.016)
Covid-19 x MFN	0.015***	0.016***		
	(0.004)	(0.005)		
Covid-19 x ERP			0.017***	0.022***
			(0.005)	(0.005)
Covid-19 x Util	0.001	-0.002	-0.006	-0.010
	(0.008)	(0.008)	(0.007)	(0.008)
MFN x Ind19	-0.789*	-0.797*		
	(0.444)	(0.447)		
MFN x Ind23	0.214	-4.279***		
	(0.565)	(1.438)		
MFN x Ind31	0.050	0.028		
	(0.161)	(0.168)		
MFN x Ind34	0.198	0.178		
	(0.655)	(0.663)		
MFN x Ind17	-1.866***	-1.519**		
	(0.611)	(0.691)		

Table E.1

Results of separately effect of tariff and FTA on TFP by ACF method (Cont.)

VARIABLES	ACF			
MFN x Ind35	-2.398	-1.123		
	(7.068)	(7.282)		
MFN x Ind36	0.007	0.016		
	(0.025)	(0.026)		
MFN x Ind21	-0.118	-0.077		
	(0.088)	(0.096)		
MFN x Ind26	-0.622***	-0.671***		
	(0.166)	(0.191)		
Covid-19 x MFN x Ind19		-0.001		
		(0.006)		
Covid-19 x MFN x Ind23		0.638***		
		(0.185)		
Covid-19 x MFN x Ind31		-0.004		
		(0.010)		
Covid-19 x MFN x Ind34		-0.000		
		(0.005)		
Covid-19 x MFN x Ind17		0.008		
		(0.007)		
Covid-19 x MFN x Ind35		-0.007		
		(0.009)		
Covid-19 x MFN x Ind36		0.004		
		(0.005)		
Covid-19 x MFN x Ind21		0.010		
		(0.009)		
Covid-19 x MFN x Ind26		-0.002		
		(0.006)		
ERP x Ind19			-0.022	-0.174
			(0.301)	(0.365)
ERP x Ind23			-4.235***	-4.475***
			(1.372)	(1.382)
ERP x Ind31			0.014	0.006
			(0.119)	(0.120)
ERP x Ind34			0.039	-0.136
			(0.242)	(0.352)
ERP x Ind17			0.266**	0.250**
			(0.109)	(0.112)
ERP x Ind35			-0.011	-0.417
			(0.299)	(0.393)

Table E.1

Results of separately effect of tariff and FTA on TFP by ACF method (Cont.)

VARIABLES	ACF			
ERP x Ind36			-0.032	-0.011
			(0.027)	(0.030)
ERP x Ind21			-0.118	-0.126
			(0.096)	(0.097)
ERP x Ind26			-0.460***	-0.841***
			(0.109)	(0.162)
Covid-19 x ERP x Ind19				0.003
				(0.006)
Covid-19 x ERP x Ind23				0.041**
				(0.020)
Covid-19 x ERP x Ind31				0.005
				(0.008)
Covid-19 x ERP x Ind34				-0.003
				(0.005)
Covid-19 x ERP x Ind17				0.011**
				(0.004)
Covid-19 x ERP x Ind35				-0.014
				(0.010)
Covid-19 x ERP x Ind36				0.003
				(0.004)
Covid-19 x ERP x Ind21				0.008
				(0.005)
Covid-19 x ERP x Ind26				-0.016***
				(0.005)
Constant	1.827***	1.756***	1.398***	1.641***
	(0.299)	(0.318)	(0.105)	(0.130)
Observations	8,810	8,810	8,227	8,227
R-squared	0.024	0.027	0.027	0.032
Number of ID	3,443	3,443	3,252	3,252

Note. PCA (covariance) is principal-component factors analysis using covariance; PCA (correlation) is principal-component factors analysis using correlation; other factors and estimation methods see table 5.2. Ind19 is the tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (division 19); Ind 23 is the manufacture of coke, refined petroleum products and nuclear fuel (division 23); Ind31 is the manufacture of electrical machinery and apparatus n.e.c. ;Ind34 is the manufacture of motor vehicles, trailers and simi-trailers ; Ind17 is the manufacture of textiles (division 17); Ind 35 is the manufacture of other transport equipment (division 35); Ind 36 is the manufacture of furniture (division 36); Ind 21 is the manufacture of paper and paper products (division 21) and Ind26 is the manufacture of other non-metallic mineral products (division 26). Author’s estimations.

Table E.2

Results of combining the effect of tariff and FTA on TFP by ACF method

VARIABLES	ACF			
XI	-0.003	-0.002	-0.004	-0.001
	(0.005)	(0.005)	(0.006)	(0.006)
MI	-0.004	-0.005	0.009	-0.000
	(0.005)	(0.006)	(0.006)	(0.006)
RDI	0.006	0.009*	0.017***	0.025***
	(0.005)	(0.005)	(0.006)	(0.006)
Skill	0.003*	0.003	0.004**	0.004*
	(0.002)	(0.002)	(0.002)	(0.002)
HHI	-0.005	-0.005	-0.005	-0.005
	(0.004)	(0.005)	(0.005)	(0.005)
Covid-19	-0.018*	-0.016	-0.017	-0.021
	(0.010)	(0.010)	(0.013)	(0.014)
MFN*	-0.058***	-0.059***		
	(0.014)	(0.014)		
ERP*			-0.019**	-0.026**
			(0.010)	(0.010)
Covid-19 x MFN*	0.017***	0.017***		
	(0.003)	(0.003)		
Covid-19 x ERP*			0.013***	0.016***
			(0.004)	(0.004)
MFN* x Ind19	-0.438**	-0.840***		
	(0.220)	(0.304)		
MFN* x Ind23	0.573	-8.295***		
	(0.514)	(2.731)		
MFN* x Ind31	-0.002	-0.032		
	(0.133)	(0.144)		
MFN* x Ind34	0.008	-0.008		
	(0.277)	(0.294)		
MFN* x Ind17	-0.907***	-0.769**		
	(0.265)	(0.352)		
MFN* x Ind35	0.184	0.072		
	(0.550)	(0.928)		
MFN* x Ind36	0.022	0.031		
	(0.022)	(0.024)		
MFN* x Ind21	-0.121	-0.068		
	(0.076)	(0.090)		
MFN* x Ind26	-0.447***	-0.490***		
	(0.126)	(0.145)		

Table E.2

Results of combining the effect of tariff and FTA on TFP by ACF method (Cont.)

VARIABLES	ACF		
Covid-19 x MFN* x Ind19	-0.015*		
	(0.008)		
Covid-19 x MFN* x Ind23	1.541***		
	(0.465)		
Covid-19 x MFN* x Ind31	-0.004		
	(0.010)		
Covid-19 x MFN* x Ind34	0.001		
	(0.005)		
Covid-19 x MFN* x Ind17	0.005		
	(0.008)		
Covid-19 x MFN* x Ind35	-0.002		
	(0.014)		
Covid-19 x MFN* x Ind36	0.006		
	(0.005)		
Covid-19 x MFN* x Ind21	0.011		
	(0.010)		
Covid-19 x MFN* x Ind26	-0.003		
	(0.006)		
ERP *x Ind19		-0.054	-0.034
		(0.036)	(0.037)
ERP* x Ind23		1.233	-55.964***
		(1.492)	(16.570)
ERP* x Ind31		-0.044	-0.043
		(0.103)	(0.103)
ERP* x Ind34		-0.193	-0.437
		(0.274)	(0.378)
ERP* x Ind17		0.225**	0.225**
		(0.106)	(0.106)
ERP* x Ind35		-0.253	-0.788
		(0.251)	(0.500)
ERP* x Ind36		-0.012	0.002
		(0.023)	(0.026)
ERP* x Ind21		-0.097	-0.085
		(0.082)	(0.083)
ERP* x Ind26		-0.328***	-0.602***
		(0.084)	(0.115)

Table E.2

Results of combining the effect of tariff and FTA on TFP by ACF method (Cont.)

VARIABLES	ACF			
				(0.005)
Covid-19 x ERP* x Ind23				0.803***
				(0.230)
Covid-19 x ERP* x Ind31				0.004
				(0.008)
Covid-19 x ERP* x Ind34				-0.003
				(0.005)
Covid-19 x ERP* x Ind17				0.013***
				(0.005)
Covid-19 x ERP* x Ind35				-0.018
				(0.015)
Covid-19 x ERP* x Ind36				0.004
				(0.004)
Covid-19 x ERP* x Ind21				0.009
				(0.005)
Covid-19 x ERP* x Ind26				-0.015***
				(0.005)
Constant	1.667***	1.704***	1.544***	2.180***
	(0.069)	(0.079)	(0.069)	(0.163)
Observations	8,814	8,814	8,274	8,274
R-squared	0.024	0.027	0.023	0.030
Number of ID	3,447	3,447	3,260	3,260

Note. PCA (covariance) is principal-component factors analysis using covariance; PCA (correlation) is principal-component factors analysis using correlation; other factors and estimation methods see table 5.2. Ind19 is the tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (division 19); Ind 23 is the manufacture of coke, refined petroleum products and nuclear fuel (division 23); Ind31 is the manufacture of electrical machinery and apparatus n.e.c. ;Ind34 is the manufacture of motor vehicles, trailers and simi-trailers ; Ind17 is the manufacture of textiles (division 17); Ind 35 is the manufacture of other transport equipment (division 35); Ind 36 is the manufacture of furniture (division 36); Ind 21 is the manufacture of paper and paper products (division 21) and Ind26 is the manufacture of other non-metallic mineral products (division 26). Author’s estimations.

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