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Effectiveness of Industrial Policy on Firms' Productivity: Evidence from Thai Manufacturing

Juthathip Jongwanich

and Archanun Kohpaiboon

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Faculty of Economics, Thammasat University

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Juthathip Jongwanich and Archanun Kohpaiboon

Faculty of Economics*
Thammasat University, Bangkok, Thailand

Abstract: This paper examines the role of industrial policy on firms' productivity, using three-years panel data of Thai manufacturing as a case study. A range of industrial policy tools is defined, including tariff measures, subsidies, and investment incentives through the Board of Investment (BOI), which are the main tools used in Thailand. The effect on firm productivity of partial trade liberalisation undertaken through free trade agreements (FTAs) signed between Thailand and her trading partners is also examined. The key finding is that trade openness and research and development (R&D) are more crucial in fostering firms' productivity than industrial policies. This is especially true for the narrow definition of industrial policy focusing on trade policy protection, measured by the effective rate of protection. In addition, the FTA-led trade liberalisation effect fails to add substantial competitive pressure and make firms improve productivity. For subsidies, our results show that sectors benefiting from subsidies show noticeably lower productivity than others. Our study found weak support for investment promotion policy through BOI, even when the domestic competitive environment is considered in our analysis.

Keyword: Industrial policies, productivity, Thailand

JEL Code: F13, L52, O53

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1. Introduction

The debate over the role of government in nurturing industry, so-called industrial policy, dates back to the 18th century between Davide Ricardo and Alexander Hamilton. After the very heated debate between the late 1970s and the mid-1980s, prompted by the economic success of Northeast Asian economies such as Japan and the failure of Latin America, the debate on industrial policy lapsed into three decades of ideologically motivated wilful neglect. However, the role of industrial policy has regained policy attention in the last two decades as a series of crises has hit many countries around the globe, beginning with the Asian financial crisis in mid-1997. Many countries have been disappointed by pursuing conventional economic policies known as the Washington Consensus (Pack and Saggi, 2006; Cimoli, Dosi, and Stiglitz, 2009; Chang and Andreoni, 2016). This has led the governments of many countries to step in and try to alter the structure of production in favour of sectors that are expected to offer better prospects for economic growth in a way that would not occur if they operated under market forces.

Industrial policy, defined as non-neutral inter-industry (and sometimes inter-firm) incentives, covers a wide range of policy tools not limited to traditional cross-border trade barriers such as tariffs. It must be widely defined to include not only trade policies but also science and technology policies, public procurement, policies affecting foreign direct investment, intellectual property rights, and the allocation of financial resources. Proponents of industrial policy claim that the failure of industrial policies in the past was largely due to the actual contribution of industrial policy being understated. Chang and Andreoni (2016) argued that these non-tariff measures were employed and contributed to economic success in East Asian economies.

The debate is also found in theoretical works of international economic literature such as Melitz (2005), Greenwald and Stiglitz (2006), Sauré (2007), and Aghion et al. (2015). All but Sauré (2007) were in favour of the role of industrial policy in generating economic growth. Melitz (2005) and Aghion et al. (2015) pointed out that the choice of policy tools used in promoting industries matters in terms of their effectiveness.

The effectiveness of industrial policy also depends on the supporting environment. For example, Melitz (2005) highlighted the role of industry characteristics such as learning potential, the shape of the learning curve, and the degree of substitutability between domestic and foreign goods that must be taken into consideration when assessing policy effectiveness. Aghion et al. (2015) pointed to the importance of domestic competition for suitably designed industrial policies in inducing innovation and productivity growth. In the absence of domestic competition, firms may choose to operate in different sectors to face lower competition on the product market, leading to high sectoral concentration and low incentives to innovate. This theoretical model is empirically tested, using Chinese medium and large enterprises as a case study.

This issue could be related to the proliferation of free trade agreements (FTAs) around the globe in the new millennium. As multilateral liberalisation pursued under the World Trade Organization (WTO) has long been stalled, many countries have pursued trade liberalisation amongst a smaller group of countries by signing FTAs. These can be bilateral, regional, or multilateral. Such liberalisation is at best partial, as trade barriers are eliminated only in some trading partners. Interestingly, attempts to pursue industrial policy are often observed in developing countries alert to FTA opportunities. How these two policies are combined in a growth-promoting strategy remains a relevant policy question.

Against this backdrop, this paper examines the role of industrial policy on firms' productivity, using the available panel data of Thai manufacturing, i.e. 2006, 2011, and 2016, as a case study. A range of industrial policy tools is defined, including tariff measures, subsidies, and investment incentives, which are the main tools used in Thailand. In addition, the effect of partial trade liberalisation undertaken through FTAs between Thailand and its trading partners on firm productivity is examined. Thailand is suitable for the research question at hand for at least two reasons. First, the Thai government has pursued industrial policy to promote innovation and technology, aiming at knowledge-based economies, and to focus on local sectors by targeting strategic value chains and/or export-oriented clusters. This is reflected in a series of policy initiatives, including 10 new targeted industries (known as the 10 S-curve or new S-curve industries), the Thailand 4.0 policy, and the Eastern Economic Corridor. The scope of industrial policy in this paper covers tariff protection as well as investment incentives granted. Second, Thailand is one of the developing countries, which actively involve with FTA initiatives. So far, it has signed 18 FTAs and others are

forthcoming, including the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP).

Our paper contributes to the existing literature in at least two ways. First, we use a wider scope of industrial policy tools, including both tariff protection and investment promotion measures. There is a lack of empirical works, examining the effect of industrial policy with a wider scope of policy tools. To the best of our knowledge so far, the only study is Aghion et al. (2015), which used a data set of Chinese medium-sized and large enterprises from 1998 to 2007. China has unique features such as its enormous domestic market, long experience under a centralised system, and strong role of government. Hence, one needs to be cautious in generalising the findings for other much smaller developing countries. Empirical works are needed based on typical developing countries whose governments have a much smaller role and which are subject to weak institutional factors. Second, our paper examines the effect of FTA-induced trade liberalisation on firms' productivity. Few empirical works have examined the effect of FTAs on firm productivity in developing countries, mostly focusing on the effect of developed countries' firms (e.g. Lilleva, 2008; Hayakawa, 2012). The novel feature in this paper is that the effective rate of protection (ERP) across industries is estimated, using the weighted average of tariffs between most-favoured nation (MFN) rates and preferential tariffs offered in FTAs. Import value and preferential import value are used as the alternative weight in estimating the ERP. Such an estimate would capture the partial trade liberalisation through FTAs.

The paper is organised as follows. Section 2 presents a literature survey of industrial policy as well as the current debate, followed by discussion of the use of industrial policy in Thailand (section 3). Section 4 discusses the research methodology used in this paper, including the empirical model, data set, and econometric procedures. Estimation results are in section 5. The conclusion and policy inferences are in the final section.

2. Literature Survey

The debate over implementing industrial policy was first introduced by Hamilton (1791) and List (1856), who supported implementing measures to protect emerging industries in the United States (US) and Germany against more competitive industries from Britain. Since then, the rationale of implementing industrial policy has been continuously debated; and both

theoretical and empirical evidence on industrial policy success and failure has been mixed. On the one hand, based on neoclassical economic theory, selective industrial policies tend to distort the allocative efficiency of markets. Markets encourage a competitive environment amongst firms, which rewards efficient entrepreneurs and drives inefficient firms out of the market. In addition, to be efficient, firms must undertake innovation, which drives productivity and long-term economic growth. The process of firms' entry, exit, and innovation in a competitive environment determines a country's comparative advantage. Since this process is dynamic, complex, and hard to anticipate, implementing industrial policy by channelling resources to activities which the government projects to be competitive in the future would eventually lead to inefficient resource allocation.

Esser et al. (1996) and Taylor (1998) argued that import substitution policies implemented in developed countries during the 1960s and 1970s failed because most industries established were unable to create competitiveness and productivity after liberalisation. Di Maio (2008) pointed out that trade policy implemented in Latin America during the import substitution regime did not work well, and industries protected under this regime became inefficient. The case of the machine tool industry is an example of industrial policy failure in Latin America under the import substitution regime, in which the lack of economies of scale and production specialisation resulted in higher domestic prices than the world market after liberalisation. Large-scale industrial policy failures were evident in other countries, such as the development of the fast breeder reactor in Germany and the Concorde project in France (Altenburg, 2011). With the failure of import substitution regimes in many countries during the 1980s and 1990s, the debate on industrial policy lapsed into ideologically motivated wilful neglect (Cimoli, Dosi, and Stiglitz, 2009; Altenburg, 2011).

On the other hand, there is evidence that industrial policy has played an important and successful role in supporting latecomer industrialisation. Pack and Saggi (2006) and Chang (2009) argued that industrial policies are needed because of pervasive market failures, i.e. the market cannot provide price signals that lead to optimal resource allocation. A number of theoretical arguments are used to justify intervention, e.g. coordination failure in which firms will not invest until others undertake the necessary related investments; dynamic scale economies and knowledge spillovers, where industrial policy helps to determine future production possibilities under learning-by-doing economies; and information externality, where governments can encourage the discovery of future business opportunities.

The main purpose of pursuing industrial policy is to nurture firms in a nascent industry at the early stage of development, when they cannot compete with (foreign) mature competitors. Protection at the initial stage is needed for firms to experience learning by doing and benefit dynamic economies. Firms could eventually compete with (foreign) mature competitors and operate profitably without continued protection (List, 1856). Granting of such protection is justified in the presence of dynamic learning effects which are external to firms. This was alluded to by neo-classical trade economists, e.g. Mill (1848) and van Haberler (1936), and is widely known as the infant industry argument. Subsequently, an additional condition is added to justify the protection–growth nexus, i.e. the cumulative net benefits provided by the protected industry should exceed the cumulative costs of protection. This is known as the Mill-Bastable test (Kemp, 1960; Corden, 1997). The literature survey by Pack and Saggi (2006) points to the arguments for industrial policy derived from the presence of positive externalities. There are three forms of externalities: knowledge spillovers, dynamic scale economies, and information externalities.

The acceptance of using industrial policy emerged during mercantilism in the 16th to 18th centuries and import substitution industrialisation during the 1950s and 1970s. As mentioned earlier, industrial policy tended to be rejected during the 1980s–1990s. However, since the late 1990s, many developing country governments have been returning to more proactive implementation of industrial policy for two key reasons. First, many countries have encountered great disappointment since the late 1990s with the results of pursuing the conventional economic policies that John Williamson in 1990 crystallised and named the Washington Consensus (Williamson, 2005). Some Asian countries, including Thailand, have adhered to many policies set out in the Washington Consensus and used to experience extraordinary rapid growth in early 1990s but begun to displease with economic performance observed after the late 1990s. This has caused policymakers in those countries to search for alternative development strategies. The crises that have hit many countries, from the Mexican and Asian financial crises to the global financial crisis, tend to accelerate the revival of industrial policy.

Second, a number of recent studies offer new seeds of thought regarding the use of industrial policies, address the shortcomings of industrial policy failures, and illustrate the conditions to make them work well. Implementing policy has also entered mainstream

development economics, e.g. the narrative of Perkins (2013) on East Asian development and the synthesis of former World Bank chief economist Justin Lin (2012). There is much general agreement in the development economics and political economy literature about the factors that underpin rapid economic development. These include macroeconomic stability; openness to trade, investment, and technology; a stable and business-friendly commercial environment; mechanisms that ensure broad-based, inclusive development; and investment in supply-side capabilities, ranging from infrastructure to human capital. The contestation focuses on whether these general, economy-wide approaches are sufficient, or whether there is also a role for sector-specific interventions. Here, the arguments typically centre on the presence of dynamic externalities, learning by doing, linkages, and various forms of technology acquisition that will not be forthcoming if an economy is based on the market force (Hill and Kohpaiboon, 2017). Freeman (2008) argued that policy interventions of different kinds (regulatory and supportive, generic and specific) are needed to generate new and competitive activities; and that interventions should focus on the macro, meso, and micro levels. Esser et al. (1996) developed the concept of systemic competitiveness to capture the complexity of interventions relating to four different levels and highlights the existence of systemic interdependencies between these determinants.[1]

Chang and Andreoni (2016) are strongly in favour of industrial policy. Not only must protection be granted through a wider range of policy tools, including both tariff protection and investment promotion measures, but complementary measures such as monopoly rights of production, exchange rate intervention, and active intervention in research and development (R&D, referred to as learning in production) are also needed to ensure the effectiveness of the protection granted. Note that their argument is based on an implicit assumption that learning automatically takes place once the above government roles are in place and fully effective. However, such an assumption seems to be rather restrictive, especially in the context of developing countries (Kohpaiboon and Jongwanich, 2013).

The other works reflect varying degrees of support for industrial policies. Greenwald and Stiglitz (2006) illustrated when there is an economy-wide positive externality from R&D investment in the industrial sector (advance sector), such an externality is likely to benefit other sectors, thereby promoting a country's long-term economic development. Such a

positive effect outweighs the static loss from imposing trade restrictions. Hence, protection is needed to ensure the positive externality. Interestingly, Sauré (2007) provided a counterargument to Greenwald and Stiglitz (2006). Despite its presence, such a positive externality might not materialise because it is hard to tell firms how to allocate their resources. In fact, imposing protection could create an environment in which firms specialise in certain niches relevant for highly protected domestic markets. Such a circumstance has been found in much empirical evidence (Kokko, 1994; Kohpaiboon, 2006; and Kohpaiboon and Jongwanich, 2013). It is referred to in Kohpaiboon (2006); and Kohpaiboon and Jongwanich (2013) as the traditional technology sector, with meagre learning effects and poor productivity growth, which would eventually generate immiserising growth. Melitz (2005) demonstrated a possibility that a government can protect infant industry using a wider range of policy tools (e.g. tariffs, subsidies, quotas) and that protection should be granted according to the industry's characteristics (e.g. learning potential, the shape of the learning curve, and the degree of substitutability between domestic and foreign goods). All of these matter in terms of policy effectiveness.

Interestingly, Aghion et al. (2015) raised a highly policy-relevant issue: a conducive environment must be in place to ensure that industrial policy works as planned, i.e. to promote innovation and growth. In the absence of domestic competition, firms may choose to operate in different sectors to face lower competition on the product market, leading to high sectoral concentration and low incentives to innovate. The theoretical model based on the endogenous growth theory was tested empirically on medium-sized and large Chinese enterprises from 1998 to 2007. The empirical evidence supported the hypothesis postulated by the theoretical model. So far, Aghion et al. (2015) has been the most systematic analysis examining conditions that must complement the implementation of industrial policy. Nonetheless, whether the key finding of this paper could be generalised for other countries, especially for small developing countries, remains debatable since it is unlikely to find any developing countries whose economic fundamentals are compatible with China.

The effect of industrial policy on productivity is also related to the trade and investment liberalisation approach recently adopted in many East Asian developing economies. Although gains from trade liberalisation, especially long-run effects, are widely recognised, they are overshadowed by adjustment costs in the short run. As a consequence, policymakers in many countries in the region express reluctance towards undertaking

unilateral/multilateral WTO-based trade liberalisation. Instead, they prefer gradual trade liberalisation through FTAs with trading partners in the region. This is done to give firms adequate time to adjust to the increasing global competition. This is evident for members of the Association of Southeast Asian Nations (ASEAN), which committed to full trade liberalisation under the ASEAN Economic Community (AEC) but remain cautious in non-ASEAN FTAs. To a large extent, this is in line with the infant industry argument. Whether partial trade liberalisation works remains an open empirical question since few empirical works have examined the effect of FTAs on firm productivity in the ASEAN region, mostly focusing on the North American Free Trade Agreement (NAFTA) such as Lilleva (2008) and López-Córdova and Moreira (2002).

3. Industrial Policy in Thailand

3.1 Brief History of Government Role in Industrialisation

The Thai government rarely adopted industrial policy in the sense of the government targeting specific industries and collective actions being implemented over time to nurture them. While the government had ambiguous targets on occasion, such efforts were neither effective nor long-lasting. This was because of the fragmented political parties and frequent changes in government. No political group or private firm could capture sector agencies on a permanent basis, so policies resulted in a fairly flexible and less regressive policy incentive framework. This was especially true for industrial policy, which was not a political priority and was dominated by rural 'big men' who controlled their localities through their own patronage networks and focused on policies that allowed them win votes in particular localities such as rural roads, hospitals, and airports (Siamwalla, 2011: 74). In addition, the country's political history since World War II has been punctuated by a succession of military and attempted coups, as well as subject to frequent changes in government. The government was dominated by the military whereas political parties were loosely formed. Since 1932, when the first constitutional government was established, Thailand has had 20 constitutions and 37 prime ministers (29 persons), who stayed in power only 2 years and 3 months on average. Because of the weak governments, economic policy was mainly influenced by technocrats who emphasised prudence and stability.

The only exception was the automotive industry, which has been the main interest of technocrats from the Ministry of Industry and the subject of government efforts since the mid-1970s (i.e. imposing local content requirements on carmakers) up to the new millennium (Kohpaiboon, 2006). As illustrated in Hill and Kohpaiboon (2017), nurturing efforts in the automotive industries were in line with economic fundamentals instead of smartly picking up by government like many believe.

Most of the policy efforts for nurturing industry are a form of cross-border protection or investment incentive, both of which are discussed further below. These were granted to a broad range of industries. For example, from the 1960s to the 1980s Thailand promoted import substitution industries. The range of industries covered in this policy effort was wide, from basic materials such as steel, textiles, and fertilisers to finished/consumer products such as garments and footwear. Such a strategy is also found in recent years under the current government led by the Prime Minister General Prayut Chan-o-cha, with the 10 S-curve and new S-curve industries: (i) next-generation automotive, (ii) intelligent electronics, (iii) advanced agriculture and biotechnology, (iv) food processing, (v) health and medical tourism, (vi) digital, (vii) robotics, (viii) aviation and logistics, (ix) comprehensive healthcare, and (x) biofuel and biochemical industries.

3.2 Trade Policy

Trade policy in Thailand is conducted by tariff measures whereas non-tariff measures (NTMs) have been imposed on few agricultural products (WTO, 2015). From 1970 to 2016, the most comprehensive tariff reform was implemented in the late 1990s to lower and rationalise tariff rates. As a result, the simple tariff average dropped substantially to 17% in 1997 from 40% in the mid-1980s. Tariff bands were cut from 39 to six (0%, 1%, 5%, 10%, 20%, and 30%). Nonetheless, substantial exemptions had tariffs greater than 30%. While tariff restructuring received renewed emphasis in the new millennium (i.e. from June 2003 to 2008), the magnitude of such tariff reduction was moderate and focused on intermediate tariffs. The average tariff in the new millennium has been around 11%. Note that the new millennium tariff restructuring was pursued with ambitious targets, i.e. three tariff bands: 0%–1% for raw materials, 5% for intermediates, and 10% for finished products. By 2008 nearly one-fifth of tariff lines had a tariff rate greater than 20% (Table 1).

Insert Table 1 here

What remains unchanged in Thailand's tariff structure is the cascading nature of tariff rates. This occurs even though the government tended to lower the level of tariff protection. Protection granted to industries producing raw materials as well as intermediate goods (e.g. chemicals, fertiliser, metal products, and construction material) was lower than for finished products (e.g. food and drinks, pharmaceuticals, garments, and vehicles) (Table 2). The key implication of the cascading tariff structure is that using actual tariff to represent protection tends to understate the true protection from which an industry benefits.

Insert Table 2 here

In the new millennium, the slowdown in WTO liberalisation negotiations has resulted in a switch of political attention and negotiating resources in Thailand towards preferential trade agreements and bilateral free trade agreements. This process accelerated as a result of a significant change in Thailand's political situation. After Thaksin Shinawatra's Thai Rak Thai political party came to power in the early 2000s with a strong mandate, Thailand expressed enthusiasm to sign as many FTAs as possible (Sally, 2007).

From 2001 to 2006, 15 FTAs were initiated during the Thaksin administration. They were implemented without consulting government officials in charge of trade policy. FTA commitments made during this period largely involved tariff liberalisation and market access for goods. Many of the FTAs signed were hastily concluded, without careful consideration or public consultation. Indeed, some were signed off on with scant due diligence of the prospective advantages and disadvantages, as well as inadequate consultation with interested parties outside of government.

From 2006 to May 2011, FTA enthusiasm in Thailand stalled. Under the new constitution promulgated in 2007 after the coup in 2006, the execution of international trade agreements is subject to parliamentary approval (Article 190) to prevent the rushed conclusion of agreements without careful study and public consultation. This article ensures that all international trade agreements are carefully scrutinised and subject to countrywide public hearings. Thus, more time is now needed to enact international trade agreements than in the Thaksin period. As a result, no bilateral FTA was ratified from 2006 to May 2011.

During this period, new FTA negotiations were only instigated within the ASEAN 'plus' format.[2]

From May 2011, Prime Minister Yingluck Shinawatra, the younger sister of former Prime Minister Thaksin Shinawatra, started to pay attention to FTA negotiations again. Negotiations concerning several prospective FTAs (e.g. Thailand-European Free Trade Association (EFTA), Thailand–Chile FTA, and Thailand–Peru FTA), which had stalled from 2006 to May 2011, were resumed and progress towards completion recommenced. The subsequent administration also launched several new FTA talks, including negotiations with Canada in March 2012 and the expression of interest in becoming a member of the Trans-Pacific Partnership (TPP) made during the visit of US President Barack Obama to Thailand in November 2012.

In May 2014, the Royal Thai Armed Forces, led by General Prayut Chan-o-cha, launched a coup d'état, the 12th since the country's first coup in 1932 against the caretaker government. This stalled all FTA talks involving developed country FTA partners, including those with the US and European countries. Starting in 2016, nonetheless, attention to FTA negotiations resumed. Deputy Prime Minister Somkit Jatusripitak, who was also the key person in the Thaksin administration, has been keen to bring Thailand into the TPP and later the CPTPP.

A total of 18 FTAs have been signed so far, of which 12 have come into force (Table 3). Of these, only eight involve substantial tariff cuts, covering more than 80% of tariff lines and having been offered since 2010. These are the ASEAN Free Trade Area (now known as the ASEAN Economic Community (AEC)), the ASEAN–China FTA (ACFTA), the Thailand–Australia FTA (TAFTA), the Thailand–New Zealand FTA, the Japan–Thailand Economic Partnership Agreement (JTEPA), the ASEAN–Japan FTA, the ASEAN–Korea FTA, and the ASEAN–Australia–New Zealand FTA. In the other three FTAs (i.e. the Thailand–Peru FTA, the Thailand–Chile FTA, and the ASEAN–India FTA), substantial tariff cuts only took place in recent years, i.e. 2015 and 2016.

Insert Table 3 here

Another important point from Table 3 is that the tariff cuts offered by Thailand in FTA deals were associated with rather long-time schedules. For example, the first tariff elimination offered by Thailand to Australia under the Thailand–Australia FTA was only 49.5% of product lines in 2005, rising to 93.3% in 2010. By contrast, the offer made by Australia was substantial when the FTA was signed, i.e. tariff elimination covered 83% of tariff lines in 2005. By 2010, the Australian offer was 96.1% of total tariff lines. This implied that tariff cuts under FTAs might not induce any substantial trade-enhancing effect from FTA partners to Thailand.

In addition, tariff cuts offered by Thailand in each FTA were in the narrow range of 6.3%–10.2% compared with the MFN rate (Table 4). The highest tariff margin was for the AEC (10.2%) and the lowest was for the JTEPA (6.3%). The distribution of the five tariff margin categories offered by Thailand is not different amongst the FTAs. In general, about half of the product lines are subject to tariff margins of less than 5%. Given that Thailand has the highest average MFN rate amongst the original ASEAN members, more than 20% of its tariff lines are subject to 10% or higher preferential tariffs.

Insert Table 4 here

3.3 Investment Incentives

Another instrument the Thai government has used extensively to influence the resource allocation of the private sector is granting investment incentives. Thailand Board of Investment (BOI), the government agency in charge of granting investment incentives, was established in 1959. Investment incentive measures included tax concessions on imported machinery, equipment, raw materials, and intermediate inputs needed directly for production. The first Investment Promotion Act was enacted in 1960 and subsequently amended many times (Kohpaiboon and Jongwanich, 2013).

In general, the industries targeted under the investment promotion acts are widely defined and flexible. For example, from 2000 to 2013 the BOI prioritised activities relating to alternative energy, energy conservation, technology and innovation, agricultural equipment,

and environmentally friendly products. This is due to the price hike in petroleum products worldwide. For example, in 2004 (announcement No. Sor10/2547) the manufacture of alcohol or fuel from agriculture products, public utilities and basic services, and the production of electricity or steam power are classified as priority activities of special importance and benefit to the country, so such projects are not subject to the cap on the amount of corporate income tax (CIT) exemption. Another example was in 2009 (announcement No. 6/2552), i.e. to encourage promoted activities to develop skill, technology and innovation, exemption of CIT was introduced and granted to such activities, although revenues of those activities have not yet generated.

Investment incentives from 2009 to 2012 (announcement No. 10/2552 and Sor1/2556) were also provided to eco-car manufacturing through an import duty exemption on machinery, raw materials, and essential parts regardless of zone for 2 years or for the period approved by the Board of Investment, as well as CIT exemption for 6 years regardless of zone. Occasionally, the BOI provides privileges to assist manufacturers that experienced negative shocks such as the Asian financial crisis in 1997/98 or flooding in 2011/12. Despite all changes mentioned above, all industries could still be eligible to apply for privileges from 2000 to 2012.

Even though the new BOI five-year strategy plan (2013–2017) was launched to make promotion more selective instead of broad-based, the problem remains. Under the new plan, 10 industries are targeted: (i) logistics-related industries, (ii) basic industries, (iii) medical and science equipment, (iv) renewable energy and environment-related industries, (v) technology-supporting industries, (vi) high-technology related industries, (vii) food and food-related industries, (viii) hospitality and wellness, (ix) automotive and auto parts industries, and (x) electronics and electrical appliances. Privileges are reclassified into two main groups (A and B), which will be applied differently to each project in each area. Tables 5 and 6 summarise privileges in these two main groups. The key difference between the groups is a CIT exemption privilege, which is applied only to group A. Privileges provided to reinvestment are lower than those to new investment. Note that the non-tax incentives include permits to own land and transfer money out of Thailand.

Insert Tables 5 and 6 here

Nonetheless, the industry coverage is still very wide. Some 100 out of 130 industries (under these 10 major sectors) listed to be promoted by the BOI receive privileges under category A, the highest one (Table 6). These include the petrochemical, paper and machinery, electronics and electrical appliances, alternative energy, and food industries. Although category A can be further divided into four sub-classes (i.e. A1*, A1, A2, and A3), the main difference is the length of the tax holiday – descending from 8 years without a ceiling (A1*) to 8 years (A1), 5 years (A2), and 3 years (A3). Around 30 activities receive privileges under category B.

All in all, this indicates that investment promotion remains a policy instrument to assist firms. This is especially true for indigenous firms. By contrast, foreign firms are not required to apply for BOI investment privileges. But most of foreign investors apply for BOI promotion privileges to bypass restrictions on land ownership (i.e. the Land Code, 1954) and hiring of foreign migrants (i.e. Alien Occupation Law, 1978). Hence, the promotion granted to indigenous firms would be regarded as part of the industrial policy which has been argued recently in the literature.

4. Empirical Model

The empirical model used in this paper is based on the standard equation of productivity determinants measured by total factor productivity. Determinants include firm- and industry-specific factors. The first set of firm-specific factors captures the effect of the extent to which firms are exposed to the world. This includes whether a plant under consideration exports its output $\left(\exp_{ijt}\right)$ or whether it uses imported raw material $\left(rim_{ijt}\right)$, and plant foreign ownership $\left(own_{ijt}\right)$. The second set is the firms' effort to increase productivity such as R&D investment $\left(RD_{ijt}\right)$ and the skill intensity $\left(skill_{ijt}\right)$. Firms' productivity is positively affected by these variables in theory.

Four industry-specific factors are included in the empirical model. The export–output ratio $\left(XOR_{jt}\right)$ and import penetration ratio $\left(MPR_{jt}\right)$ are included to capture the effect of

international competitive pressure on firms' productivity. To capture the domestic competitive pressure, the sale concentration ratio $\left(CON_{jt}\right)$ is used. In addition, the extent to which an industry is engaged in the global production network $\left(network_{jt}\right)$ on firms' productivity is included in our analysis. All of them are expected to attain a positive relationship with productivity.

The empirical model examines three aspects of industrial policy. The first aspect is the role of trade protection measured by ERP_{jt}. In this paper, the formula of the ERP is as in equation 1:[3]

$$ERP_{j,t} = \frac{t_{j,t} - \sum_{i=1}^{n} a^{*}_{ij,t} t_{i,t}}{1 - \sum_{i=1}^{n} a^{*}_{ij,t}} \quad (1)$$

where $t_{j,t}$ = tariff on product *j* at time *t*

$t_{i,t}$ = tariff on product *i* at time *t*

$a^{*}_{ij,t}$ = share of product *i* used in producing product *j* at time *t.*

As mentioned above, we want to examine the effect of partial trade liberalisation induced by FTAs signed. The weighted tariff $\left(t^{*}_{j,t}\right)$ is used instead of the MFN tariff as expressed in equation 2.

$$t^{*}_{j,t} = \left(1 - \sum_{k=1}^{n} q_k\right) t^{MFN}_{j,t} + \sum_{k=1}^{n} q_k t^{FTA}_{jk,t} \quad (2)$$

where $t^{MFN}_{j,t}$ = MFN tariff on product *j* at time *t*

$t^{FTA}_{jk,t}$ = FTA tariff on product *j* at time *t* Thailand offered to FTA partner *k*

q_k = import share of FTA partner *k* to total import.

The second aspect is the investment incentive granted to domestic plants $\left(BOIdomestic_{ijt}\right)$. This is simply because obtaining investment promotion for foreign firms is de facto compulsory to run a business in Thailand. Foreign firms are still subject to many constraints in operating business in Thailand. Clear examples are the prohibition on land ownership and constraints on work permits granted to foreign professionals, from which BOI-promoted foreign firms are exempted (Jongwanich and Kohpaiboon, 2014). This implicitly encouraged foreign investors to apply for BOI promotion privileges. This is in sharp contrast to indigenous firms. The BOI criteria are always subject to discretion, so promoted indigenous firms can be used as a proxy for policy attempts to promote specific firms/industries.

The final aspect of industrial policy covered in this study is the export subsidy granted to an industry $\left(Subsidy_{j}\right)$. Many assistance programmes (e.g. packing credits and special concessions) are offered to exporting firms, regardless of the industry. This could be regarded as a policy attempt to nurture firms in the boarder scope of industrial policy. Hence, it is captured in our analysis.

As postulated in the previous study, the effectiveness of industrial policy is conditioned by the level of domestic competition (Aghion et al., 2015). To test the postulated hypothesis empirically, two interaction terms are introduced: CON_{jt} interacted with $BOIdomestic_{ijt}$ and CON_{jt} with ERP_{jt}. The positive sign of coefficients associated with these two variables is expected because in the absence of domestic competition firms may choose to operate in different sectors to face lower competition on the product market, leading to high sectoral concentration and low incentives to innovate. Firms' productivity improvement would become lower.

All in all, the empirical model used in our analysis is presented in equation 3:

$$\begin{aligned} TFP = {} & a_0 + a_1 \exp_{ijt} + a_2 rim_{ijt} + a_3 own_{ijt} + a_4 RD_{ijt} + a_5 skill_{ijt} \\ & + a_6 ERP_{jt} + a_7 XOR_{jt} + a_8 MPR_{jt} + a_9 CON_{jt} + a_{10} network_{jt} + \\ & + b_1 BOIdomestic_{ijt} + b_2 BOIdomestic_{ijt} * CON_{jt} + + b_3 ERP_{jt} * CON_{jt} + + b_1 Subsidy_{j} + e_{ijt} \end{aligned} \quad (3)$$

5. Data and Variable Measurement

The data set used in this research is Thailand's industrial census, conducted by the National Statistical Office. So far, four censuses are available (i.e. 1996, 2006, 2011, and 2016). A fraction of observation can be matched and conduct a panel-data analysis amongst the three latest censuses (2006, 2011, and 2016), i.e. 9,211 observations. In this paper, the panel data of 9,912 observations over the three latest censuses are used.

Data cleaning in our study starts with examining the possibility of duplicated observations, i.e. samples with different plants' identification numbers report the same value of key variables. Presumably, this is largely driven by multi-plant cases where all affiliates fill in the questionnaire using company-level information where all affiliates are included. Seven key variables are used to identify duplication: (i) years in operation, (ii) total employment, (iii) wage compensation, (iv) raw materials, (v) initial raw material stocks, (vi) initial finished product stock, and (vii) initial fixed assets. When duplicated samples are found, only one is kept in the sample and the others are removed.

The next step is to examine whether samples provide reliable information in the questionnaire. To do so, we drop observations which report annual sales less than ฿12,000 (less than $400), annual value added less than ฿10,000, and/or less than ฿10,000 of initial fixed assets. To mitigate the discretionary criteria employed, we ran a sensitivity analysis of them. As illustrated in Table 7, a number of the remaining observations are not sensitive to choices made. In addition, small/micro enterprises, defined as plants with less than 20 workers (i.e. 3,342 observations), employ less than 10 workers. These are excluded as they would behave differently from the others and might not participate directly with larger plants. The final feature that must be addressed is industrial classification. Generally, the International Standard of Industrial Classification (ISIC) revision 3 is employed for these three censuses and these observations are matched as a panel dataset by plant identification. There are 2,780 cases where ISIC assigned to a given plant identification changes among these three censuses because of changes in product coverage in the censuses. Note that all the nominal variables (e.g. sales, raw materials expenses, and inventory) are converted into the 2001 price, using the price deflator at the 4-digit ISIC disaggregation.

Insert Table 7 here

To calculate TFP_{ijt}, the Levinsohn and Petrin (LP) approach (Levinsohn and Petrin, 2003) is used to address the endogeneity problem widely cited in estimating the production function. If firms choose the optimal level of inputs consumed in the production process (i.e. as the solution of a dynamic profit maximisation problem), then inputs are likely to be endogenous variables because the error term of the model typically contains output determinants. According to the LP approach, intermediate inputs are used as a proxy for the unobserved determinants and mitigate any endogeneity bias that might occur in Ordinary Least Squares (OLS) estimation.

Value added used in LP calculation is measured by the difference between the sale value adjusted by inventory changes net of raw materials and intermediates $\left(\ln VA_{ijt}\right)$. A number of workers are total workers, including both operational and office workers, regarded as blue- and white-collar workers respectively, whereas capital is proxied by the initial fixed asset of plants. Intermediate inputs are adjusted by the change in their inventories.

Three firm-specific variables measuring the extent to which an establishment is exposed to the world market are available in the questionnaire. They are the export–sales ratio $\exp_{ijt}$, the proportion of imported to total raw materials used, and the foreign ownership (% of total equity). Their corresponding estimated coefficients are theoretically expected to be positive. The ratio of blue-collar to total workers is a proxy of $skill_{ijt}$ so that the expected sign is negative. To measure RD_{ijt}, two proxies are used as alternatives. The first is the binary dummy variable $\left(RDD_{ijt}\right)$, which equals to 1 when establishments commit to R&D investment, whereas the second is the ratio of R&D expenditure to total sales $\left(RDS_{ijt}\right)$. The positive sign is expected for the estimated coefficient. BOI-promoted indigenous establishments are measured by the binary dummy $\left(BOID_{ijt}\right)$, which equals to 1 if an establishment does not have foreign ownership and is promoted by the BOI.

To calculate $ERP_{j,t}$, the inter-industry linkage relationship is from Thailand's input–output table by the National Economic and Social Development Board (NESDB).[4] The latest input–output table (2010) is used for all 3 years of the ERP calculation. This is done to ensure that any changes in $ERP_{j,t}$ reflect those in tariffs instead of changes in the input–output relationship. The 2006 $ERP_{j,t}$ set reflects the pre-FTA era. The major FTA import sources include ACFTA, TAFTA, JTEPA, and AEC). Substantial tariff commitments took place after 2006 (90% in 2010 for the ACFTA, 93% of tariff lines in 2010 for the TAFTA, and 100% in 2010 for the AEC). In the case of the JTEPA, there are two tariff cuts, i.e. before and after 2011. Hence, the effect of FTAs is captured in the other two series (the 2011 and 2016 $ERP_{j,t}$). Note that $ERP_{j,t}$ in this study is industry-specific time variants over three periods.

Concentration (CON_{jt}) is measured by the Hirschman Herfindahl index $\left(HHI_{jt}\right)$, which is calculated using information from each census. The formula is expressed in equation 4. Before using it, we clean the data using the same criteria used with the panal data set, i.e. removing duplicated observations and dropping observations that provide unreliable information.

$$HHI_j = \sum_{i=1}^{n}\left(S_{ij}\right)^2 \tag{4}$$

where S_{ij} is the market share of firm *i* in industry *j* and *n* is the number of firms.

The export–output ratio (XOR_{jt}), import penetration ratio (MPR_{jt}), and production network ($Network_{jt}$) are constructed by the authors according to the formulae expressed in equations 5–7. Note that the list of parts and components used in this study is based on Athukorala and Kohpaiboon (2012) which the lists are drawn heavily from interview surveys. International trade data are retrieved from the United Nations Comtrade database (UNCOMTRADE)[5] whereas gross output data are from the National Economic and Social

Development Board. These are classified according to six-digit Harmonized Commodity Description and Coding Systems (HS-6 digit, 2002) and the ISIC 4 digit, respectively. The standard concordance between the HS and ISIC is used to match. All data used to construct are the average of 1- and 2-year lagged value. For example, $XOR_{j,2006(2005data)}$ is based on the average value from 2003 to 2004.

$$XOR_{jt} = \frac{X_{j,t-1,t-2}}{O_{j,t-1,t-2}} \tag{5}$$

$$MPR_{jt} = \frac{M_{j,t-1,t-2}}{M_{j,t-1,t-2} + O_{j,t-1,t-2}} \tag{6}$$

$$Network = \frac{PCX_{j,t-1,t-2} + PCM_{j,t-1,t-2}}{X_{j,t-1,t-2} + M_{j,t-1,t-2}} \tag{7}$$

where $X_{j,t-1,t-2}$ = total export of product j^{th} averaging out between *t-1* and *t-2*
$M_{j,t-1,t-2}$ = total import of product j^{th} averaging out between *t-1* and *t-2*
$O_{j,t-1,t-2}$ = total output of product j^{th} averaging out between *t-1* and *t-2*
$PCX_{j,t-1,t-2}$ = parts and components export of product j^{th} averaging out between *t-1* and *t-2*
$PCM_{j,t-1,t-2}$ = parts and components import of product j^{th} averaging out between *t-1* and *t-2*

To construct $Subsidy_j$, this study uses the WTO data set on subsidies and countervailing measures. The data set has two categories of subsidies, i.e. prohibited and actionable subsidies. The former refers to subsidies granted with the requirement that recipients meet a certain export target or use domestic goods instead of imported goods. In the latter, the subsidy is defined in broader terms, i.e. it will proceed when there is convincing evidence of adverse effects by the complaining country. In this data set, Thailand was charged with countervailing measures in two industries – section VII (plastics and articles thereof, and rubber and articles thereof) and section XV (base metals and articles of base metal) from 1995 to 2017 by three countries (Canada, the US, and EU). There were 11 manufacturing sectors, which were charged with the countervailing measures.[6] A binary

dummy variable is introduced to examine the effect of the subsidy on firm productivity. The dummy variable equals to 1 for those industries listed above and zero otherwise.

All in all, the empirical model used in this study is summarised in equation 8 with the expected sign in the parentheses:

$$\begin{aligned} TFP_{ijt} = {} & a_0 + a_1 \exp_{ijt} + a_2 rim_{ijt} + a_3 own_{ijt} + a_4 RD_{ijt} + a_5 skill_{ijt} + a_6 ERP_{jt} \\ & + a_7 XOR_{jt} + a_8 MPR_{jt} + a_9 HHI_{jt} + a_{10} network_{jt} + b_1 BOIdomestic_{ijt} \\ & + b_2 BOIdomestic_{ijt} * HHI_{jt} + + b_3 ERP_{jt} * HHI_{jt} + + b_1 Subsidy_j + e_{ijt} \end{aligned} \quad (8)$$

where TFP_{ijt} = LP total factor productivity of establishment i^{th} of industry j^{th} at time t

$\exp_{ijt}$ (+) = export-sales ratio of establishment i^{th} of industry j^{th} at time t

rim_{ijt} (+) = imported raw materials as a share of total raw materials of establishment i^{th} of industry j^{th} at time t

own_{ijt} (+) = foreign share of establishment i^{th} of industry j^{th} at time t

RD_{ijt} (+) = R&D effort by establishment i^{th} of industry j^{th} at time t measured by two alternatives:

(1) RDD_{ijt} = the binary dummy variable, equal to 1 when there is R&D effort and zero otherwise,

(2) RDS_{ijt} = the R&D expense to sale of establishment i^{th} of industry j^{th} at time t

$skill_{ijt}$ (-) = the ratio of blue-collar to total workers of establishment i^{th} of industry j^{th} at time t

ERP_{jt} (+/-) = effective rate of protection of industry j^{th} at time t using equation (1)

XOR_{jt} (+) = export-output ratio of industry j^{th} at time t

MPR_{jt} (+) = import penetration ratio of industry j^{th} at time t

HHI_{jt} (-) = Hirschman Herfindahl producer concentration of industry j^{th} at time t

$network_{jt}$ (+) = share of part and component trade to total trade

$BOIdomestic_{ijt}$ (?) = a zero-one binary dummy which equals to 1 when an establishment is BOI-promoted and indigenous and zero otherwise

$Subsidy_j$ (?) = a zero-one binary dummy which equals to 1 when industry j^{th} was subject to subsidy charges on the WTO database

6. Results

The standard panel econometric analyses, i.e. fixed and random effect estimations, are performed to estimate equation 8. The Hausman test is used to choose our preferred model.

Table 8 presents the panel estimation results based on the empirical model discussed above. As reported in each estimation result, the Hausman test result is in favour of the fixed effect (FE) model although the results are to a large extent similar. Hence, the following discussion is based on the FE model.

All equations in Table 8 attain overall significance at 1%, indicated by the Wald test statistics. Columns A and B in Table 8 are based on RDD_{ijt} and RDS_{ijt}, respectively. All coefficients associated with variables of these two equations are similar, except the coefficient corresponding to R&D effort in which only the coefficient corresponding to RDD_{ijt} is statistically significant. The coefficient associated with RDS_{ijt} is statistically insignificant, which could be explained by the rather narrow definition of R&D adopted and used in the questionnaire, which emphasized product innovation. While R&D expense on product innovation is undeniably beneficial, inventing newly produced goods implies establishing a new business. This makes some firms reluctant to do so. With this definition, firms tend to lower their true effort on R&D expenditure so our study is in favour of RDD_{ijt} as opposed to RDS_{ijt}.

Insert Table 8 here

Coefficients corresponding to all firm-specific determinants reach the theoretical expected sign. Firms more exposed to the world market exhibit higher productivity. This can take place through either exporting output abroad, sourcing imported raw materials, or both. Note that the positive coefficient associated with the export–sales ratio ($\exp_{ijt}$) is marginally significant at 10%. Such a finding is consistent with the consensus found in the firm heterogeneity literature. Despite a mild significance (i.e. 10%), foreign firms have higher productivity than indigenous ones. The coefficients corresponding to $skill_{ijt}$ are negative and significant at the 5% level. Firms committing on R&D effort as well as hiring white-collar workers gain more productivity than those which do not.

Amongst industry-specific factors, a coefficient associated with the export–output ratio (XOR_{jt}) turns to be statistically significant with the positive expected sign. This shows

that firms who exports, i.e. high export-output ratio, tend to have higher productivity than those with a low export–output ratio, all other things being equal. This can be regarded as export productivity spillover. Exporting firms bring knowledge at the frontier to the others to follow suit. By contrast, the import threat measured in MPR_{jt} is not a significant force. Such a finding could be due to the dualistic trade policy adopted in Thailand where high tariffs are associated with effective tariff exemption schemes. Under this circumstance, firms can be either export-oriented to access a larger market or serve local niches, which are not directly compete with imported products.

The coefficient corresponding to HHI_{jt} is also found to be negative and statistically significant. This highlights the relative importance of the enabling environment such as domestic competition, which must be in place as market discipline to foster productivity. The coefficient corresponding to $Network_{jt}$ is found to be statistically insignificant. This could be due to the caveat of the global production network proxied by the share of parts and components trade to total trade. Such a proxy is based on the assumption that participating in the global production network occurs within a given product where parts and components share the same ISIC with finished products. This can partially capture certain aspects of the relative importance of the global production network.

To examine the effect of industrial policy, coefficients corresponding to $BOIdomestic_{ijt}$, $BOIdomestic_{ijt} * HHI_{jt}$ ERP_{jt}, and $ERP_{jt} * HHI_{jt}$ are closely examined. Note that $Subsidy_{j}$ cannot be examined under the FE model. The coefficients corresponding to $BOIdomestic_{ijt}$ and its interaction terms with HHI_{jt} are both positive but statistically insignificant when the R&D effort is measured by both RDD_{ijt} and RDS_{ijt} (Table 8: columns A and B).

The coefficient corresponding to $ERP_{jt} * HHI_{jt}$ turns out to be negative and statistically significant at 5% whereas the coefficient associated with ERP_{jt} is not different from zero statistically. Such a finding echoes the key finding in the past about the traditional argument on industrial policy where cross-border protection cannot foster firms' productivity.

The negative coefficient on the interaction term implies that protection granted to the highly concentrated industry could be counterproductive.

The statistical insignificance of ERP_{jt} also suggests that the FTA-led trade liberalisation effect fails to add substantial competitive pressure and make firms improve productivity. This reflects the nature of FTA commitments that Thailand has made so far. As mentioned in Section 3.2, Thailand often expresses reluctance to offer preferential tariffs to FTA partners. Sectors that are subject to high tariffs are also often in the sensitive list in the FTA negotiations. This will remain a challenge to the Thai government in materialising potential of FTAs signed so far.

Nonetheless, the gain highlighted in the industrial policy could be different in each period since assistances providing to firms in each period are different. A number of firms applying for assistance tended to diversify over the period, which could affect the productivity gains of firms. Hence, to properly assess the role of industrial policy, the time dimension must be taken into consideration. To do so, we replace $BOIdomestic_{ijt}$ with two dummies.[7] The first one is $BOIdomestic06_{ijt}$, which equals to 1 if indigenous firms were beginning to receive BOI-privilege in 2006 and zero otherwise. The second one is $BOIdomestic11_{ijt}$, which equals to 1 if indigenous firms begin to receive BOI-privilege in 2011 and zero otherwise. Both dummies are interacted with HHI_{jt}. The estimated coefficients would capture the effect of the granted investment incentive in 2006 and 2011, respectively, on productivity over the whole period. The result is reported in Table 9 (Column A).

Insert Table 9 here

The other coefficients except $BOIdomestic06_{ijt}$; $BOIdomestic11_{ijt}$; and their interaction terms with HHI_{jt} remain unchanged to a large extent, with a difference in coefficient magnitudes. Only the coefficient of $BOIdomestic06_{ijt}$ is positive and statistically significant at the 10% level while $BOIdomestic11_{ijt}$ and its interaction terms are statistically

insignificant. Such evidence points to the dynamic gain of indigenous firms promoted by the BOI in 2006. The insignificance of $BOIdomestic11_{ijt}$ may be because benefits receiving BOI privileges takes times to be materialised. By contrast, statistical significance is found in the case where firms received BOI privileges in 2006. This would suggest room for the government to promote indigenous firms through BOI promotion. Nonetheless, the found productivity premium in the BOI 2006 variable incurs costs in terms of forgone government revenues by the granted investment incentives (e.g. tax holidays and tariff exemptions). Hence, the net benefit of the BOI 2006 remains unknown to a large extent.

It is worth examining the relative importance of the BOI as opposed to other determinants such as exports, sourcing raw materials abroad, and R&D efforts. To do so, equation 9.2 is estimated by replacing the export–sales ratio ($\exp_{ijt}$) and imported raw materials as a share of total raw materials (rim_{ijt}) with the binary dummy variables, i.e. the dummy variable is equal to 1 when a firm exports $\left(\exp d_{ijt}\right)$ and when a firm imports raw materials $\left(rawd_{ijt}\right)$ respectively, and zero otherwise. This makes all firms-specific determinants in Table 9: column B, except $skill_{ijt}$, become a binary dummy variable for the sake of comparison. The results in Table 9: column B turn out to be resilient to those in Table 9: column A, to a large extent, although the coefficient associated with $BOIdomestic06_{ijt}$ turns to be statistically insignificant. The insignificance of $BOIdomestic06_{ijt}$ reflects that other determinants, especially trade openness and R&D effort, are more crucial in fostering firms' productivity than industrial policy.

Finally, to examine the effect of subsidies, the random effect model is employed. This is due to the data availability where $Subsidy_{jt}$ is time-invariant 0-1 dummy. Hence, equation 8 is re-estimated by the random effect model, where industry and time dummies are included. Results are reported in Table 10. As mentioned earlier, the above findings are not sensitive to the estimation methods (Fixed vs Random effect model). The coefficient corresponding to $Subsidy_{jt}$ turns out to be negative and statistically significant at 1%. This suggests that firms in the subsidised sectors tend to perform poorer in terms of productivity improvement than the other firms. All in all, basing on 3 years of panel data analysis, our

results show that the effectiveness of industrial policy in enhancing firms' productivity is rather limited in Thailand, particularly when industrial policy is defined narrowly as trade policy. It seems that industrial policy via providing investment promotion, i.e. through the BOI, could to some certain extent foster firms' productivity, but its significance is relatively weak.

Insert Table 10 here

6. Conclusions and Inferences

The debate over the role of government in nurturing an industry is not new, but has gone back and forth over the past four centuries. In the new millennium, the focus of the debate has been on widening the scope of policy measures treated under the broader definition of industrial policy, which not only covers cross-border protection but also investment promotion and subsidy. Interestingly, attempts to pursue industrial policy are often observed in developing countries alert to FTA opportunities. How these two policies can be combined in growth-promoting strategy remains an open question. Against this backdrop, this paper examined the role of industrial policy on firms' productivity, using 3 years of panel data on Thai manufacturing (2006, 2011, and 2016) as a case study. A range of industrial policy tools was widely defined in this study, including tariff measures, subsidies, and investment incentives, all of which are the main tools used in Thailand. In addition, the effect on firms' productivity of partial trade liberalisation undertaken through FTAs signed between Thailand and its trading partners was examined.

Our paper contributes to the existing literature in at least two ways. First, it examines a wide scope of industrial policy that includes tariff protection, investment promotion measures, and subsidies. Empirical work examining the effect of industrial policy with a wider scope of policy tools remains sparse. Second, our paper examined the effect of FTA-induced trade liberalisation on firms' productivity. So far, few empirical works have examined the effect of FTAs on firm productivity in developing countries, mostly focusing on the effect on developed countries' firms. In this paper, the ERP across industries was estimated, using the weighted average of tariffs between MFN rates and preferential tariffs offered in FTAs. Such an estimate captures the partial trade liberalisation through FTAs.

The key result is that we failed to find statistical evidence that all three types of industrial policies work to foster firms' productivity. It seems that trade openness and R&D effort are more crucial in fostering firms' productivity than industrial policies. This is especially true for the narrow definition of industrial policy that focuses on trade policy protection, measured by the ERP. The statistical insignificance of protection also suggests that the FTA-led trade liberalisation effect fails to add substantial competitive pressure and make firms improve productivity. Such statistical insignificance reflects the nature of FTA commitments that Thailand has made so far. This would remain the challenge to Thai government which yet materialise potential of signed FTAs. For subsidies, our results show that sectors benefiting from subsidies show noticeably lower productivity than the others, all other things being equal. Interestingly, when the time dimension is taken into consideration to assess the role of investment policy through the BOI, we find that such policy could foster indigenous firms' productivity, but only in 2006. The significance of the BOI in 2006 suggests room for the government to design an appropriate investment promotion programme to attract indigenous firms to apply for and receive benefits from BOI promotion.

Three policy inferences can be drawn from these findings. Firstly, our results highlight the role of traditional tools in fostering firms' productivity, including trade openness, R&D, and promoting a competitive environment. This is especially true for the narrow definition of industrial policy which focuses on trade policy protection measured by the ERP. Secondly, there was evidence of the positive effect of industrial policy. This suggests room for the government to implements investment promotion strategy as one of the industrial policies. However, this is associated with costs, so the net benefit of implementing investment promotion strategy remains an open question. It could encourage rent-seeking behaviour and drains limited fiscal resources. Finally, as FTA negotiations are expected to drive further trade liberalisation, tariff cuts must be undertaken in a comprehensive manner with minimum exceptions.

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Table 1: Share of 4-Digit HS Categories of Applied Tariff Rates in Thailand, 1989–2008

Tariff band	1989	1995	2002	2003	2004–2008
0	2.5	2.6	5.6	5.7	6.0
0.1–5	14.4	17.3	33.3	37.7	48.8
5.1–10	14.2	17.6	14.1	14.2	14.8
10.1–15	12.7	3.2	3.9	4.5	3.6
15.1–20	15.4	16.4	21.4	17.9	8.4
20.1–30	15.8	16.0	13.8	14.3	12.7
30.1–100	25.0	26.8	7.8	5.8	5.7

HS= Harmonized System
Source: Jongwanich and Kohpaiboon (2017: Table 2).

Table 2: Nominal Rates of Protection in Thailand, 1980–2003
(%)

Sector	**1980**	**1985**	**2002**	**2003**
Processed foods	34.4	30.9	22.7	20.3
Textile products	41.0	27.8	18.9	18.6
Leather and footwear products	54.1	26.8	18.8	18.5
Wood products	31.6	28.2	13.7	13.5
Paper and pulp	24.0	17.8	14.4	10.5
Chemical and petroleum products	32.8	21.4	9.4	8.4
Rubber products	29.1	26.8	23.2	23.2
Other non-metal products	36.7	23.0	15.0	10.0
Metal products	25.2	16.6	13.2	10.7
Machinery	22.4	14.3	6.2	6.2
Consumer goods and motor vehicles	31.2	19.7	11.4	10.6
Total manufacturing	**32.9**	**23.8**	**16.4**	**15.4**
Overall	**n.a.**	**22.9**	**14.7**	**13.9**

n.a. = not applicable.
Source: Authors' calculation.

Table 3: Thailand's FTAs from 1990

FTA	Signed	Effective	Remarks
1. ASEAN	1990	2006	Tariff reduction completed in 2010 for original ASEAN members; 2015 for new members
2. ASEAN–China	2003	2003	Early harvest programme was launched to eliminate tariff on fruit and vegetables (HS 07 and 08) in October 2003. China's tariff reduction – 60% (2009), 90% (2010) Thailand's tariff reduction – 33.3% (2009), more than 90% (2010)
3. India	Oct. 2003	n.a.	Early Harvest Programme was launched to gradually liberalise 82 product items in September 2004. The rest is under negotiation.
4. Australia	Jul. 2004	Jan. 2005	Australia's tariff reduction – 83% (2005), 96.1% (2010), and 100% (2015) Thailand's tariff reduction – 49.5% (2005), 93.3% (2010), and 100% (2025)
5. New Zealand	Apr. 2005	Jul. 2005	New Zealand's tariff reduction – 79.1% (2005), 88.5% (2010), and 100% (2015) Thailand's tariff reduction – 54.1% (2005), 89.7% (2010), and 100% (2025)
6. Peru	Nov. 2005	Dec. 2011	Tariff reduction between Thailand and Peru – 50% (2011) and 70% (2015)
7. Chile	2006	Nov. 2015	Tariff of 90% of product lines was cut to zero by November 2015.
8. Japan	Apr. 2007	Nov. 2007	Japan's tariff reduction – 86.1% (2007) and 91.2% (2017) Thailand's tariff reduction – 31.1% (2007) and 97.6% (2017) Currently, there is talk regarding further liberalisation known as the Japan–Thailand Economic Partnership Agreement Phase 2.
9. ASEAN–Japan	Apr. 2008	Jun. 2008	Japan's tariff reduction – 85.51% (December 2008), 90.16% (April 2018) Thailand's tariff reduction – 30.94% (June 2009), 86.17% (April 2018)
10. ASEAN–Korea	Feb. 2009	Jan. 2010	Korea's tariff reduction – 90% (2010) Thailand's tariff reduction – 81% (2010), 83% (2012),

FTA	Signed	Effective	Remarks
			86% (2016), and 90% (2017)
11. ASEAN–Australia–New Zealand	Feb. 2009	Jan. 2010	Australia's tariff reduction – 96.34% (2010), 96.85% (2016), 100% (2020) New Zealand's tariff reduction – 82.47% (2010), 88.01% (2016), 100% (2020) Thailand's tariff reduction – 73.05% (2010), 91.11% (2016), 98.89% (2020)
12. ASEAN–India	Aug. 2009	2010	Tariff reduction began in 2010 with a target of 80% for Brunei Darussalam, Indonesia, India, Malaysia, Philippines, Singapore, and Thailand by 2016; and by 2021 for new ASEAN members.
13. Regional Comprehensive Economic Partnership	Under negotiation		Initiated by August 2006, known as ASEAN+6; changed to RCEP in 2011. Plan to cut tariff to zero immediately on at least 65% of product lines. The negotiation is expected to be concluded by the end of 2019.
14. Thailand–European Union	Under negotiation/ Stalled		Initiated by November 2007 under ASEAN– European Union; shift to bilateral agreement with individual ASEAN members in 2009. Four meetings held from May 2013 to April 2014, but talk was stalled because of the 2014 coup. The negotiation is expected to be resumed after the newly elected government in office.
15. Thailand–Canada	Under negotiation		Initiated by March 2012 but stalled because of the 2014 coup.
16. Thailand–European Free Trade Association	Under negotiation/ Stalled		Initiated by October 2005 but stalled because of the 2014 coup.
17. Trans-Pacific Partnership	Uncertain		Thai Prime Minister expressed interest in Trans-Pacific Partnership (TPP) during the United States President's visit to Thailand in November 2012. TPP was abolished after the US withdrew on January 23, 2017.
18. Thailand–Turkey	Launching in July 2017		Negotiations launched in July 2016.
19. Comprehensive and Progressive Trans-pacific Partnership (CPTPP)	Applying		

ASEAN = Association of Southeast Asian Nations, FTA = free trade agreement, n.a. = not applicable.
Source: Author's compilation from official data source. http://www.dtn.go.th/index.php/forum.html (accessed day month year).

Table 4: Margin between General and Preferential Tariff Rates Offered by Thailand and their Distribution in 2010

(%)

	AFTA	ASEAN–China	Thailand–Australia	Thailand–New Zealand	Japan–Thailand	ASEAN–Korea
Tariff margin	10.2	9.3	9.7	9.5	6.3	8.6
Distribution of the margin between general and preferential tariffs (% of total tariff lines)						
$\Delta t = 0$	20.1	25.3	21.2	20.7	30.7	26.7
$0 < \Delta t \leq 5$	39.9	38.3	39.3	39.6	42.5	37.9
$5 < \Delta t \leq 10$	15.3	13.3	15.6	15.6	13.1	13.8
$10 < \Delta t \leq 20$	6.6	6.3	6.6	6.7	4.5	7.9
$20 < \Delta t \leq 30$	14.8	13.6	14.4	14.4	8.0	11.0
$30 < \Delta t$	3.4	3.1	3.0	3.1	1.3	2.7
Number of tariff lines	4,995	4,996	4,996	4,996	4,985	4,996

AFTA = ASEAN Free Trade Area, ASEAN = Association of Southeast Asian Nations.

Note: The average most favoured nation rate of Thailand in 2010 was 10.7%. Some 993 items have a most favoured nation tariff of zero.

Sources: Data are based on the author's calculations using official documents from Office of Fiscal Economics, Ministry of Finance, Thailand.

Table 5: Number of Activities Classified under Each Category, 2013

Industry	A1*	A1	A2	A3	B1	B2	B3	B4
1. Logistics-related industries	1	-	4	1	1	2	-	-
2. Basic industries such as petrochemicals, iron, paper, and machinery	-	5	9	10	4	2	2	-
3. Medical and science equipment	-	2	3	3	1	2	-	-
4. Renewable energy and environment-related industries such as recycling	1	6	2	-	-	-	-	-
5. Technology-supporting industries such as research and development, HRD, engineering design, and software	5	-	1	-	-	1	-	1
6. High-technology related industries such as nanotechnology	1	1	-	1	-	-	-	-
7. Food and food-related industries	-	2	2	5	-	2	-	-
8. Hospitality and wellness	-	-	3	-	-	-	-	3
9. Automotive and auto parts industries	-	6	1	3	1	-	-	-
10. Electronics and electrical appliances	2	-	10	11	1	-	-	-

Note: Granted investment incentives are in descending order, from A*1 to B4 categories, i.e. A*1 is the category receiving the most incentives whereas B4 is that receiving the smallest.
Source: Thailand Board of Investment.

Table 6: Privileges from Thailand Board of Investment for Activities Classified under Groups A and B

	Corporate income tax exemption		Exemption for raw materials		
Group	**New investment**	**Reinvestment**	**Exemption for tariff on machinery**	**Exemption for tariff on raw materials**	**Non-tax**
A1*	8 years (no cap)	8 years (no cap)	Y	Y	Y
A1	8 years (with cap)	8 years (with cap)	Y	Y	Y
A2	5 years (with cap)	3 years (with cap)	Y	Y	Y
A3	3 years (with cap)	1 year (with cap)	Y	Y	Y
B1	-	-	Y	Y	Y
B2	-	-	Y	-	Y
B3	-	-	-	Y	Y
B4	-	-	-	-	Y

Notes: Y= Offered

1. Investors can receive another 50% tax exemption for another 5 years after periods of full tax exemption shown in the table.
2. Activities classified in groups A1, A2, and A3 and relating to research and development (R&D) can receive additional privileges in terms of Corporate Income Tax exemption as follows:

   2.1 R&D expenditure to total sales = 1% or less than ฿150 million receives 1-year addition; = 2% or less than

   ฿300 million receives 2-year addition; = 3% or less than ฿450 million receives 3-year addition.

   2.2 Receiving ISO14000 or carbon footprint prompts 1-year addition.

Source: Thailand Board of Investment.

Table 7: Sensitivity Analysis of Data Cleaning Criteria

No. of workers	Real output 12,000 Baht			Real output 10,000 Baht		
	K 9,000	K10,000	K 11,000	K 9,000	K10,000	K 11000
18	3,612	3,609	3,426	3,612	3,524	3,524
19	3,516	3,513	3,385	3,477	3,475	3,475
20	3,437	3,434	3,349	3,436	3,434	3,434
21	3,300	3,299	3,299	3,300	3,299	3,299
22	3,214	3,213	3,213	3,214	3,213	3,213

No. = number.
Source: Authors' calculation.

Table 8: Productivity Determinants and Industrial Policy of Thai Manufacturing

Variables	Column A		Column B	
	Coeff	*t-stat*	Coeff	*t-stat*
Intercept	9.41***	78.9	9.44***	79.0
own_{ijt}	0.19*	1.58	0.20**	1.63
$\exp_{ijt}$	0.16*	1.57	0.17**	1.66
rim_{ijt}	0.27***	2.62	0.27***	2.64
RDD_{ijt}	0.15***	3.46		
RDS_{ijt}			- 0.02	- 0.30
$skill_{ijt}$	-0.17***	-3.21	-0.18***	-3.36
XOR_{jt}	0.003*	1.55	0.004**	1.61
MPR_{jt}	0.002	0.72	0.0025	0.75
HHI_{jt}	-0.58**	-1.63	-0.63**	-1.73
$network_{jt}$	-0.004	- 0.47	-0.003	-0.43
$BOIdomestic_{ijt}$	0.075	1.24	0.082	1.37
$BOIdomestic_{ijt} * HHI_{jt}$	0.54	1.03	0.57	1.11
ERP_{jt}	0.001	0.77	0.001	0.81
$ERP_{jt} * HHI_{jt}$	-0.05**	-1.85	-0.053**	-1.87
No. of observations	6,517		6,517	
F-test (p-value)	5.75 (0.00)		5.22	

Notes: The above estimation is the FE model; ***, **, and * indicate the 1%, 5%, and 10% levels of statistical significance of one tail test; t-stat is derived from the robustness SE.
Source: Authors' estimation.

Table 9: Productivity Determinants and Dynamic Economies of Thai Manufacturing

Variables	Column A		Column B	
	Coeff	*t-stat*	Coeff	*t-stat*
Intercept	9.4067***	78.4	9.39***	77.99
own_{ijt}	0.20**	1.65	0.16*	1.30
exp_{ijt}	0.15*	1.47		
$expd_{ijt}$			0.09**	1.80
rim_{ijt}	0.27***	2.63		
$rimd_{ijt}$			0.12***	2.78
RDD_{ijt}	0.153***	3.45	0.15***	3.41
$skill_{ijt}$	-0.16***	-2.89	-0.16	-2.96
XOR_{jt}	0.003**	1.53	0.0034**	1.52
MPR_{jt}	0.003	0.82	0.003	0.82
HHI_{jt}	-0.61**	-1.71	-0.61**	-1.70
$network_{jt}$	-0.004	-0.49	-0.004	-0.44
$BOIdomestic06_{ijt}$	0.097*	1.48	0.06	0.90
$BOIdomestic06_{ijt} * HHI_{jt}$	0.52	0.96	0.49	0.92
$BOIdomestic11_{ijt}$	0.11	0.85	0.094	0.74
$BOIdomestic11_{ijt} * HHI_{jt}$	0.63	0.54	0.68	0.58
ERP_{jt}	0.0011	0.82	0.001	0.76
$ERP_{jt} * HHI_{jt}$	-0.053**	-1.89	-0.054**	-1.93
No. of observations	6,517		6,517	
F-test (p-value)	5.20 (0.00)		5.36 (0.00)	

Notes: The above estimation is the FE model; ***, **, and * indicate the 1%, 5%, and 10% levels of statistical significance of one tail test; t-stat is derived from the robustness SE.
Source: Authors' estimation.

Table 10: Productivity Determinants and the Effect of Subsidy of Thai Manufacturing

Variables	**Coeff**	***Z-stat***
Intercept	11.65***	69.54
own_{ijt}	0.56***	5.56
$\exp_{ijt}$	0.38***	4.73
rim_{ijt}	0.37***	4.26
RDD_{ijt}	0.27***	7.02
$skill_{ijt}$	-0.10*	-1.30
XOR_{jt}	0.002	1.27
MPR_{jt}	0.002	0.63
HHI_{jt}	-0.34	-1.06
$network_{jt}$	-0.006	-0.78
$BOIdomestic_{ijt}$	0.26***	4.77
$BOIdomestic_{ijt} * HHI_{jt}$	0.29	0.52
ERP_{jt}	0.002*	1.37
$ERP_{jt} * HHI_{jt}$	-0.06**	-2.06
$Subsidy_{jt}$	-0.77***	-3.80
No. of observations	6,517	
Wald Chi-sq (P value)	28868.6 (0.00)	

Notes: The above estimation is the random effects model; ***, **, and * indicate the 1%, 5%, and 10% levels of statistical significance; time and industry-specific dummies are introduced.
Source: Authors' estimation.