DOCTORAL DISSERTATION

THREE EMPIRICAL ESSAYS IN INTERNATIONAL TRADE AND INDUSTRIAL ORGANIZATION

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ABSTRACT

This dissertation contributes to the understanding of trade liberalization and import variety and export sophistication as well as the market power in the Japanese automobile tire industry. This dissertation is comprised of three independent chapters.

Chapter 1 investigates the effects of Japan's economic partnership agreements (EPAs) on the Japanese import variety with respect to tariff reductions and outward foreign direct investments. The study is focused on the impact of changing tariffs and investments on the range of goods that EPA partners export to Japan for the periods 2005-2010 and 2007-2012. By using disaggregate tariff and trade data at the nine digit HS level and introducing the logit estimates with goods-specific effects, the chapter finds that both tariff reductions and Japan's outward foreign direct investment help increase the likeliness of a commodity in the industrial sector to be exported to Japan from its EPA partner countries in the periods 2005-2010 and 2007-2012.

Chapter 2, coauthored with Xavier de Vanssay and Craig Parsons, investigates the evolution of competition in the Japanese tire market from 1976 to 2010 (35 years). We employ an innovative measure of competition, from J. Boone (2008a, 2008b), as well as traditional competition indices, and price-cost margin regressions, using accounting data

at the firm level. Traditional indicators such as the concentration ratio and Herfindahl-Hirschman Index (HHI) suggest a very high market concentration. However, regressions using the two Boone measures and price-cost margin suggest that some competitive behavior in the Japanese tire industry exists. By introducing dummy variables for the Sumitomo-Ohtsu merger and anti-monopoly action by the Japan Fair Trade Commission, the Boone-style regressions also suggest that the merger had no impact, but the cartel breakup did have a statistically significant (at 10% level) impact on firm's profitability in this oligopolistic market.

Chapter 3 empirically examines the impacts of trade liberalization policy on the sophistication level of Vietnam's exports from 2001 to 2010. The export sophistication measure proposed by Hausmann et al. (2007) is computed by using the disaggregated trade data. By descriptive analysis, this indicator reveals that Vietnam's export structure was similar to that of Indonesia and the Philippines and then became much more similar to Thailand after Vietnam's accession to World Trade Organization (WTO). In addition, this paper econometrically analyzes the effects of trade liberalization on Vietnam's industry-level export sophistication with the additional consideration of its WTO accession in 2007. This paper suggests that tariff reductions have a positive impact on the sophistication level of Vietnam's industry exports. Trade liberalization has a

stronger impact on the nonmanufacturing sectors than on manufacturing sectors. However, the results also imply that the WTO membership does not have any additional effects on Vietnam's industry export sophistication.

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Chapter 1

Effects of Japan's Economic Partnership Agreements on the Extensive Margin of International Trade

1.1. Introduction

There has been limited progress in efforts to liberalize global trade through the World Trade Organization (WTO) since the Doha round of negotiations was launched in 2001. The Doha tariff elimination negotiation is deadlocked due to disagreements between developed and developing economies, and between the European Union (EU) and Japan on one side and the United States (US) on the other. This limited ability to achieve far reaching multilateral trade liberalization under the auspices of the WTO has forced the WTO member countries (the United States and EU in particular) to adopt a free trade area (FTA) as an alternative to promote trade[1]. The trend toward FTAs has generated a domino effect in which one FTA triggers the creation of others. Japan has also been involved in this domino effect. Japan's strategy on the so-called economic partnership agreements (EPAs) seems to be disciplined and progressive[2]. As a result, 12 bilateral EPAs and one regional EPA with ASEAN (Association of Southeast Asian Nations) countries as a whole have been concluded and implemented. Japan's EPAs aim

[1] Following WTO terminology, in a free trade area, trade among members are duty free, but members set their own tariffs on imports from non-members.
[2] Due to the coverage and distinctive approach toward FTAs, Japan calls her FTAs "EPAs".

not only to promote trade liberalization but also to improve business environments and enhance competitiveness with economic cooperation in the partner countries where many Japanese affiliates have operations. Japan's EPAs target developing countries rather than advanced countries with large markets as they encompass an FTA and other elements such as investment, competition policy, intellectual property rights, customs procedure cooperation, technical regulations, standards and conformity assessments, movement of natural persons, energy and mineral resource development cooperation, and government procurement. Due to these characteristics of EPAs, the implementation of EPAs means to Japan that EPA partners make strong commitments to improve their business environments for Japanese affiliates. Thus, the effective implementation of EPAs is becoming an increasingly pressing issue for Japanese firms because they have expanded overseas, particularly into the rest of Asia, which has contributed to the formation of production networks in East Asia.

There have been few studies on the impact of EPAs. Ando (2007) conducted *ex post* EPA impacts of the Japan–Singapore and Japan–Mexico EPAs using gravity model estimations. The Japan–Singapore EPA was found to have almost no direct impact on trade because actual reduction of tariffs was quite limited. However, the Japan–Mexico EPA had a positive impact on trade, particularly on exports. Another study by Brown,

Kiyota, and Stern (2004) to investigate the impacts of FTA involving Japan found that unilateral free trade liberalization on a non-discretionary most favored nation (MFN) basis would increase Japanese welfare by 3.7%, with partner countries also reaping large gains. These effects are greater than the effects of combined bilateral FTAs. Finally, global free trade liberalization was estimated to increase Japan's GDP by 7.4%.

However, this chapter examines the impact of Japan's bilateral EPAs on the extensive margin of international trade in terms of tariff reductions and outward foreign direct investment. I provide the first careful measure of exactly how much Japan's import variety (the extensive margin, i.e., the range of imported goods) has increased at a highly disaggregated data level due to the conclusion of EPAs with several partner countries.

Why am I interested in the import of new varieties? In a world of differentiated goods, consumers and producers benefit from having more varieties of final and intermediate goods, respectively. This has been theoretically demonstrated in the monopolistic competition model pioneered by Dixit and Stiglitz (1977). In addition, most studies focus on the conventional sources of gains from trade, including productivity improvements resulting for increasing returns of scale, trade induced innovation, technology spillovers and improved market efficiency due to severe competition among others. These studies are often based on the assumption of a constant product set over

time, and therefore neglect the benefit that consumers may gain from new import variety. Using disaggregated U.S. import data, and adopting Feenstra's methodology, Broda and Weinstein (2006) found that the gains from newly imported varieties from 1972 to 2001 amount to 2.6% of the U.S. GDP. Chen and Ma (2012), Chen and Jacks (2012), Minondo and Requena (2010), Mohler (2009) also confirmed the substantial gains from magnified import variety for the case of China, Canada, Spain and Switzerland, respectively. Parsons and Nguyen (2009) looked at the effects of import variety using the Feenstra measures on Japanese domestic productivity at a sectoral level and found a positive relation.

This chapter is also related to empirical studies on the relationship between tariffs and the extensive and intensive margin of trade. Surprisingly, few papers have investigated the impacts of tariff reductions from trade arrangement membership on trade flows, in general, and on import variety in particular. Buono and Lalanne (2012) studied the response of French export margins to the tariff reductions implemented after the Uruguay Round in 1995. They found that tariffs have a noticeable impact on exports and up to 4.7% of the total French export growth between 1993 and 2002 were explained in their study. However, Debaere and Mostashari (2010) estimated the impact of tariff reductions on the extensive margin on the import side. By using disaggregate U.S.

bilateral trade data, they supported the arguments by Yi (2003), Ruhl (2004) and Kehoe and Ruhl (2003) that changes along the extensive margin of trade may reconcile the strong trade growth with the overall moderate tariff reductions.

Tariff eliminations also increase the likelihood of international fragmentation of the production process in which a product crosses border many times at different stages of its manufacturing (Jones and Kierzkowski, 2001). Moreover, most favored treatment extended by source countries to Japanese investors as a result of EPAs commitments also accelerates the internationally fragmented production process. This trend suggests that even moderate tariff reductions, which give rise to magnified vertical specialization, result in expanded trade in terms of the extensive margin. In this chapter, I attempt to quantify the exact contribution of tariff eliminations and Japan's outward foreign direct investments to the changing range of commodities that EPA partner countries export to Japan by using highly disaggregated Japanese trade and tariff data. To do this, I slightly modify the empirical model originally proposed by Debaere and Mostashari (2010) by including Japanese bilateral outward foreign direct investments to take into account the contribution of Japanese affiliates in EPA partner countries to the Japanese import variety growth[3]. However, I do not restrict myself to manufacturing goods only, but consider all

[3] According to the 41st Basic Survey of Overseas Business Structure and Activities conducted by the Ministry of Economy, Trade and Industry of Japan, the purpose of Japanese firms'

products that are exported to Japan. I follow the approach developed by Kehoe and Ruhl (2003) and Hilberry and McDaniel (2002) which focus on the countries that have concluded bilateral EPAs with Japan[4]. The economic benefits from EPAs are unclear, as the Japanese authorities have not, in most instances, conducted quantitative analysis on the effects of FTAs on Japan's trade before or after the entry into force of these agreements[5]. I hope the findings will have policy implications for Japanese policy makers.

The descriptive analysis of the data suggests that disappearing import varieties on average outnumber the newly traded varieties by about 1.18 times in 2010 compared to 2005. Also, the total import varieties decreased 8.03% between 2010 and 2005. However, the intensive margin, or value of total imports increased 6.70% from 56.95 trillion yen in 2005 to 60.76 trillion yen in 2010. In addition, the results based on econometric analysis suggest that the impact of bilateral EPAs owing to tariff reductions and outward foreign

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overseas business development, is either to capture overseas markets or to take advantage of comparative endowments to export made in emerging countries to Japan. So the Japanese affiliates in the emerging countries such as China and India are used to function mainly as manufacturers' supply and production bases.

[4] A seminal paper by Baier and Bergstrand (2009) takes a detailed look at the long-run treatment effects of free trade agreements on member's bilateral trade flows using nonparametric matching econometrics, and finds a narrower range and more economically plausible values of the long-run effects of FTAs on members' trade using nonparametric estimates than parametric ones in cross-section. The current paper instead focuses more narrowly on EPA partners of Japan at import varieties.

[5] In the context of *inter alia* Japan's possible participation in the Trans-Pacific Partnership (TPP) initiative, various governmental bodies have recently estimated the cost (and benefit) of its participation in FTAs (EPAs). METI online information (in Japanese). Viewed at: http://www.meti.go.jp/topic/downloadfiles/ 101027strategy02_00_00.pdf [30.11.2010].

direct investment helped to increase by 0.70 and 0.05%, respectively, the probability that a good is imported from EPA partner countries to Japan controlling for various other factors that should affect trade volume[6].

The remainder of this chapter is organized as follows. Section 1.2 briefly discusses Japan's current situation on its Economic Partnership Agreements (EPAs). Section 1.3 focuses on the descriptive analysis of the dataset and data sources. Section 1.4 reviews the theoretical setting and econometric model based on the methodology originally proposed by Debare and Mostashari (2010). Section 1.5 reports the estimation results and section VI concludes.

1.2. Japan's Current Situation on Economic Partnership Agreements (EPAs)

The Japanese government holds the view that its regional and bilateral trade agreements complement the multilateral system[7]. Concurrently, Japan has been intensifying its pursuit of bilateral/regional arrangements involving free trade agreements. The Japanese authorities state that this is not just in areas covered by existing WTO

[6] These results seem contrary to the findings of investigations by Cieślik and Hagemejer (2011) into institutionalized trade liberalization in Central and Eastern Europe (CEE). They found that institutionalized trade liberalization is more effective compared to trade liberalization on a bilateral basis in CEE countries.

[7] See "Foreign Policy Speech by Minister for Foreign Affairs Katsuya Okada to the 174th Session of the Diet". MOFA online information. Viewed at: http://www.mofa.go.jp/announce/fm/okada/speech1001.html [19.07.2010].

agreements, but also in areas like trade facilitation, investment, movement of natural persons, competition policy, and improvement of the business environment[8].

The key point to the Japanese EPA concept is the interpretation of GATT Article XXIV (Trade in Goods). It is stipulated that tariff elimination should cover "substantially all the trade" between parties and be implemented within a reasonable period of time. However, Japan's interpretation of GATT Article XXIV is that tariff elimination should cover more than 90% of goods on a trade value basis and be implemented within 10 years. Although Japan had no preferential trade agreement before 2002, it now has 12 bilateral EPAs in force (with Singapore, Mexico, Malaysia, Chile, Thailand, Indonesia, Brunei, the Philippines, Switzerland, Viet Nam, Peru and India) and one regional EPA with ASEAN. Japan's bilateral EPAs with Singapore, Mexico, Malaysia, Chile, Thailand, Indonesia, Brunei, ASEAN, the Philippines, and Switzerland include provisions on investment. Articles on national treatment, MFN treatment, access to the courts of justice, and prohibition of performance requirements are generally included in the agreements[9]. The EPAs accord preferential treatment to investment from the EPA parties over other foreign investors. The provisions are similar to the provisions of Japan's bilateral

[8] Japan prefers to call these preferential agreements Economic Partnership Agreements (EPAs) rather than FTAs.

[9] JSEPA includes a national treatment provision (Article 73) but does not include an MFN provision; it includes a provision on access to the courts of justice (Article 92).

investment treaties (BITs). These articles are applied to investors and investments as defined in the agreements, with exceptions specified in the annexes. Japan's FTAs with Vietnam and Peru do not contain provisions on investment, as separate BITs have been signed with these countries and have been incorporated into the EPAs. Japan is currently negotiating EPAs with the Australia, Canada, Colombia, Mongolia, and the EU and a trilateral EPA with China and the Republic of Korea and a regional comprehensive economic partnership agreement (RCEP)[10].

Japan – ASEAN:

The ASEAN-Japan Comprehensive Economic Partnership Agreement (AJCEP), which includes trade in goods, trade in services, investment, and economic cooperation, entered into force on December 1, 2008 between Japan, Lao PDR, Myanmar, Singapore and Viet Nam (the Agreement is to become effective in relation to other ASEAN members once they have made the necessary notification on the completion of their respective legal procedures). The AJCEP is legally independent from the individual EPAs concluded bilaterally between Japan and ASEAN member countries and its entry

[10] Regional Comprehensive Economic Partnership (RCEP) is an initiative to link the ten ASEAN member states and the group's Free Trade Agreement partners, Australia, China, India, Japan, South Korea and New Zealand. In total, the grouping of 16 nations includes more than 3 billion people, has a combined GDP of about $17 trillion, and accounts for about 40 percent of world trade. If negotiated successfully, RCEP would create the world's largest trading bloc and have major implications for Asian countries and the world economy. Negotiations among the 16 parties began in early 2013 and are scheduled to conclude by the end of 2015.

into force will neither nullify nor integrate these EPAs. The Japanese Customs applies a preferential tariff based on a bilateral EPA or the AJCEP, depending upon the certificate of origin of the item concerned, thus adding to the complexity of Japan's rules of origin[11]. The AJCEP eliminates tariffs on about 93% of the total value of Japan's imports from ASEAN countries, based on 2006 data.

Japan – Singapore EPA:

The Agreement between Japan and the Republic of Singapore for a New-Age Economic Partnership (JSEPA) entered into force on November 30, 2002. The JSEPA eliminates tariffs on over 98% of the total value of bilateral trade (based on data in 2005). Nonetheless, about 10.5% of tariff lines under the JSEPA, based on the 2008 tariff schedule, have rates higher than zero[12], partly because it is believed that elimination of these tariffs would not lead to significant trade expansion; tariff lines with non-zero rates included many covering agriculture, fish and fish products, petroleum oils (other than crude oil), leather, leather products and footwear, and laminated wood[13]. On March 19, 2007, the two countries agreed to improve market access in the area of industrial and agricultural products, improve specific commitments for financial services, revise rules

[11] The authorities maintain that this broadens the choice of preferential tariffs from which exporters can choose.
[12] Duty-free tariff lines account for about 82% of total lines.
[13] The authorities maintain that duties have been eliminated for about 21% of Japan's tariff lines in agriculture (WTO document WT/REG140/7, 7 February 2006).

of origin and customs procedures, and technically alter provisions on competition.

Japan – Mexico EPA:

The Agreement between Japan and the United Mexican States for the Strengthening of Economic Partnership (JUMSEPA) entered into force on April 1, 2005. Many agricultural products and some industrial products have been excluded from the agreement[14]. The authorities indicate that the JUMSEPA eliminates tariffs on some 96% of the total value of bilateral trade, based on 2002 data.

Japan – Malaysia EPA:

The Economic Partnership Agreement between Japan and Malaysia (JMEPA) entered into force on July 13, 2006. Many agricultural products and some industrial products have been excluded from the agreement[15]. The authorities indicate that the JMEPA eliminates tariffs on some 97% of the total value of bilateral trade, based on 2004 data. In 2007, exports from Japan to Malaysia increased by 14.0%, while Japan's imports from Malaysia increased by 12.4%.

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[14] Excluded items include: meat and meat offal, dairy products, apples, rice, rice products, wheat, plywood, blue fin tuna, leather, leather products, and footwear. Under the JUMSEPA, applied tariff rates for 86.3% of total tariff lines are either zero or lower than the corresponding applied MFN rates; duty-free tariff lines account for 79.2% of all the total lines.

[15] Excluded items include: dairy products, pineapples, rice, rice products, wheat, meat and meat products, wood and wood products, fish and fish products, leather, leather products, and footwear. Under the JMEPA, applied tariff rates for 89.8% of total tariff lines are either zero or lower than the corresponding applied MFN rates; duty-free tariff lines account for 82.3% of all lines.

Japan – Thailand EPA:

Japan – Thailand Economic Partnership Agreement (JTEPA) entered into force on November 1, 2007. The agreement excludes many agricultural products and some industrial products (e.g. rice and rice products, meat and meat products, fish and fish products, dairy products, products of milling industry, leather, leather products and footwear, and wood products)[16]. The authorities indicate that the JTEPA eliminates tariffs on some 95% of the total value of bilateral trade, based on 2004 data for Japan and 2003 data for Thailand.

Japan – Indonesia EPA:

The Agreement between Japan and Indonesia for an Economic Partnership (JIEPA) entered into force on July 1, 2008. Many agricultural products and some industrial products (e.g. rice and rice products, meat and meat products, fish and fish products, dairy products, pineapples, products of milling industry, leather, leather products and footwear, and wood products) have been excluded from the agreement[17]. The authorities indicate that the JIEPA eliminates tariffs on some 92% of the total value of bilateral trade, based on 2005 data.

[16] Under the JTEPA, applied tariff rates for 90.1% of total tariff lines are either zero or lower than the corresponding applied MFN rates; duty-free tariff lines account for 81.9% of all lines.
[17] Under the JIEPA, applied tariff rates for 88.7% of total tariff lines are either zero or lower than the corresponding applied MFN rates; duty-free tariff lines account for 81.8% of all lines.

Japan – Brunei EPA:

The Japan - Brunei Economic Partnership Agreement (JBEPA) entered into force on July 31, 2008. The agreement excludes many agricultural products and some industrial products (e.g. rice and rice products, meat and meat products, fish and fish products, dairy products, pineapples, products of milling industry, leather, leather products and footwear, and wood products)[18]. The authorities indicate that the JBEPA is to eliminate tariffs on over 99.9% of the total value of bilateral trade, based on 2005 data.

Japan – Philippines EPA:

The Japan – Philippines Economic Partnership Agreement (JPEPA) entered into force on December 11, 2008. A high degree of liberalization far beyond the level sought under WTO rules has been achieved, including the elimination of tariffs on around 94 percent of goods on a trade value basis within 10 years[19].

Japan – Switzerland EPA:

The Free Trade and Economic Partnership Agreement between Japan and Switzerland (FTEPA) entered into force on September 1, 2009. The Agreement excludes

[18] Under the JBEPA, applied tariff rates for 86.9% of total tariff lines are either zero or lower than the corresponding applied MFN rates; duty-free tariff lines account for 81.5% of all lines.

[19] Japan excluded 238 tariff lines: 202 agricultural products (including fish products such as cod, herrings, sardines, and mackerel which the Philippines has an advantage in) and 36 industrial products (including slippers and footwear). Moreover, Japan likewise maximized its privilege to impose quotas and delay tariff reduction on certain agricultural products coming in from the Philippines, including bananas which are supposed to be the primary export to Japan. On the other hand, the Philippines excluded only 6 tariff lines: five for rice, and one for salt.

some agricultural and industrial products that are similar to other EPAs. The authorities indicate that FTEPA eliminates tariffs on some 99.3% of the total value of bilateral trade.

Japan – Vietnam EPA:

The Japan-Vietnam Economic Partnership Agreement (JVEPA) entered into force on October 1, 2009. The agreement excludes some items of agricultural and fishery products, petroleum oils (other than crude oil), leather, leather products, and footwear; and laminated wood. The authorities indicate that JVEPA eliminates tariffs on some 92% of the total value of bilateral trade.

Japan – India EPA:

The Japan – India Comprehensive Economic Partnership Agreement (CEPA) entered into force on April 1, 2011. The CEPA eliminates tariffs on 94% of the total value of bilateral trade. The major gains from CEPA will be reduction by 17.41 percent of all tariff lines which would go to zero duty immediately. Most of these are in the textiles sector (1800 lines in 8 digit), where India will benefit immensely by the immediate total bilateral elimination of duties in this sector. However, Japan will immediately place 87 percent of lines and 93 percent of volume under zero duty. The major items of India's export includes seafood, spices, fruits such as mangoes, lemons, spirits and most textile products, chemicals, etc. In fact, most auto parts and agricultural and other sensitive items

have been kept out of the liberalization schedule. India's exclusion list covers 12.84% of all tariff lines and 9.9% of trade volume.

Japan – Peru EPA:

The Economic Partnership Agreement between Japan and Peru entered into force on March 1, 2012. Peru's import duty on certain industrial items, currently at nine percent for most of items, such as cars, automotive parts, steel products, machinery, and electrical items, will be reduced either progressively or immediately to zero percent in the tenth year. Japan's import duties on almost all industrial items will immediately be duty free upon implementation of the EPA. Import duties on some agricultural products will be reduced through a tariff quota system or progressively reduced within ten years, such as pork, chicken, asparagus, and corn. However, some of Japan's sensitive agricultural products are excluded from the tariff reduction, such as rice, wheat, and beef[20].

For further details, Appendices 1.1 and 1.2 describe the trade liberalization levels and main contents covered by bilateral EPAs in effect.

[20] Ministry of Foreign Affairs of Japan:
http://www.mofa.go.jp/announce/announce/2012/1/0124_01.html

1.3. Data Description

Import Variety

Tables 1.1 and 1.2 report the Japanese variety changes in 2005-2010 and 2007-2012, respectively. As can be seen from Table 1.1, the number of goods imported by Japan fell by 8 percent from 94,707 items to 87,099 items. However, the total import value increased by 6.7 percent from 56.95 trillion JPY in 2005 to 60.77 trillion JPY in 2010. The same trend is also seen with regards to the imports from the nine EPA partner countries. In this period, the extensive margin of Japanese imports fell; the intensive margin, however, increased.

Table 1.1: Number of Goods Imported by Japan in 2005-2010

EPA Partners	2005 (9261 lines)			2010 (8826 lines)		
	Number of HS-9 lines	Value (in trillion JPY)	Share in Total Variety	Number of HS-9 lines	Value (in trillion JPY)	Share in Total Variety
VNM	1,793	502	1.9%	2,051	716	2.4%
THA	3,114	1,718	3.3%	3,053	1,840	3.5%
SGP	1,800	739	1.9%	1,487	715	1.7%
MYS	1,996	1,619	2.1%	1,883	1,987	2.2%
PHL	1,828	850	1.9%	1,597	695	1.8%
IDN	2,473	2,298	2.6%	2,338	2,476	2.7%
IND	2,025	352	2.1%	2,157	499	2.5%
CHE	2,358	557	2.5%	2,020	596	2.3%
MEX	1,293	280	1.4%	1,263	305	1.5%
Total of 9 EPAs	18,680	8,915	19.7%	17,849	9,829	20.5%
Total Imports	94,707	56,949	100%	87,099	60,765	100%

Source: Author's own calculation from Trade Statistics, Ministry of Finance of Japan

Table 1.2: Number of Goods Imported by Japan in 2007-2012

EPA Partners	2007 (9042 lines)			2012 (9168 lines)		
	Number of HS-9 lines	Value (in trillion JPY)	Share in Total Variety	Number of HS-9 lines	Value (in trillion JPY)	Share in Total Variety
VNM	1,887	720	2.0%	8,839	1,203	2.7%
THA	3,066	2,154	3.3%	13,016	1,886	4.0%
SGP	1,723	829	1.8%	3,796	700	1.2%
MYS	1,980	2,047	2.1%	6,829	2,621	2.1%
PHL	1,774	1,026	1.9%	5,333	745	1.6%
IDN	2,453	3,117	2.6%	9,028	2,576	2.8%
IND	2,144	491	2.3%	7,413	558	2.3%
CHE	2,244	614	2.4%	4,880	656	1.5%
MEX	1,309	371	1.4%	3,466	351	1.1%
Total of 9 EPAs	18,580	11,367	19.7%	62,600	11,298	19.2%
Total Imports	94,249	73,136	100%	325,482	70,689	100%

Source: Author's own calculation from Trade Statistics, Ministry of Finance of Japan

The number of import varieties from the nine EPA partners fell in the absolute terms but increased by 0.8 percent in the relative terms.

As shown in Table 1.2, the number of Japanese import varieties grew by 3.5 times in the period 2007-2012. However, the import value fell by 3.3 percent from 73.1 trillion JPY in 2007 to 70.7 trillion JPY in 2012. The same trend is also represented by the imports from the nine EPA partner countries. In contrast to the period 2005-2010, the number of goods imported from the nine EPA partners in 2007-2012 period increased 3.4 times in the absolute terms but decreased by 0.5 percent in the relative terms.

The observations included in the estimation focus on the consistently defined HS

codes only as the number of HS-9 digit tariff lines change every year. There are 8,102 HS-9 digit tariff lines that are commonly and consistently defined between 2005 and 2010. As one can see from Table 1.3, the number of import varieties from the nine EPA partner countries fell from 16,631 varieties in 2005 to 15,946 varieties in 2010. However, in the relative terms, the import varieties increased by 0.7 percent from 17.6 percent to 18.3 percent in this period.

Table 1.4 reports the import varieties from EPA partners based on the commonly and consistently defined HS codes between 2007 and 2012. There are 8,171 common tariff lines in this period. In contrast to the period 2005-2010, the number of import varieties slightly increased, however, decreased very sharply in the relative terms from 18.8 percent in 2007 to 5.5 percent in 2012.

Table 1.5 presents the changes in import varieties from the nine EPA partner countries based on the common HS-9 digit codes. In the period 2005-2010, the number of newly traded goods is larger than the number of disappearing goods for most partner countries except Vietnam and India. However, in the period 2007-2012, the new goods exceed the disappearing goods for most partners except Singapore, Switzerland, Malaysia and Philippines. Newly traded goods in 2007-2012 are also larger than those in 2005-2010. This is supportive of an argument, made in Hummels and Klenow (2005) and

elsewhere, that the extensive margin growth should be more manifest for less-developed countries. An increase in import varieties from less-developed countries such as Vietnam and India is larger than an increase from more-developed countries such as Singapore and Switzerland.

Table 1.3: Number of Import Varieties based on Common HS Codes in 2005-2010

EPA Partners	Common HS (8102 tariff lines) 2005			2010		
	Number of HS-9 lines	Value (in trillion JPY)	Share in Total Variety	Number of HS-9 lines	Value (in trillion JPY)	Share in Total Variety
VNM	1,606	411	1.7%	1,825	621	2.1%
THA	2,793	1,394	2.9%	2,727	1,499	3.1%
SGP	1,591	454	1.7%	1,334	428	1.5%
MYS	1,747	1,102	1.8%	1,640	1,436	1.9%
PHL	1,593	520	1.7%	1,410	478	1.6%
IDN	2,183	1,860	2.3%	2,058	2,094	2.4%
IND	1,834	340	1.9%	1,985	482	2.3%
CHE	2,133	556	2.3%	1,833	578	2.1%
MEX	1,151	253	1.2%	1,134	272	1.3%
Total of 9 EPAs	16,631	6,889	17.6%	15,946	7,889	18.3%
Total Imports			100%			100%

Source: Author's own calculation from Trade Statistics, Ministry of Finance of Japan

Table 1.4: Number of Import Varieties based on Common HS Codes in 2007-2012

EPA Partners	Common HS (8171 tariff lines)					
	2007			2012		
	Number of HS-9 lines	Value (in trillion JPY)	Share in Total Variety	Number of HS-9 lines	Value (in trillion JPY)	Share in Total Variety
VNM	1,782	640	1.9%	2,158	228	0.7%
THA	2,904	1,845	3.1%	2,959	394	0.9%
SGP	1,660	640	1.8%	1,395	132	0.4%
MYS	1,903	1,876	2.0%	1,846	417	0.6%
PHL	1,688	911	1.8%	1,526	190	0.5%
IDN	2,339	2,915	2.5%	2,356	365	0.7%
IND	2,024	335	2.1%	2,290	58	0.7%
CHE	2,184	589	2.3%	1,905	101	0.6%
MEX	1,242	354	1.3%	1,309	111	0.4%
Total of 9 EPAs	17,726	10,105	18.8%	17,744	1,997	5.5%
Total Imports			100%			100%

Source: Author's own calculation from Trade Statistics, Ministry of Finance of Japan

Table 1.5: Changes in Number of Import Varieties based on Common HS Codes

EPA Partners	2005-2010			2007-2012		
	Newly Traded Goods	Continuously Traded Goods	Disappearing Goods	Newly Traded Goods	Continuously Traded Goods	Disappearing Goods
VNM	616	1,209	397	728	1430	352
THA	539	2,188	605	630	2,329	575
SGP	305	1,029	562	305	1,090	570
MYS	388	1,252	495	448	1,398	505
PHL	319	1,091	502	332	1,194	494
IDN	442	1,616	567	551	1,805	534
IND	616	1,369	465	713	1,577	447
CHE	305	1,528	605	329	1,576	608
MEX	351	783	368	415	894	348
Total of 9 EPAs	3,881	12,065	4,566	4,451	13,293	4,433

Source: Author's own calculation from Trade Statistics, Ministry of Finance of Japan

1.3.1. Data Sources and Variables

Tariff and trade data

In my study, I focus on tariff changes and trade data between the year 2005 and 2010, and data between 2007 and 2012 for robustness of estimation at the nine digit Harmonized System (HS) level. The source of tariff data for this study is the World Bank's World Integrated Trade Solution database (WITS). WITS further provides access to three other important sources of data: TRAINS (by UNCTAD), COMTRADE (by UNSD) and IDB (by WTO). I used tariff data from the TRAINS database for my regressions for the years 2005, 2007 and 2010. Due to the unavailability in this database,

the 2012 tariff data are from the WTO's IDB database. All tariff data are provided by Japanese authorities to the WTO and WB.

My objectives are to analyze changes in the range of goods that EPA partner countries export to Japan and to quantify the importance in Japanese tariff eliminations that are a result of EPA commitments. As with the United States, there is significant instability in Japanese import code classifications, which challenges the efforts to define a distinct set of goods over time. According to the TRAINS database, there are 9025 tariff lines at the nine digit HS level in 2010 (HS 2007). However, there are 9261 tariff lines in 2005 (HS 2002). I focus on all product categories that were consistently defined over the time period between 2005 and 2010. I also include the categories that were redefined in the 2010 HS classification. As a result, 8012 goods are included in the regression. I also determine the common categories between 2007 (HS 2007) and 2012 (HS 2012). There are 8,171 tariff lines that are consistently defined between 2007 and 2012 at the HS 9 digit level. My tariff data includes ad valorem tariff rates and ad valorem equivalents (AVEs) of specific tariffs calculated by UNCTAD Method 1. The tariff rates included in my regression are the lowest ones among such preferential programs as the WTO bound rate, the MFN applied rate, bilateral EPA rates and GSP

rates[21].

Trade data are collected from Trade Statistics, Japan Customs, Ministry of Finance for years 2005, 2007, 2010 and 2012 at the HS nine digit level. If the positive import value of a good is recorded in 2010 or 2012, the value of status variable is 1. Otherwise, the value is 0. In a similar vein, if trade value of a good is nonzero in 2005 or 2007, the status of exporting that good in 2005 is 1, otherwise the status takes a value of 0.

1.3.2. Japanese outward foreign direct investment and other data

Due to the specificity of the EPAs which also aim at improvement of the business environment in EPA partner countries, I also consider the impact of Japanese outward foreign direct investment. The measures of FDI used in empirical studies include FDI stock (see Eaton and Tamura (1994) and Stein and Daude (2007)), affiliate sales (see Carr, Markusen, Markus (2001) and Bergstrand and Egger (2007)) and cross-border merger and acquisition activity. Due to the data availability[22], Japanese overseas affiliate sales and FDI stock are used as FDI measures for 2005-2010 and

[21] The Japanese tariff schedule has three distinct sets of rates: statutory rates (include both general and temporary rates); WTO bound rates; and preferential rates (under the GSP, and EPAs with Singapore, Mexico, Malaysia, Chile, Thailand, Indonesia, Brunei, Vietnam, Philippines, Switzerland, India, and Peru). In the case of statutory rates, the "temporary" rate, which is reviewed annually, is normally used instead of the higher general rate; the lower of the statutory and WTO bound rates are applied to WTO Members on an MFN basis, except when preferential rates are applied. Where the temporary, general, or preferential rate is above the WTO bound rate, the latter rate applies to WTO Members.

[22] Sales data are available on www.meti.go.jp updated until 2011 as of October 1st 2013.

2007-2012, respectively. The affiliate sales data are taken from the "36th and 41st Basic Survey of Overseas Business Structure and Activities" conducted by Ministry of Economy, Trade and Industry of Japan[23]. The sales of Japanese affiliates comprise of sales from selling products in the host country where Japanese firms have affiliates, and sales from selling product back to Japan as well as sales from selling products to the third parties' markets. If the Japanese firms target vertical specialization, an increase in sales of Japanese affiliates would help increase Japanese new import varieties. The data on outward FDI stock for the years 2007 and 2012 are from Japan External Trade Organization (JETRO) Statistics on Trade and Investment. These FDI data are deflated by the economy-wide GDP deflator for Japan from the World Bank's World Development Indicator Database 2013.

The data on GDP are as used by Hummels and Klenow (2005) and from the World Bank's World Development Indicator Database 2013. The distance data are obtained from the CEPII Database. These variables are included to capture the country-specific effects.

[23] This survey targets Japanese enterprises (excluding the finance, insurance and real estate industries) that hold overseas subsidiaries at the end of fiscal year.

1.4. Econometric model

To determine the Japanese bilateral EPAs' effects on the extensive margin of international trade, I have made slight modifications to the methodology of Debaere and Mostashari's paper (2010). I consider not only the effects of tariff reductions but also of the Japanese outward foreign direct investment as the Japanese EPAs cover a chapter on investment and their purpose is also aimed at EPA partners' commitments in business environment improvements. Perhaps most importantly, trade literature and common sense suggest that FDI is a very good control variable for the amount (number and/or volume) of trade between countries. Moreover, intra-firm trade is such a large part of any country's trade, especially Japan.

My goals are to explore the changing range of goods that EPA partner countries export to Japan and to quantify the contribution of tariff changes to Japanese import variety. The econometric model studies the probability that a good is exported from EPA partner countries to Japan in 2010 controlling for whether or not it was exported to Japan in 2005. I include product-specific fixed effects in the regression. This enables us to examine the significance of changes in the tariff rate and other important factors to the trading status of goods.

The following equation is estimated using a Logit model with product-specific

fixed effects.

$$y_{iz} = \beta_1 + \beta_2 \Delta \ln(1 + \tau_{iz}) + \beta_3 status2005_{iz} + \beta_4 fdi_i + \beta_5 gdp_i + \beta_6 dist_i + \alpha_z \quad (1.1)$$

where y_{iz} is an indicator variable whose value determines whether or not a product was exported from EPA partner country i to Japan in 2010; $\Delta\ln(1+\tau_{iz})$ denotes the change in the natural log of the ad valorem tariff (including AVEs using UNCTAD Method 1) imposed by Japan on good z against country i between 2005 and 2010; $status2005_{iz}$ is an indicator variable, which takes the value of 1 if good z was exported from EPA partner country i to Japan in 2005; fdi_i denotes the change in the natural log of sales by Japanese affiliates in EPA partner country i between 2010 and 2005. I also include the country-specific natural log transformed explanatory variables such as GDP and distance. GDP_i denotes the change in PPP GDP that is the EPA partner country i's gross domestic product converted to international dollars using purchasing power parity rates between 2010 and 2005. $Dist_i$ denotes the distance from the EPA partner country i to Japan. Finally, as mentioned above, I run the regression using a Logit model with fixed effects.

The expected signs of coefficients of tariff and distance variables are negative, whereas the expected signs of status05, sales and GDP variables are positive. This

means that tariff reductions, export status in 2005, EPA partners' GDP and Japanese outward FDI should have a positive impact and distances should have a negative impact on the extensive margin of international trade. However, the coefficients of my interest are tariff reductions and FDI.

The exact same model is also used for the period 2007-2012 to check for robustness of the 2005-2010 period.

1.5. Estimation Results

First, I conduct a regression with a full sample in the period 2005-2010. There are 8,102 tariff lines in common in this period. Thus, I have a panel containing 72,918 observations from nine EPA partner countries. I estimate this panel using a conditional fixed effects logistic regression. 41,148 observations remain after 31,770 observations are dropped because of all positive or negative outcomes. As shown in Tables 1.6 and 1.7[24], the signs of the coefficients of all variables included in the regression are statistically significant at the 1% level and are as expected. Regarding the partial effects on the probability of exporting a certain commodity to Japan, a one percent decrease in Japanese tariff rate causes the probability to increase by 0.7 percent. Similarly, a one

[24] Tables 1.6 and 1.7 present only the results of the key variables of interest.

percent increase in total revenue of Japanese affiliates in EPA partners raise probability by 0.05 percent. For robustness, the estimates for the period 2007-2012 confirm 1% level of significances of all variables. However, the elasticities of tariff reductions and FDI are larger, 6.74 percent and 0.16 percent respectively, than the 2005-2010 period.

Table 1.6: Conditional Fixed Effects Logistic Estimates for the Effects of Tariff Reductions and Outbound FDI on Import Varieties (2005-2010)

	Positive Imports in 2010			
	tariff		fdi	
	Coefficient	Marginal effect	Coefficient	Marginal effect
All products	-2.80***	-0.70***	0.20***	0.05***
Traded in 2005	-1.88	-0.18	0.29***	0.03***
Not traded in 2005	-3.60***	-0.78***	0.16***	0.03***
Agricultural goods	-4.04***	-0.69***	0.004	0.001
Industrial goods	-2.08***	-0.51***	0.24***	0.06***
* Indicates significance at the 10% level.				
** indicates significance at the 5% level.				
*** indicates significance at the 1% level.				

Table 1.7: Conditional Fixed Effects Logistic Estimates for the Effects of Tariff Reductions and Outbound FDI on Import Varieties (2007-2012)

	Positive Imports in 2012			
	tariff		fdi	
	Coefficient	Marginal effect	Coefficient	Marginal effect
All products	-6.74***	-1.64***	0.16***	0.04***
Traded in 2007	-10.19***	-1.55***	0.18***	0.03***
Not traded in 2007	-10.07***	-2.50***	0.07	0.02
Agricultural goods	-1.17	-0.03	0.38***	0.01***
Industrial goods	-7.39***	-1.58***	0.13***	0.03***
* Indicates significance at the 10% level.				
** indicates significance at the 5% level.				
*** indicates significance at the 1* level.				

In order to examine in which section/sector a commodity is more likely to

exported from EPA partners to Japan, I divide the full sample into several subsamples: Goods traded in 2005 (and 2007) and Goods not traded in 2005 (2007); Agricultural goods (from chapter 1 to chapter 24) and Industrial goods (from chapter 25 to chapter 97); and 21 product groups. The results are also shown in Tables 1.6, 1.7, 1.8 and 1.9.

I have a panel containing 16,631 observations for the goods that are traded in 2005. After dropping 7,337 observations because of all positive or all negative outcomes, the estimates suggest that only FDI is statistically significant at a 1% level and has an elasticity of 0.29. However, in the period 2007-2012, a panel comprising of 17,726 observations, after dropping 8,151 observations, found that both tariff reductions and FDI are statistically significant at the 1% level and have elasticities of 10.19 and 0.18 respectively. This implies that the more Japan firms invest into EPA partner countries, the more likely the goods that have been already traded are exported to Japan.

The goods that are not traded in 2005 contain 56,287 items. After dropping 39,272 items because of all positive or all negative outcomes, the conditional fixed effects logistic estimates indicate that all variables are significant at the 1% level. A subsample for the goods that are not traded in 2007 contains 55,813 observations. The conditional logistic estimates for 18,719 remaining observations show that only the coefficient of tariff reductions is statistically significant at the 1% level and has an

elasticity of 10.07. This elasticity is much larger than the value of 3.60 in the period 2005-2010. These results suggest that Japanese tariff reductions cause a greater increase in new import varieties.

In the agricultural sector, I have 16,866 and 12,966 observations in the period 2005-2010 and 2007-2012, respectively. The subsample of 2005-2010 retains 6,813 observations after dropping 10,053 observations, results in only the coefficient of tariff reductions being significant at the 1% level with an elasticity is 4.04. However, the conditional fixed effects logistic estimates for the period 2007-2012 present a 1% level of significance of FDI only, with an elasticity of 0.38. These results indicate that tariff reductions in agricultural sector are found to cause the Japanese import varieties to rise in the period 2005-2010. It is, however, not a robust impact.

In the industrial sector, panels containing 56,052 observations in 2005-2010, and 60,543 observations in 2007-2012. After dropping 21,717 observations in 2005-2010, the conditional fixed effects logistic estimates show that all coefficients of all variables are statistically significant at a 1% level. The values of elasticity of tariff reductions and FDI are 2.07 and 0.24, respectively. A subsample in 2007-2012 retains 37,665 observations and results in a 1% level of significance of all variables of interest[25]. The

[25] Only the distance variable is insignificant.

elasticity of tariff reductions is larger, but the FDI is smaller than the values in the period 2005-2010. Both tariffs and FDI cause the Japanese import varieties to rise due to the signing of EPAs. The benefits for Japanese firms are two-fold. First, Japan is a developed country with high labor costs, while most of its EPA partners are developing countries with relatively cheap labor cost[26]. For investing firms, FDI is used as a way to take advantage of relative factor endowments. Secondly, Japan's tariff reductions in the industrial sector help Japanese firms that are exporting, or will export industrial goods to Japan, to lower trade cost and maximize profit margins.

I also divided the full sample into 21 product-group subsamples. Then, a similar regression approach is applied to these subsamples. The results are also presented in Tables 1.8 and 1.9[27]. In the period 2005-2010, tariff reductions are found to be statistically significant and have the expected signs in Animal product group, Food, beverage and tobacco product group, Mineral product group, Plastics and rubber product group, and Textile and apparel product group. In contrast, in the period 2007-2012, the expected and statistically significant coefficients of tariff reductions are found in the Plastic and rubber product group, the Wood product group, and the Textile and apparel product group. A one percent cut in tariffs helps to increase by 0.45 and

[26] GDP per capital, PPP from World Bank's Development Indicator Database 2013 is used as a proxy for labor cost.
[27] Tables 1.8 and 1.9 present only the results of key variables of interest.

3.77 percent in 2005-2010 and 2007-2012, respectively, the probability that a commodity in “Plastic and rubber” exports to Japan. Similarly, a one percent cut in tariffs in Textile and apparels causes the probability to rise by 0.71 and 0.05 percent in 2005-2010 and 2007-2012, respectively. These results indicate that tariff reductions cause Japanese import variety to increase in “Plastic, rubber products” and “Textile and apparel products”. These findings are in line with the fact that most of EPA partners are developing countries with relatively low labor costs.

Regarding FDI, the coefficients are found to be significant and as expected in such sectors as “Chemicals”, “Leather”, “Wood”, “Paper”, “Textile and apparel”, “Metals”, “Machinery” and “Precision Machine” product groups over the period 2005-2010. The expected and significant coefficients are also found in “Vegetables”, “Food, beverage and tobacco”, “Chemicals”, “Footwear”, “Metals”, “Precision Machines”, “Other manufacturing products” and “Miscellaneous product” groups. As shown in Tables 1.9, the Japanese outward FDI helps increase the probability that a commodity in Chemicals, Metals and Precision machine product exports to Japan. However, their elasticities are small, about 0.0001, 0.002 and 0.01 percent, respectively.

Table 1.8: Conditional Fixed Effects Logistic Estimates for the Effects of Tariff Reductions and Outbound FDI on Import Varieties (2005-2010) by Product Sector

	Positive Imports in 2010			
	tariff		fdi	
Product Sectors	Coefficient	Marginal effect	Coefficient	Marginal effect
Animal products	-22.13***	-0.15***	-0.02	-0.0002
Vegetable products	-1.97	-0.01	0.04	0.0003
Animal and vegetable oils	8.95	0	-0.31	0
Foods, beverage and tobacco	-3.58**	-0.001**	0.08	0
Mineral products	-27.53*	-6.34*	-0.14	-0.03
Chemicals	1.44	0	0.32***	0***
Plastics and rubber	-17.92**	-0.45**	-0.17	-0.004
Leather	6.85**	0.55**	0.31**	0.02**
Wood	9.81	0.03	0.38*	0.001*
Paper	Omitted		0.35***	0.03***
Textiles and apparels	-6.31***	-0.71***	0.26***	0.03***
Footwear	-4.13	-0.08	0.15	0.003
Ceramics and glassware	6.28	0.06	0.06	0.001
Precious stones	8	1.83	0.24	0.05
Base metals	4.16	0.07	0.22***	0.004***
General machinery	13.11	1.02	0.22***	0.02***
Transport vehicles	Omitted		-0.40**	-0.01**
Precision machines	17.04	4.07	0.55***	0.13***
Arms and ammunition	-510.14	0	-12.44	0
Other manufacturing goods	7.15	0	0.46***	0***
Antiques	Omitted		1.12*	0*

* Indicates significance at the 10% level.
** indicates significance at the 5% level.
*** indicates significance at the 1* level.

Table 1.9: Conditional Fixed Effects Logistic Estimates for the Effects of Tariff Reductions and Outbound FDI on Import Varieties (2007-2012) by Product Sector

	Positive Imports in 2012			
	tariff		fdi	
Product Sectors	Coefficient	Marginal effect	Coefficient	Marginal effect
Animal products	-4.62	-0.95	0.43	0.09
Vegetable products	8.31	2.02	0.48**	0.12**
Animal and vegetable oils	22.26	0.001	-0.75	0
Foods, beverage and tobacco	-3.62	-0.001	0.42***	0***
Mineral products	-16.02	-0.01	-0.13	0
Chemicals	-1.17	0	0.28**	0.0001**
Plastics and rubber	-15.34*	-3.77*	-0.36**	-0.09**
Leather	1.5	0.12	0.21	0.02
Wood	15.25**	2.79**	0.16	-0.03
Paper	Omitted		-0.14	-0.03
Textiles and apparels	-19.14***	-0.05***	-0.39***	-0.001***
Footwear	0.27	0.06	0.7***	0.16***
Ceramics and glassware	-0.34	-0.05	-0.05	-0.01
Precious stones	-2.19	-0.001	0.33	0
Base metals	-7.31	-0.07	0.24**	0.002**
General machinery	-5.63	-0.32	0.13	0.01
Transport vehicles	omitted		-0.34	-0.06
Precision machines	31.01*	0.57*	0.62***	0.01***
Arms and ammunition	8.54	0	0.39	0
Other manufacturing goods	7.73	0.15	0.56***	0.01***
Others	Omitted		2.03**	0.19**

* Indicates significance at the 10% level.
** indicates significance at the 5% level.
*** indicates significance at the 1* level.

1.6. Conclusion

In this paper, I investigate the new sources of gains from trade in recent studies by using disaggregated Japanese tariff and trade data at the HS nine digit level to explore how a commodity is likely to be imported from EPA partner countries to Japan

due to tariff reductions and increased outbound FDI resulted by the implementation of EPAs. Although there are reverse trends in the Japanese import variety between the two periods 2005-2010 and 2007-2012 in both absolute and relative terms, this chapter suggests a consistent result that both tariff reductions and Japanese outward FDI have a positive impact on Japanese import variety, especially in the industrial goods. The additional effect of the FDI channel has not yet been considered in the import variety literature. As with tariff reductions, Japan's outbound FDI also contributes to Japanese import variety growth. The plastics, rubber, textile and apparel products are more likely to be exported from EPA partner countries to Japan due to tariff reductions following the enforcement of EPAs. Meanwhile, chemicals, base metals and precision machines are found to be more likely to be imported to Japan due to an increase in Japanese outward foreign direct investments. As Japan continues to enter into bilateral and multilateral (TPP) trade agreements in the near future, a better understanding on the degree in which lower tariffs actually translate to a greater volume and variety is needed. The findings presented here are also suggestive of research initiatives that may further illuminate the causal links between bilateral FDI and both imports and exports due to the conclusion of Japanese bilateral economic partnership agreements.

Chapter 2: The Japanese Automobile Tire Industry under Scrutiny

2.1. Introduction

Competition is an important and interesting issue for both economists and policy makers. It is generally believed that competitive pressure stimulates firms to lower costs to optimize their efficiency and profitability. It also brings prices in line with marginal costs, lowering the rents of producers, increasing consumer surplus, and reducing deadweight loss, thereby leading to better resource allocation in the economy. However, a frequently asked question in both economic policy and research circles is how the degree of competition evolves over time in a certain sector.

In the policy arena, the Japanese competition authority (the Japan Fair Trade Commission or JFTC) has made efforts to restore competition by issuing cease and desist orders when illegal acts have been detected and fine payment orders when price cartels have taken place in order to promote competition since the competition law was enacted in 1947.[28] In 2006, the JFTC ordered two of the four largest automobile tire makers, Yokohama[29] and Bridgestone,[30] to pay a fine for operating an illegal

[28] See "For Fair and Free Market Competition" booklet (in English language) at: http://www.jftc.go.jp/en/about_jftc/role.html.2013.10.10.

[29] Yokohama Rubber Corporation was (Yokohama, YRC) founded and started in 1917 in Yokohama City, Japan in a joint venture between Yokohama Cable Manufacturing Co., Ltd (currently Furukawa Electric Co., Ltd) and BF Goodrich of the United States. In 1920 the company began the production of

bid-rigging scheme (*dangou*).[31] The Japanese competition authority has historically used traditional competition measures, such as the concentration ratio and the Herfindahl-Hirschman Index (HHI), as reference criteria to determine market structure and the nature of competition.[32]

In the economic literature, HHI, but also the price-cost margin (PCM), are widely used as measures of competition. If the HHI or the industry average PCM falls over time, the industry is generally characterized as being more competitive over time (see Aghion *et al.* (2005), Clarke *et al.* (1984), Goldberg and Knetter (1999) and Nickell (1996)). However, theoretical papers such as Stiglitz (1989) and Amir (2002) present models where greater competition leads to *higher rather than lower* PCM margins.

A new measure of competition has been developed in a series of papers (Boone 2008a,

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Yokohama branded tires.

[30] The very first Bridgestone tire was produced on April 9, 1930, by the Japanese "Tabi" Socks Tire Division (which originally made *jika-tabi* socks for construction workers). One year later on March 1, 1931, the founder, Shojiro Ishibashi, made the "Tabi" Socks Tire Division independent and established the Bridgestone Tire Co., Ltd. in the city of Kurume, Fukuoka Prefecture. The name Bridgestone comes from a literal translation and transposition of *ishibashi*, meaning "stone bridge" in Japanese. As Japan's automobile industry grew, the Bridgestone Group expanded its business to become Japan's largest tire manufacturer. In 1951, Bridgestone was the first company in Japan to begin selling rayon cord tires, and a five-year project to modernize production facilities was started. This year also saw another Bridgestone building opened in Kyobashi, Tokyo, which contained the Bridgestone Museum. Sales surpassed ten billion yen in 1953, placing Bridgestone at the top of the tire industry in Japan.

[31] See the fine payment orders for Bridgestone at: http://snk.jftc.go.jp/JDSWeb/jds/dc/DC005.do?documentKey=H180127H18J03000004_.2013.10.10 . For the case of Yokohama: http://snk.jftc.go.jp/JDSWeb/jds/dc/DC005.do?documentKey=H180127H18J03000001_.2013.10.10 . Unfortunately, both are only in the Japanese language.

[32] See "Kigyouketsugoushinsanikansurudokusenkinshihou no un-youhoushin" (in Japanese) at: http://www.jftc.go.jp/dk/kiketsu/guideline/guideline/shishin01.html.2010.10.10. Also refer to "Guidelines to Application of the Antimonopoly Act concerning review of Business Combination" (in English) at: http://www.cas.go.jp/jp/seisaku/hourei/data/GUIDE_2.pdf.2010.10.10

2008b) to resolve these two conflicting sets of predictions. Boone presents models that rely on a relative profits measure based on the notion that more competition punishes the less efficient firms and rewards more efficient ones. The Boone measures are increasingly used with actual industry data in empirical studies, such as Bikker and van Leuvensteijn (2008), van Leuvensteijn *et al.* (2013) and Parsons and de Vanssay (2014). In their papers, they adopt an econometric approach to assess the competitive behavior in the Dutch insurance industry, the effect of competition on bank interest rate pass-through in the European banking industry and the market power in the Japanese beer industry, respectively. In the first and last papers, using average variable costs as a proxy for marginal cost along with other data for the Dutch insurance and Japanese beer markets, they regress relative profits on the marginal cost proxy and then the market share on the marginal cost proxy. The Dutch insurance industry was found to be uncompetitive while the Japanese beer industry seemingly behaves in a more competitive manner.

Our methodology adopts the econometric approach of Bikker and van Leuvensteijn (2008) to determine how competition in the Japanese tire industry developed over the period from 1976 to 2010. We go further by analyzing the changes in the PCM to allow a comparison among competition measures. We contribute to the

existing literature by testifying to the usefulness of Boone's relative profit measure and by comparing the Boone measure to traditional competition indicators.

The rest of this chapter is organized as follows. Section 2 gives a brief history and characteristics of the Japanese automobile tire industry. Section 3 discusses empirical measures of competition. Section 4 describes the firm-level data and analyzes the estimation results. Finally, Section 5 concludes.

2.2. Industry history and characteristics

2.2.1. *Industry developments and characteristics*

The first Japanese made automobile tire was produced in 1913 by a Japanese subsidiary of the British company Dunlop Rubber which was acquired by Sumitomo[33] in 1963, laying a foundation for the development of the Japanese tire industry. The industry was affected by the developments of the Japanese automobile industry and became one of the most important supporting industries for the automobile industry. The Japanese automobile is also one of the most prominent and largest industries in the world, putting Japan in the top three countries in terms of cars manufactured since the

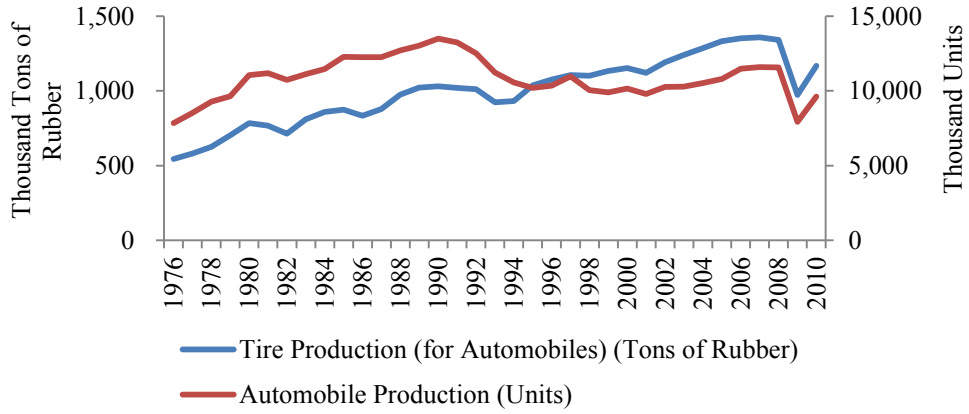
[33] Sumitomo Rubber Industries, Ltd (Sumitomo, SRI) is one of the largest tire manufactures in Japan. The company traces its origins to 1909, when the Sumitomo Group made an investment in Dunlop Japan, the newly formed Japanese subsidiary of the British company Dunlop Rubber. It was the first company to produce automobile tires in Japan. It also was the first developer of tubeless tires in 1954.

1960s. This motorization resulted in increased automobiles and the introduction of express highways, which in turn spurred the tire industry to make more investments in plants, equipment and technological innovations. The industry grew rapidly due to the rising demand for automobile tires during this decade. The industry suffered temporary demand downturns due to the first oil crisis in the 1970s, but started its growth again as the number of automobiles increased due to export-led growth. The second oil crisis in 1979 was also an extremely difficult period for the industry. Though the Japanese economy gradually recovered in the early 1980s, the industry still experienced a demand slowdown due to appreciation of the yen in 1985. The industry again fell into a difficult period during and after the Japanese bubble economy. In the late 1990s, the Japanese economy began its recovery and the world economy became more stable, largely supported by a relatively robust United States economy. As a result, the industry grew steadily. In the 2000s, gradual recovery of Japanese economy and strong growth in the United States, Europe, Middle East and BRICs countries helped the tire industry achieve record high levels of production. However, due to the global economic downturn since 2008, the Great East Japan Earthquake in 2011 and the record appreciation of Japanese yen in this period, tire production in 2012 fell for the first time

in three years to 1.15 million tons on a rubber consumption base.[34]

Figure 2.1 shows the changes in production volume of tires and automobiles over the period from 1976 to 2010. As can be seen from this Figure, production volume of automobile tires in terms of tonnage of rubber increased gradually in line with the rising number of automobiles produced. However, despite a moderate drop in automobile production from 1996, the production of tires grew steadily due to a gradual increase in exports.

Figure 2.1: Production Volume of Tires and Automobiles



Source: Automotive Yearbook and Tire Yearbook

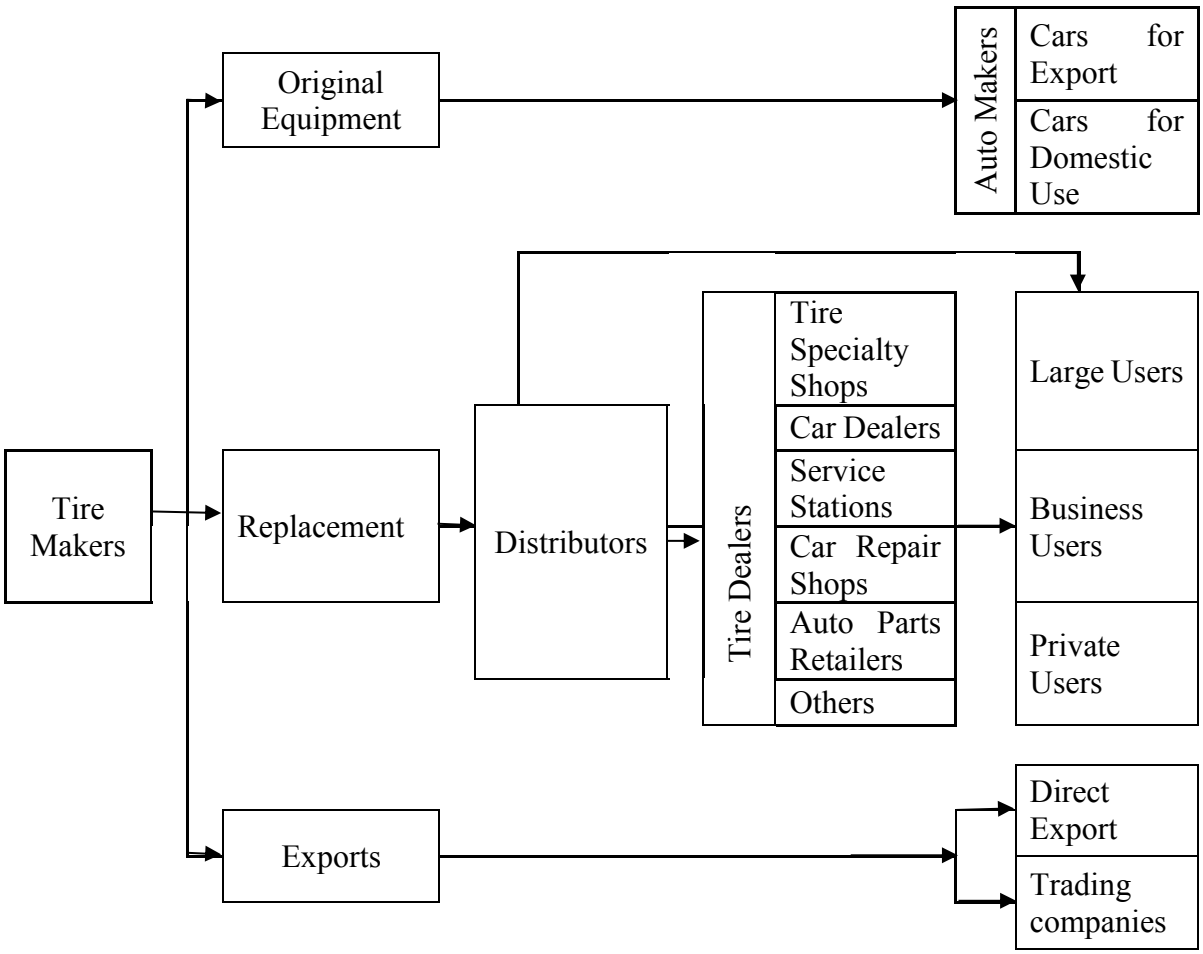
The distribution of automobile tires is divided into three channels: original equipment, replacements and exports. As shown in Figure 2.2 tires are sold via an original equipment channel to automobile manufacturers to produce cars for both

[34] Most of the history in this section is from "Tyre Industry of Japan 2013" at the Japan Automobile Tyre Manufacturers Association's homepage:
http://www.jatma.or.jp/media/pdf/tyre_industry_2013.pdf.2013.10.10

domestic use and exports as well as via the export channel to direct importers or trading companies for export purposes. The replacement channel has particularly wide-ranging distributors. Consequently, tires are consumed domestically via original equipment and replacement channels and abroad via the export channel. The distribution routes can be roughly divided into two types: direct and indirect sales. The direct sales refer to those under which distributors sell tires directly to some large users, such as transport, bus, taxi companies, and governmental and municipal users. Indirect sales are those under which tire dealers supply tires to end users. There are about 100 distributors and 120,000 tire dealers on the replacement channel.[35]

[35] See "Tyre Industry of Japan 2013" at the homepage of the Japan Automobile Tyre Manufacturers Association (JATMA).

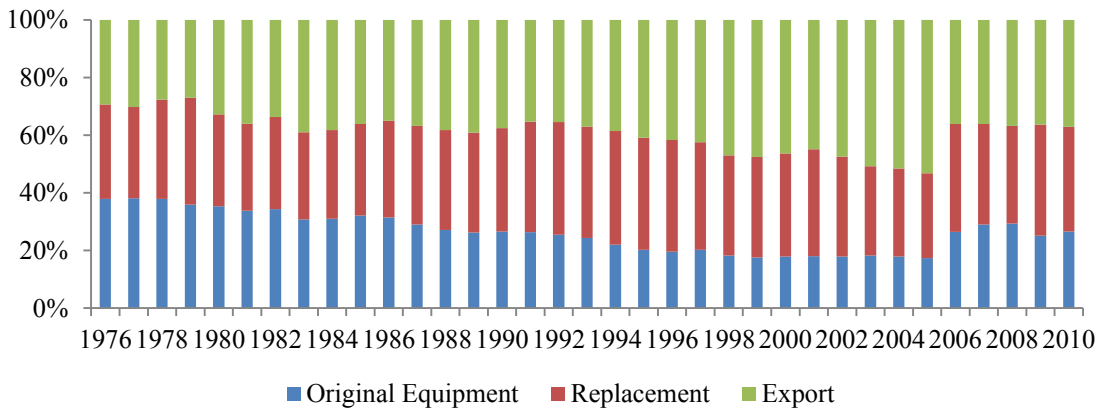
Figure 2.2: Tire Distribution Channels



Source: Tyre Industry of Japan 2013, Japan Automobile Tyre Manufacturers Association

The shares of sales via these three channels are illustrated in Figure 2.3. As one can see from this Figure, on average, the domestic sales of tires (via the original equipment and replacement channels) account for about more than 60 percent of the total sales. This means that the Japanese market plays a critical role for the tire makers.

Figure 2.3: Trends in shares of tire distribution channels



Source: Tire Yearbook, RK Tsushinsha

2.2.2. *Japanese Automobile Tire Market*

Table 2.1 presents the market shares from 1976 to 2010. As one can see from this Table, from 1976 to 2002, the five major firms accounted for approximately 97 percent of the market on average (the so-called "five-firm concentration ratio" or "CR-5"). This concentration increased such that from 2003 to 2010, the *four* major firms made up nearly 99 percent of the market. Bridgestone has historically been the dominant firm with nearly one half of the market. Note: the econometric analysis that follows is also based on this time series data. Yokohama used to be the second largest maker. However, an acquisition of Ohtsu by Sumitomo in 2003 made Sumitomo the second largest firm. As can be seen from this Table, the Herfindahl-Hirschman Index (HHI) values are also very high, with values over 3200 from 2003 onwards. This alone,

however, is by no means sufficient evidence of collusion or less competition. As discussed in the next paragraph, the results of an investigation carried out by the Japanese competition authority uncovered the fact that the largest four firms had indeed colluded to determine the contract price, as prospective contractors in the bid for procurement of automobile tires by the Japanese Defense Agency. Yokohama and Bridgestone were also ordered to pay a fine.

Table 2.1: Market share, concentration ratios and HHI indices

Year	Bridgestone	Sumitomo	Yokohama	Toyo	Ohtsu	CR4	CR5	HHI
1976	48.0	10.5	18.1	4.8	9.3	81.4	90.7	2765
1977	48.6	10.0	18.2	4.6	9.3	81.4	90.7	2814
1978	48.3	10.6	17.1	9.9	10.3	85.9	96.2	2836
1979	50.0	12.5	17.0	12.5	4.0	92.0	96.0	3102
1980	49.5	12.2	17.0	11.4	7.6	90.1	97.7	3018
1981	50.1	12.4	17.2	11.0	7.1	90.7	97.8	3081
1982	47.3	14.7	18.9	11.8	4.4	92.7	97.1	2950
1983	45.7	15.4	18.2	11.8	4.6	91.1	95.7	2796
1984	45.8	14.9	18.8	11.9	4.7	91.4	96.1	2815
1985	46.2	14.9	19.1	12.2	4.5	92.4	96.9	2870
1986	47.8	14.7	19.3	12.0	4.3	93.8	98.1	3017
1987	47.8	14.7	19.3	12.0	4.3	93.8	98.1	3017
1988	48.2	14.7	18.7	10.8	6.0	92.4	98.4	3006
1989	49.0	15.0	19.0	10.0	5.8	93.0	98.8	3087
1990	48.2	13.7	21.6	10.0	5.2	93.5	98.7	3077
1991	48.0	13.0	21.0	10.0	5.0	92.0	97.0	3014
1992	48.0	13.0	21.0	10.0	5.0	92.0	97.0	3014
1993	40.0	15.5	21.0	15.3	6.0	91.8	97.8	2515
1994	49.6	11.7	20.2	8.2	7.1	89.7	96.8	3072
1995	49.7	11.7	20.2	8.3	7.1	89.9	97.0	3084
1996	48.0	14.0	16.0	9.0	7.5	87.0	94.5	2837
1997	48.0	14.0	16.0	9.0	7.5	87.0	94.5	2837
1998	51.8	14.3	15.1	9.9	7.3	91.1	98.4	3214
1999	53.2	13.9	14.7	10.0	6.8	91.8	98.6	3340

2000	52.1	14.8	14.8	10.1	6.9	91.8	98.7	3255
2001	42.4	19.0	18.0	12.7	6.3	92.1	98.4	2644
2002	42.2	19.4	17.8	12.7	6.3	92.1	98.4	2635
2003	50.1	18.9	17.2	12.1	-	98.3	-	3309
2004	48.9	18.6	17.6	13.2	-	98.3	-	3221
2005	49.5	18.8	17.1	12.5	-	97.9	-	3252
2006	49.4	20.0	17.5	11.3	-	98.2	-	3274
2007	50.9	18.9	18.0	10.5	-	98.3	-	3382
2008	49.8	21.1	17.6	10.2	-	98.7	-	3339
2009	50.1	20.1	18.1	10.4	-	98.7	-	3350
2010	48.2	24.7	17.9	9.2	-	100.0	-	3338

Source: Japan Market Share Dictionary, Yano Research Institute and authors' calculations.

2.2.3. *Investigation into Tire Manufacturers*

The Japanese competition law, known as the Antimonopoly Act (official name: Act on Prohibition of Private Monopolization and Maintenance of Fair Trade) was enacted in July 1947 for the purpose of promoting sound development of the Japanese economy and assuring the interests of general consumers by promoting fair and free competition through prohibition of private monopolization, unreasonable restraints of trade and unfair trade practices. There are many cases where several firms established agreements for product prices and volumes in order to protect mutual interests, thus voluntarily restraining market competition. The Antimonopoly Act prohibits any artificial competition-restricting acts such as cartels and bid-rigging schemes. Its enforcement body, known as the Japan Fair Trade Commission (JFTC), is tasked with supervising the functions of the market, economy and business activities in order to

prevent or detect acts against the Antimonopoly Acts and strictly regulates and takes measures against unlawful acts.[36]

In the period from 1974 to 2010, the JFTC made investigations into tire manufacturers to detect and eliminate violations. In 2004, the JFTC began an investigation of the industry and made the following findings.[37]

The Japan Defense Agency organized general competitive bidding for the procurement of automobile tires for the use by Japan's Ground, Maritime and Air Self-defense Forces.[38] In this bidding system, a successful bidder must offer a lower price than a predetermined (and unknown to the bidder) price set by the Defense Agency. The lowest bid (all of which are lower than the predetermined price) wins the contract. If all of the offered prices are higher than the predetermined price, the Agency will hold a private negotiation session with the lowest price bidder to conclude a contract. If negotiations cannot achieve a price below the predetermined price, the Agency terminates negotiations and tenders the bid again on another day. If the price is below the predetermined price after negotiations, the contract with the winning firm is

[36] For further information, see JFTC's homepage at: http://www.jftc.go.jp/en/about_jftc/index.html.2013.10.10.

[37] This is the only investigation which resulted in any financial punitive measures. See the trial decision (*shinketsu*) in the Japanese language at: http://snk.jftc.go.jp/JDSWeb/jds/dc/DC005.do?documentKey=H170131H16J02000036_.2013.10.10.

[38] Though Japan's military expenditure budget is no small amount (it amounts to around 1% of its GDP), tires would be a very tiny portion of total military expenditures (see: http://data.worldbank.org/indicator/MS.MIL.XPND.GD.ZS).

concluded. This process can go on for several days. Also, firms may decide to withdraw from succeeding rounds. As is explained below, the decision of who would withdraw and when was done strategically and with forethought and planning among the collusive firms.

Bridgestone, Yokohama, Sumitomo, Toyo[39] and their sales companies and Goodyear had developed a collusive, bid-rigging scheme (*dangou*) in which all present and future Defense contracts would be shared out over time. For example, Bridgestone, the largest maker, was to receive 35.55% of all orders. Goodyear would receive only 3.47%.[40] Additional considerations were made to allow for specialty tires contracts in which only two of the firms might have the particular mold for the tire. Bid prices were also coordinated ahead of the bidding process to ensure that the designated "winner" would have the lowest bid of all bidding firms. Not only did they quote prices higher than the predetermined price, but the scheme also made the decisions as to the sequential number of bids that would ensue and at which point each of the firms (save for the "winner") would drop out of the bidding process. Ultimately, this carefully

[39] Toyo Tire & Rubber Co., Ltd (Toyo) was founded in 1945 in Osaka City, Japan as a result of a merger between Hirano Rubber Manufacturing Inc. and Toyo Rubber Industrial Co., Ltd. The company started exporting automobile tires in 1947 and was listed on the Osaka Securities Exchange in 1949. It expanded its business to United States in 1966 and to Australia in 1974. Toyo also established a comprehensive business partnership with Nitto Tire Co., Ltd in 1979. The Toyo and Nitto branded tires are among the top ten sellers in Japan.

[40] These shares were set at the same time Ohtsu was merging with Sumitomo.

plotted scheme would result in only one firm left. The negotiations with the Agency inevitably (by design of the cartel) ended up in a failure. The final agreed upon price typically ended up remarkably close to the prices agreed upon in previous contracts. In this way, the cartel could ensure the maximum price received and allocate monopoly profits based essentially on historical market shares.

In fiscal year 2003, most orders for tires by the Defense Agency went to Bridgestone, Yokohama, Sumitomo and Toyo under the aforementioned collusive bid-rigging scheme.

In March 4th 2004, Goodyear cancelled the sales of tires to the Agency. Yokohama Tire Tokyo Sales Company knew of this contract cancellation between Goodyear and the Japanese Defense Agency and thus held a meeting with the other companies on May 26th 2004 to determine how to go about redistributing their portions of the contract abandoned by Goodyear.

This cancellation by Goodyear apparently spurred the JFTC to initiate an investigation into this case on June 17th 2004. In light of this serious investigation, the four firms and their sales representatives ceased the collusive behavior. Based on their findings, the JFTC made a decision on January 31st 2005 to the effect that Bridgestone, Yokohama, Sumitomo and their sales representatives must: (1) adopt a resolution to

confirm their cancellation of collusive action; (2) notify the Agency and JFTC of the adopted resolutions as well as commitments to acknowledge an order independently without determining prospective participants or planned quotations related to the tire contract with the Agency; (3) not determine prospective bidders and their prices regarding the general competitive bidding tendered by the Agency about the procurement of tires; (4) take necessary measures to train sales staff about the Antimonopoly Act and get inspected by legal professionals as well as report to the JFTC about all measures taken.

Finally, Yokohama and Bridgestone were ordered by the JFTC on January 27th 2006 to pay administrative fines of 39.8 million yen and 36.1 million yen for the violations to Article 3 of the Antimonopoly Act during the period from September 4th 2001 to June 17th 2004 and July 31st 2003 to March 24th 2004 respectively.

2.3. Measurement of Competition

To answer the question of how the intensity of competition has evolved over the period from 1976 to 2010 in the Japanese tire industry, one needs a decent measure. This is not an easy task as the way to measure competition is still a theoretically inconclusive topic in the literature. Oligopolistic competition is regarded as a game

between firms, often in several product markets, to maximize their profits. This game is complicated because of the involvement of many factors such as firm efficiency and firm innovation, as well as market demand conditions and administrative regulations. We employ two competition indicators in this chapter which give us indications on the degree of competition regardless of the underlying complexity of the model: the price-cost margin and a relative profits measure.

2.3.1. Price-cost margin

The price-cost margin (hereinafter abbreviated as PCM), also known as the Lerner index, was originally proposed by Lerner (1934) to measure market power. This competition measure is commonly used in many empirical studies and is grounded in neoclassical theory where, under perfect competition, prices (p_i) equal marginal cost (c_i). However, if market power exists, firms are able to set their prices above their marginal costs. A pure monopoly would obviously have the highest potential price markup over marginal cost. Technically, the PCM for a firm *i*, is calculated as follows:

$$PCM_i = \frac{p_i - c_i}{p_i} \quad (2.1)$$

PCM is greater than zero, if the competition is less than perfect. PCM approaches zero as competition becomes more intense. To measure competition in an industry, the average industry PCM is calculated as a market share (m_i) weighted mean of

firm-specific PCMs.

$$PCM = \sum_i m_i \times \frac{p_i - c_i}{p_i} \quad (2.2)$$

However, the common interpretation of price-cost margin is with firm-specific PCMs. Under most models, with more competition, the PCM falls, and with less competition, the PCM rises.

2.3.2. Relative Profits Measures

The main idea of the relative profits differences (RPD) developed by Boone *et al.*, (2007) and in Boone (2008a, b) is that competition rewards efficiency and that firms are punished more harshly in terms of profits for cost inefficiency. The more efficient firm will realize higher market shares and hence earn higher profits than less efficient firms in fiercer competition. The more competitive the market, the stronger is the proposed relationship between firm efficiency differences and performance differences. As discussed in Boone (2008a, b), this measure holds whether competition is intensified through entry due to a fall in entry barriers or through more aggressive conduct.[41] This relative profits measure assumes that firms are heterogeneous and have different efficiency levels or marginal costs, as productivity is inversely related to marginal costs.

[41] We wish to thank an anonymous referee for asking us to elaborate on this issue.

Therefore, when firms differ in efficiency, they will differ in profit levels. The Boone methodology is an attempt to shed light on this impact.

As shown in Boone (2008a), for any three firms, the RPD is calculated as follows:

$$RPD(n) = \frac{\pi(n**) - \pi(n)}{\pi(n*) - \pi(n)} \quad (2.3)$$

where $\boldsymbol{\pi}$ and $\boldsymbol{n}$ denote firm profits and efficiency, respectively, with $n** > n* > n$. This measure should rise if the degree of competition increases.

If there are more than three firms, it would be impossible to identify a consistently least efficient firm over the time horizon as above. Another possible way, however, proposed by Boone (2008a), is to plot the RPDs. The normalized firm efficiency and profits are calculated and plotted as a function on the horizontal and vertical coordinate axes. To evaluate the changes in competition, one should calculate the area below the curve bounded between zero and one. If the area shrinks over the time horizon, this would indicate intensified competition. In this chapter, we use a regression technique instead of plotting relative profit differences. An econometric approach, which is similar to the one adopted by Bikker and van Leuvensteijn (2008), is applied to normalized profits and efficiency. Detailed discussion of the empirical models is presented in the next section.

2.4. Empirical Analysis

2.4.1. Data Sources and Descriptions

Market share data in Table 2.1 and that used in the regressions are taken from the Japan Market Share Dictionary (*Nihon Maaketto Shea Jiten*) published in Tokyo annually by Yano Research Institute (*Yano Kenkyujo*). However, the market shares are based on the production volume in terms of tonnage of rubber until 1997, and then on the shipment value in terms of Japanese yen until 2010. Due to the discrepancy in units of tire production volume, we contacted the Japan Automobile Tyre Manufacturers Association (JATMA) to ask for the breakdown of total production volume, as well as the four major firms for their production volume. Unfortunately, both JATMA and the four firms declined to provide us with the requested data. The production volumes used to construct variables are therefore calculated consistently by multiplying market share with the total tire production in terms of tonnage of rubber, taken from the statistics of the Tire Yearbook, published in Tokyo annually by RK Tsushinsha. The calculated production volumes are almost the same as the ones shown in the Japan Market Share Dictionary. The production volumes we use in the estimates are the tires made in Japan.[42]

[42] The production volumes include the exported tires; however, as shown in the Figure 3, the domestic sales are of great importance to the Japanese tire manufacturers.

All accounting data were made real (in constant year 2000 yen) using overall economy-wide GDP deflators for Japan (Officer and Williamson, 2012). The relevant accounting data were extracted from the financial reports (*Yuuka Shouken Houkokusho*) that listed stock companies must submit to the Government annually.

In practice, marginal costs are unobservable and it is difficult to gather exact data on firm prices and marginal costs for further analysis. As such, average variable costs are used, as suggested by Boone (2008a) and as are regularly used in many empirical papers (see, for instance, Scherer and Ross (1990, p. 418), Aghion (2005)) as a proxy for marginal cost. Marginal cost should strongly co-vary with the average variable cost over time. Average variable costs are calculated by dividing cost of sales by production volumes as calculated above.

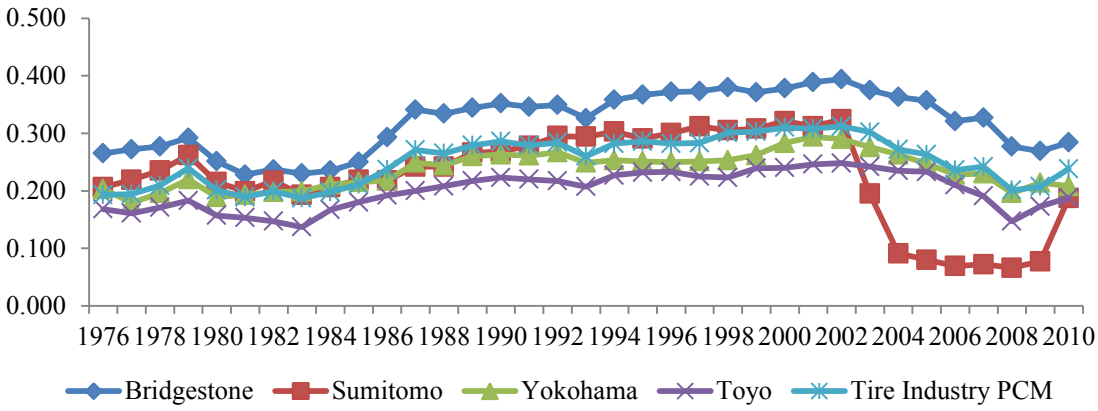
The variable (operating) profits are, as suggested by Boone (2008a), Total (annual) Revenue minus Cost of Sales. However, we do not have the breakdown of total revenues or costs of sales for automobile tires only. This means that revenue is from all products, of which tires are by far the largest.

2.4.2. Empirical Methodology

2.4.2.1. Price-cost margin (PCM)

One should note that PCM is a statistical indicator calculated directly from firm-level data. Applying it to the accounting data, we calculate the PCM as a ratio of total revenue minus total variable costs over total revenue. This yields firm-specific PCMs and a firm market share weighted average of the industry PCM.

Figure 2.4: Price-Cost Margin



As one can see from Figure 2.4, firm-specific PCMs exhibit upward trends from 1976 to 2002 and downward trends from 2003 onwards. The readers should keep in mind from the industry history section that a merger of two players occurred during this period. The acquisition of Ohtsu by Sumitomo in July 2003 led to a decrease in the number of competitors; this is literally less competition, in one sense. However, the competition in this market seems to have become more intense after the merger, as seen

in a fall in the firms' PCMs.

In order to see in an econometric manner how firm-specific PCMs change in response to a merger and cartel breakup after controlling for the shocks on both industry demand and manufacturing costs, we define our specifications[43] as follows:

$$PCM_{it} = \alpha_1 Merger_t + \sum \beta_i \, Dummies_{it} + \gamma Oilprice_t + \delta Demand_t + \varepsilon_{it} \quad (2.4)$$

$$PCM_{it} = \alpha_1 Cartel\_breakup_t + \sum \beta_i \, Dummies_{it} + \gamma Oilprice_t + \delta Demand_t + \varepsilon_{it} \quad (2.5)$$

where PCM_{it} denotes the price-cost margin of firm i (i=Bridgestone, Sumitomo, Yokohama and Toyo) at time t. *Merger* is a dummy variable which takes the value of one if the year is 2003 and after, and zero otherwise. *Cartel_breakup* is also a dummy variable which takes the value of one if the year is 2005 and after, and zero otherwise. $Dummies_i$ are firm-level fixed effects. *Oilprice* and *Demand* are the world oil price and total industry demand, respectively. Since industry demand is endogenous with the price-cost margin, we adopt the number of vehicle registrations as an instrumental variable. Vehicle registrations are highly correlated with total industry demand, but does not generally influence the PCMs.[44]

[43] All variables are expressed in logarithms, except for the dummy variables.

[44] The data on the number of vehicle registrations in Japan are taken from the Automotive Yearbook (*Jidosha Nenkan*), published annually by the *Nikkan Jidosha Shimbunsha* and the Automobile Business Association of Japan. The total industry demand data is taken from Tire Yearbook published annually by

We estimate this log-transformed equation with a panel containing 140 observations using a two-stage least squares method to correct for the potential endogeneity problem. Results are presented in Table 2.2. All the four firm dummy variables have negative signs and are statistically significant at a 1% level. We also conduct a Wald test to see if the four firm-specific coefficients (for Bridgestone, Sumitomo, Yokohama and Toyo) are simultaneously equal. The null hypothesis is rejected on the basis of F-statistics (p-value of 0.00). This leads us to believe that there are interesting, idiosyncratic (firm-specific) aspects to the evolution of the price-cost margin. The negative signs indicate decreasing trends in the firms' individual PCMs, suggesting competitive behavior in the market. The oil price and total industry demand variables also have the expected signs and are statistically significant at a 1% level. However, while both the merger and cartel breakup dummies have negative signs, they are statistically insignificant.[45] This suggests that the complete absorption of tiny Ohtsu (only 6% of the market) by the larger Sumitomo (nearly 20% of the entire market) had little or no impact on market behavior. Also bear in mind that while 100% ownership of

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RK Tsushinsha. Oil price data is from the Dow Jones & Company at: http://research.stlouisfed.org/fred2/series/MCOILWTICO .

[45] A correlation matrix was calculated to check the correlations between the variables in equation (2). The coefficient of correlation between the cartel breakup dummy and total industry demand is 0.47. This is not terribly high. Additionally, our results and standard errors are robust across many specifications. As such, we still feel comfortable including them both.

Ohtsu occurred in 2003, Sumitomo already owned 51% of Ohtsu before the complete buyout. The fact that the action by the JFTC in the defense procurement of tires seems to have had no effect on the level of competition in the market may reflect a number of things. It could reflect the small share that defense contract tires are of overall tires sales. Or it could reflect that the fact that the penalties administered were small and did little to change overall behavior. Or it could be a combination of both.

Table 2.2: Results of PCM regression (TSLS, 1976-2010)

Dependent Variables	Log PCM	Log PCM
Independent Variables	EQ. 2.4	EQ. 2.5
Merger	-0.19 (0.13)	-
Cartel_breakup	-	-0.20 (0.15)
Bridgestone (br)	-3.96 (0.76) ***	-4.04 (0.77) ***
Sumitomo (sri)	-4.39 (0.73) ***	-4.47 (0.74) ***
Yokohama (yrc)	-4.26 (0.76) ***	-4.33 (0.76) ***
Toyo (toyo)	-4.42 (0.76) ***	-4.50 (0.76) ***
Log oil price	-0.27 (0.08) ***	-0.28 (0.07) ***
Log total industry demand	0.74 (0.17) ***	0.76 (0.17) ***
Adj. R squared	0.54	0.54
S.E. Regression	0.23	0.23

Standard errors are in parentheses.
*, **, and *** indicate significance at 10%, 5% and 1% level, respectively.
Newey-West HAC standard errors & covariance, (lag truncation = 5).
Number of observations: 140 (35 years, 4 firms)
Instruments: Log vehicle registrations, Merger, br, sri, yrc, toyo, and oil price.

2.4.2.2. Relative profits measure

An alternative for measuring competition in this chapter is an econometric approach quite similar to that of Bikker and van Leuvensteijn (2008). As in that paper, we first regress normalized profits, and then in a second regression, market share, on a normalized marginal cost proxy which is in this case the annual average variable cost, as is standard in the empirical literature. This may create a bias in the results for both performance indicators. In this chapter, we use the annual means (of the tire industry) to normalize profits and efficiencies, so the empirical model becomes[46]:

$$\frac{\pi_{it}}{\bar{\pi}_t} = \alpha + \beta\left(\frac{mc_{it}}{\overline{mc}_t}\right) + \varepsilon_{it} \quad (2.6)$$

where α, β are parameters and $\boldsymbol{\pi}_{it}$ denotes the profits of firm *i* in year *t*. $\bar{\pi}_t$ and $\overline{mc}_t$ are the annual means of the four firms' profits and marginal costs in year t, respectively. The *normalized* profits, $\pi_{it}/\bar{\pi}_t$, are defined for each firm and depend on the *normalized* marginal costs of respective firms. The marginal costs are proxied by total variable cost divided by total output. The parameter of interest is β which we will refer to as the "Boone measure" or "Boone parameter". The expected sign of β is negative. A higher absolute value of the Boone measure indicates a higher level of competition.

If fixed effects, or firm dummies, are included, the specification for *relative* profits

[46] We wish to thank an anonymous referee for suggesting how to normalize our observations.

becomes:

$$\frac{\pi_{it}}{\bar{\pi}_t} = \beta\left(\frac{mc_{it}}{\overline{mc}_t}\right) + \sum \lambda_i Dummies_{it} + \varepsilon_{it} \quad (2.7)$$

To see firm effects interacted with the proxy for relative marginal cost, the regression equation becomes the following:

$$\frac{\pi_{it}}{\bar{\pi}_t} = \sum \lambda_i Dummies_{it} + \sum \beta_i \left(\frac{mc_{it}}{\overline{mc}_t}\right) Dummies_{it} + \varepsilon_{it} \quad (2.8)$$

For the market shares, we have the following:

$$Market\ share_{it} = \alpha + \beta\left(\frac{mc_{it}}{\overline{mc}_t}\right) + \varepsilon_{it} \quad (2.9)$$

and

$$Market\ share_{it} = \beta\left(\frac{mc_{it}}{\overline{mc}_t}\right) + \sum \lambda_i Dummies_{it} + \varepsilon_{it} \quad (2.10)$$

and

$$Market\ share_{it} = \sum \lambda_i Dummies_{it} + \sum \beta_i \left(\frac{mc_{it}}{\overline{mc}_t}\right) Dummies_{it} + \varepsilon_{it} \quad (2.11)$$

We estimate our log-log models with a panel containing 140 observations (35 years, 4 firms) using the least squares approach, allowing us to interpret the slope coefficients as a constant elasticity for the whole data set. These results are reported in Tables 2.3 and 2.4. The key parameter of interest is the coefficient of the relative marginal cost proxy "Relbm" (Relative Boone Measure).[47]

[47] In this paper, we are using the log-log functional form throughout. Results from the lin-lin form are available upon request. However, it should be noted that, in the lin-lin model, slope coefficients can be

In what follows, we investigate how the intensity of competition in the Japanese tire industry evolved over time and compare our results to those found for other industries in Japan and the Netherlands.

As one can see from Table 2.3 (where the dependent variable is the log of Normalized Profits), the key coefficient of interest is statistically significant and has a negative sign as expected (-2.14) in the model without fixed effects. However, it becomes insignificant when firm-specific fixed effects are included. In EQ.2.8, the interaction terms between Boone measure and a firm-specific dummy are significant for two of the four firms, but of opposite signs: for Toyo (at 10%) and Sumitomo (at 5%). Given the small sample size, allowing for firm-specific Boone measure slopes is probably not reliable. Further discussion of preferred results will be based on estimates of a common slope for the Boone measure only.

Table 2.4 (where the dependent variable is the log of Market Share) shows consistently significant and negative estimates for the Boone measure in three models. The elasticity estimate is -2.39 in the model without fixed effects, and becomes less negative (-0.89) in the model with fixed effects. The adjusted R-squared value of the model with fixed effects is, perhaps unsurprisingly, higher (0.95) than the model

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viewed as marginal increments. The corresponding elasticities will change with the data. Consequently, these two functional forms (log-log and lin-lin) have estimates that convey a distinct economic interpretation.

without fixed effects (0.58). We conduct a Wald test to see whether the four firm intercepts are simultaneously equal in EQ. 2.10. Interestingly, we reject the null hypothesis based on F-statistics with a p-value of 0.00. This confirms the importance of the firm-specific effects when estimating the Boone measure's impact on market share. These estimates lead us to believe that some competitive behavior exists in the Japanese tire industry.

Comparison with other industry estimates

The Boone measure's estimates in the models without firm dummies, [-2.39] (where the dependent variable was the log of market share) and [-2.14] (with the log of normalized profits) are in the same range as the values of [-2.58] and [-3.23], respectively, which Parsons and de Vanssay (2014) found for the Japanese beer industry.

Examining the fixed effect estimates, which presumably have more explanatory power as evidenced by higher R-squareds, also enable us to compare our results to Bikker and van Leuvensteijn (2008). This is perhaps the first paper to implement Boone's measure econometrically, but that paper only present results for the fixed effect estimations. For Japanese tires, the log of market share estimate yielded a Boone

measure of [-0.89], while for the relative profits measure, the Boone measure was not significant. For Japanese beer (Parsons and de Vanssay, 2014), the estimates were [-1.36] and [-3.14], respectively. As such, based on the market share estimates alone, it would appear that Japanese beer is more competitive than Japanese tires. Both of these Japanese industries appear to be more competitive (larger absolute value) than the Dutch insurance industry where fixed effects estimates by Bikker and van Leuvensteijn (2008) in the Dutch were [-0.37] and [-0.53], respectively. With this, and other evidence, they characterized the Dutch industry as being very uncompetitive. This suggests that the Japanese automobile tire industry is more competitive than the Dutch insurance industry (when one looks at the role of market shares), though less can be said with confidence when using the relative profits approach.

The large increase in the R-squared when firm dummies are included here (and in the Parsons and de Vanssay paper) highlights the importance of the inclusion of fixed effects, but also points to the measure of our ignorance. This sparse model, with few right hand side variables, would and should be augmented in any future industry studies when both more observations and more explanatory variables are available.[48]

Again, several Wald tests were also conducted to examine if the four firm

[48] Also, comparison here with the two previous studies must be tempered by the fact that, in this paper, as noted in Section 4.2.2 and endnote 19, our relative measures are relative to industry averages rather than to individual firms.

intercepts are simultaneously equal and if the firm-specific slopes are identical in EQ. 2.11. Based on the F-statistics, we can reject both null hypotheses regarding the firm intercepts and firm-specific slopes. Again, this reinforces the view that firms in the Japanese tire industry somehow follow their own –idiosyncratic- path when it comes to the relation between market share and relative marginal cost. Again, as with Table 2.3 results, because of the small sample size, interpretation of the firm-specific slopes is more speculative.

Table 2.3: Log Normalized Profits on Log Normalized MC proxy (OLS, 1976-2010)

Independent Variables	EQ. 2.6	EQ. 2.7	EQ. 2.8
C	-0.32 (0.10) ***	-	-
Log Relbm	-2.14 (0.38) ***	0.33 (0.23)	-
Bridgestone	-	0.93 (0.05) ***	0.89 (0.05) ***
Sumitomo	-	-0.69 (0.14) ***	-0.64 (0.10) ***
Yokohama	-	-0.39 (0.04) *	-0.44 (0.05) ***
Toyo	-	-0.95 (0.06) **	-0.84 (0.04) ***
Log Relbm*br	-	-	0.11 (0.12)
Log Relbm*sri	-	-	2.00 (0.94) **
Log Relbm*yrc	-	-	-0.12 (0.19)
Log Relbm*toyo	-	-	-0.17 (0.09) *
Adj. R squared	0.31	0.89	0.90
S.E. Regression	0.61	0.25	0.23

Standard errors are in parentheses.
*, **, and *** indicate significance at 10%, 5% and 1% level, respectively.
EQ. 6: no fixed effects; EQ. 7 and EQ. 8: fixed effects
Newey-West HAC standard errors & covariance, (lag truncation = 5).
Number of observations: 140 (35 years, 4 firms)
RelBM is the proxy for normalized marginal cost.

Table 2.4: Log Market Share on Log Normalized MC proxy (OLS, 1976-2010)

Independent Variables	EQ. 2.9	EQ. 2.10	EQ. 2.11
C	-1.70 (0.06) ***	-	-
Log Relbm	-2.39 (0.22) ***	-0.89 (0.25) ***	-
Bridgestone	-	-0.90 (0.05) ***	-0.77 (0.03) ***
Sumitomo	-	-1.93 (0.06) ***	-1.93 (0.04) ***
Yokohama	-	-1.79 (0.03) ***	-1.76 (0.03) ***
Toyo	-	-2.06 (0.05) ***	-1.85 (0.04) ***
Log Relbm*br	-	-	-0.21 (0.11) *
Log Relbm*sri	-	-	-0.98 (0.68)
Log Relbm*yrc	-	-	-0.63 (0.19) ***
Log Relbm*toyo	-	-	-1.84 (0.16) ***
Adj. R squared	0.58	0.95	0.96
S.E. Regression	0.38	0.14	0.12

Standard errors are in parentheses.
*, **, and *** indicate significance at 10%, 5% and 1% level, respectively.
EQ. 9: no fixed effects; EQ. 10 and EQ. 11: fixed effects
Newey-West HAC standard errors & covariance, (lag truncation = 5).
Number of observations: 140 (35 years, 4 firms)
Relbm is the proxy for normalized marginal cost.

We address the issue of the possible endogeneity of the left-hand side variable in Appendix 2.1.

As mentioned earlier, the acquisition of Ohtsu by Sumitomo in July 2003 decreased the number of players in the tire market, and also a bid-rigging cartel was broken up in 2005. So we would like to identify how the degree of competition intensity changed before and after these two events. To see the impact of a merger and cartel breakup on the tire market competition, we introduce the merger and cartel breakup

dummy variables which are defined in a similar way as the PCM regressions. By introducing dummy variables, the regression specifications become:

$$\frac{\pi_{it}}{\bar{\pi}_t} = \beta_0 \left(\frac{mc_{it}}{\overline{mc}_t}\right) + \beta_1 [Merger_t] \left(\frac{mc_{it}}{\overline{mc}_t}\right) + \sum \lambda_{i0} Dummies_{it} + \sum [Merger_t] \lambda_{i1} Dummies_{it} + \varepsilon_{it} \quad (2.12)$$

$$\frac{\pi_{it}}{\bar{\pi}_t} = \beta_0 \left(\frac{mc_{it}}{\overline{mc}_t}\right) + \beta_1 [Cartel\_Breakup_t] \left(\frac{mc_{it}}{\overline{mc}_t}\right) + \sum \lambda_{i0} Dummies_{it} + \sum [Cartel\_Breakup_t] \lambda_{i2}\, Dummies_{it} + \varepsilon_{it} \quad (2.13)$$

$$Market\ share_{it} = \beta_0 \left(\frac{mc_{it}}{\overline{mc}_t}\right) + \beta_1 [Merger_t] \left(\frac{mc_{it}}{\overline{mc}_t}\right) + \sum \lambda_{i0} Dummies_{it} + \sum [Merger_t] \lambda_{i1} Dummies_{it} + \varepsilon_{it} \quad (2.14)$$

$$Market\ share_{it} = \beta_0 \left(\frac{mc_{it}}{\overline{mc}_t}\right) + \beta_1 [Cartel\_Breakup_t] \left(\frac{mc_{it}}{\overline{mc}_t}\right) + \sum \lambda_{i0} Dummies_{it} + \sum [Cartel\_Breakup_t] \lambda_{i2}\, Dummies_{it} + \varepsilon_{it} \quad (2.15)$$

The results of these models are presented in Table 2.5. When the performance indicator used for the firm is market share, the Boone measure coefficient is negative and statistically significant in both EQ.2.14 and EQ.2.15. However, the cross terms between this measure and merger and cartel breakup dummies are negative and insignificant. These estimates lead us to believe that market shares do not react to a merger between

Sumitomo and Ohtsu in 2003, as well an anti-trust action by the government. This, to some extent, is in line with the results of the price-cost margin regressions.

When the indicator of firm's performance is profit margin, the coefficient of the interaction term between the Boone measure and cartel breakup dummy in EQ.2.13 is statistically significant at a 10 percent level. This shows that to some extent the impact of marginal cost after the cartel breakup on relative profits has intensified (in absolute value): it used to be 0.06, it is only (0.06 + -5.84 = -5.78) after the cartel breakup. This gives some weak evidence that the cartel breakup helped increase the degree of competition. As also seen in Table 2.5, the interaction term between the Boone measure and merger dummy is statistically insignificant. This indicates that firm's profitability does not react to a merger between Sumitomo and Ohtsu. As mentioned earlier, the bias in the results for both firm's performance indicators may be created by the measurement errors in the marginal costs proxy due to unavailable and unobservable data on marginal costs. However, as suggested by Boone (2008a), these measurement errors are unavoidable for most of such empirical studies.

Table 2.5: Log Market Shares or Log Normalized Profits on Log Normalized MC proxy (OLS, 1976-2010) with structural change after a merger and a cartel breakup

Dependent Variables	Log Normalized Profit (EQ. 2.12)	Log Normalized Profit (EQ. 2.13)	Log Market Share (EQ. 2.14)	Log Market Share (EQ. 2.15)
Independent Variables				
Log Relbm	-0.04 (0.10)	0.06 (0.12)	-0.85 (0.28) ***	-0.86 (0.28) ***
Merger*Log Relbm	-3.92 (2.55)	-	-0.53 (0.59)	-
Cartel_Breakup* Log Relbm	-	-5.84 (3.13) *	-	-0.81 (0.57)
Bridgestone	0.83 (0.03) ***	0.86 (0.03) ***	-0.92 (0.06) ***	-0.91 (0.06) ***
Sumitomo	-0.48 (0.03) ***	-0.54 (0.06) ***	-1.99 (0.05) ***	-1.98 (0.05) ***
Yokohama	-0.43 (0.05) ***	-0.42 (0.05) ***	- 1.79 (0.04) ***	-1.79 (0.03) ***
Toyo	-0.87 (0.03) ***	-0.88 (0.04) ***	- 2.08 (0.06) ***	-2.07 (0.06) ***
Merger*br	-0.19 (0.22)	-	0.10 (0.03) ***	-
Merger*sri	-1.41 (0.30) ***	-	0.23 (0.08) ***	-
Merger*yrc	-0.03 (0.09)	-	0.05 (0.05)	-
Merger*toyo	0.70 (0.46)	-	0.13 (0.11)	-
Cartel_breakup*br	-	-0.43 (0.29)	-	0.05 (0.08)
Cartel_breakup*sri	-	-1.63 (0.35) ***	-	0.19 (0.09) **
Cartel_breakup*yrc	-	0.05 (0.07)	-	0.07 (0.04)
Cartel_breakup*toyo	-	1.02 (0.57) *	-	0.13 (0.10)
Adj. R squared	0.97	0.95	0.96	0.96
S.E. Regression	0.13	0.16	0.12	0.12

Standard errors are in parentheses. *, **, and *** indicate significance at 10%, 5% and 1% level, respectively.
Newey-West HAC standard errors & covariance, (lag truncation = 5). Number of observations: 140 (35 years, 4 firms). Relbm is a proxy for normalized marginal cost.

2.5. Concluding remarks

In this chapter, we have used industry data, accounting data (at the firm-level) and reports from the Japan Fair Trade Commission to unmask three important features of this highly concentrated sector.

First, while the traditional competition indicators, such as the concentration ratio and HHI index, suggest a high market concentration, the innovative Boone measures point

to some degree of competitive behavior in the Japanese tire market.

Second, the log-log estimates enable us to compare to the previous literature to see if the parameters are large by comparison. Estimates found in this industry are quite similar to those of the Japanese beer industry which Parsons and de Vanssay (2014) characterize as being fairly competitive. Based on the market share regression with fixed effects, the Japanese beer industry may be more competitive than the Japanese tire industry. The results for the Japanese tire industry were also stronger (more competitive) than the results that Bikker and van Leuvensteijn (2008) found for the Dutch insurance industry which was characterized as being very uncompetitive by a number of measures including the ones used here. Third, on the policy side, we provide further evidence of the usefulness of Boone indicators techniques. Used in conjunction with traditional measures such as the price-cost margin, the Boone-style regressions also point in the same direction that firm's market share does not react to the merger between Sumitomo and Ohtsu in 2003 and a cartel breakup in 2005. However, the Boone measure estimates provide some weak evidence that the anti-monopoly action by the government with respect to a bid-rigging scheme in defense procurement in 2005 may have had an impact on firm’s profitability.

Chapter 3: Trade Liberalization and Export Sophistication in Vietnam

3.1. Introduction

Introducing the "Doi Moi" (economic reforms) policy in 1986, Vietnam has transformed from a centrally planned economy to a socialist oriented market economy. Hill (2000) argued that until 1997, Vietnam emerged for the first time as a sizeable manufactured exporter, and textiles and garments were the principal item in this export drive and that the *Doi Moi* reforms were obviously intended to promote economic development. He also argued that the Vietnamese government was able to get enough of the key policy variables more or less "right": these included the exchange rate, enabling exporters to source inputs at something approaching international prices, and a reasonably open foreign investment regime. Vietnam's ASEAN (Association of Southeast Asian Nations) membership in 1994, conclusion of a bilateral trade agreement with the United States in 2000 and the WTO (World Trade Organization) membership are turning points in its trade policies. Vietnam has been progressively involved in further international economic integration by taking parts in negotiations of multilateral free trade agreements such as the Regional Comprehensive Economic Partnership (RCEP) and Trans-Pacific Partnership (TPP) with its important partners.

Much of the literature on Vietnam's economic reforms has focused on the impact of trade liberalization, especially the Vietnam – U.S. Bilateral Trade Agreement, on development, poverty reduction and so on. By using variation in the structure of the labor force across Vietnam's provinces prior to the Vietnam – U.S. bilateral trade agreement, McCaig (2011) constructs provincial measures of U.S. tariffs and finds that provinces that experienced the greatest reduction in U.S. tariffs experienced faster reductions in poverty. By using the data on panel individuals from the Vietnam Household Living Standards Surveys of 2002 and 2004, and addressing the issue of endogeneity, Fukase's (2013) paper finds the existence of a "Stolper–Samuelson type" effect: those provinces which are more exposed to the increase in export opportunities experienced a larger wage growth for unskilled workers and a decline of the relative wage of skilled and unskilled workers relative to the other provinces. Her findings also support the view that improving access to developed country markets for developing countries, in particular for unskilled-labor intensive goods, is essential for the latter countries to reap benefits predicted by traditional trade theory. The foreign direct investment (FDI) and imports are the two main channels of technology diffusion. Due to the expanded global network of production, the export-oriented FDI in developing countries may lead to large imports of high technology-intensive intermediate goods.

Schott (2008) shows that export sophistication in some developing countries has risen considerably as a result. Therefore, the effects of these factors, which lead to technology spillovers via imports, are relevant and important when investigating the determinants of specialization patterns (see Bas and Strauss-Kahn, 2015 and Alessandrini et al, 2011) and export sophistication (see Zhu and Fu, 2013 and Anand et al, 2012) of a country.

This paper aims at providing a useful complement to literature by examining how the patterns of Vietnam's industry-level trade have responded to trade liberalization policies during the last decade. The empirical strategy here and in Hausmann et al. (2007) is based on an underlying model first outlined in Hausmann and Rodrik (2003) which emphasizes "cost discovery" as source of information spillovers which results in increases in productivity (and then wages). The basic idea of cost discovery is the following. Take a firm or entrepreneur (in a developing country) who is considering entering a new product market. Let's assume this product is one typically produced in an industrialized country. Hausmann et al. refer to the product (or actually a variety of products) as occurring in the "modern" sector, as opposed to a homogenous sector labeled "traditional". For a firm to enter this modern sector, they must incur sunk fixed costs, and then face unknown productivity once they enter the market. To give a concrete example, suppose an entrepreneur wants to start building an electric car. Even

with the “blueprint” for making such a car (from say, Japan), as the entrepreneur has never made this kind of car before, they are uncertain of how good (productivity) they will be at it. However, once they take the plunge and invest in this good in the modern sector, their productivity is revealed to the initial entrepreneur and all other potential entrepreneurs. As productivities in each new modern sector good (electric cars, for example) are revealed, new entrepreneurs may be enticed to enter the market without the need to incur the costs of acquiring such information. The copycat entrepreneurs are assumed to have productivities less than the initial entrant. This is realistic perhaps, and also prevents explosive equilibria in the model.

In short, Hausmann and Rodrik introduced a two-sector model in which one sector (the modern sector) has information spillovers which result in more entry into the modern sector, which in turn raises productivity and wages in the country. They rely on a sort of path dependence argument and assume that, at least for some “modern” sectors (think of the historical dominance of the Swiss in watchmaking), the reason why the Swiss successfully export so many high quality watches is because the Swiss have historically had a much higher productivity (θ max in their model) in watchmaking. This lends itself to a Ricardian story of higher productivity without ascribing where the absolute advantage in watchmaking came from. Hausmann et al. admit that this model

and story may not apply to all sectors, but assert that it may apply to a significant amount.

As such, if (developing) countries move out of their homogeneous "traditional sector" and into the those "modern" sectors, i.e. those sectors dominated by developed countries, more of the above mentioned cost discoveries can be made, information spillovers occur, and higher wages and growth is achieved.

Hausmann et al. admit that their model is similar to many other endogenous growth models, but theirs differs in that the externality is not a technological one, but rather an informational one, and one that occurs particularly in the so-called "modern" sector.

The productivity associated with a commodity (PRODY) and with a country's exports (EXPY) then follow in the empirics section of the paper to develop a measure to somehow, at least roughly, identify which products are more "productive" (identical to "sophisticated" in Hausmann et al. terminology) and then control for country size in a Revealed Comparative Advantage fashion.

This paper's contribution is twofold. First, it computes the export sophistication measure proposed by Hausmann et al. (2007) and examines how the degree of Vietnam's industry export sophistication changes over time and compares this

index to that of some other Asian countries. Second, an empirical analysis is conducted to assess the impact of Vietnam's trade liberalization policies on export sophistication level based on industry-level data with the additional consideration of Vietnam's WTO accession. In particular, as suggested by Jarreau and Poncet (2012), this paper also identifies which sectors contribute to export sophistication. The results show that tariff reductions have a positive impact on the sophistication level of Vietnam's industry exports. The effects of trade liberalization policies are more pronounced in the nonmanufacturing sectors than in manufacturing sectors. However, the WTO accession does not have any significant additional impact on the degree of Vietnam's industry export sophistication. In addition, an increase in the intensive margin of Vietnam's imports from its FTA partners also helps upgrade the quality of its industry exports.[49]

The remainder of this paper is organized as follows. Section 3.2 presents a description of Vietnam's trade reforms and export structure. Section 3.3 computes and analyzes the export sophistication trends. Section 3.4 discusses the econometric specifications for the dynamic panel data models. Section 3.5 presents the empirical results and Section 3.6 concludes.

[49] Following WTO terminology, in a free trade area (FTA), trade among members is duty free but members set their own tariffs on imports from nonmembers.

3.2.Vietnam's Trade Liberalization and Export Structure

From the adoption of *Doi Moi* (economic reform) policy in 1986 to present day, Vietnam's economy has transformed from a centrally planned model to a more market oriented one. Vietnam became the seventh member of ASEAN on 28 July 1995. This also marked an important first step towards closer regional economic integration. In 2003, ASEAN leaders decided to establish the ASEAN Community. Under this ASEAN Community framework, Vietnam began granting preferential treatment for goods to its ASEAN partners under the Common Effective Preferential Tariffs (CEPT) system in 1996. The process was foreseen to be completed by 2006 for goods on the Inclusion and Temporary Exclusion lists, and for Vietnam's list of sensitive agricultural products by 2013. The CEPT was subsequently incorporated into the ASEAN Free Trade Area (AFTA) in 2002. Building on CEPT/AFTA, ASEAN members signed the ASEAN Trade in Goods Agreement (ATIGA) in February 2009, consolidating all existing ASEAN initiatives, obligations, and commitments on trade in goods into a single document. ATIGA entered into force on 17 May 2010. Vietnam is committed to the elimination of tariffs in intra-ASEAN trade by 2015, with additional flexibilities for up to 7% of the tariff lines on the covered list applicable until 2018.[50]

[50] Cambodia, Lao P.D.R and Myanmar have the same schedule as Vietnam. However, the other

Vietnam has also concluded bilateral trade agreements with about 40 partners. These agreements aim at establishing trade relations based on reciprocal Most Favored Nation (MFN) treatment. Among those, the agreement that was signed between the Socialist Republic of Vietnam and the United States of America on Trade Relations is the most elaborate one. The Vietnam – U.S. Bilateral Trade Agreement (BTA), which entered into force in December 2001, provided substantially better access for Vietnamese exports to the United States market as average tariffs fell from 40% to less than 3%. In return, Vietnam agreed to open up some of its services sectors (banking, insurance, and telecommunications), enhanced protection of intellectual property rights, and improvements in its foreign investment regime. Most of Vietnam's commitments were phased in over three to five years. Tariff reductions were covered by Vietnam on some 250 products, 80% of which were in the agriculture sector.[51]

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members of ASEAN (Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, and Thailand) committed to the full elimination of tariffs in intra-ASEAN trade by 2010. According to ASEAN, import duties on 99.65% of all tariff lines under the CEPT-AFTA had been eliminated by 1 January 2010. For the newer ASEAN members (Vietnam, Cambodia, Lao PDR, and Myanmar), 98.96% of their tariff lines had been brought within the 0-5% range (Joint media statement of the 42nd ASEAN economic ministers' meeting in Da Nang (Vietnam), 24-25 August 2010. Viewed at: http://www.asean.org/news/asean-statementcommuniques/item/joint-media-statement-of-the-42nd-asean-economic-ministers-aem-meeting-da-nang-vietnam-24-25-august-2010-2).

[51] For more details, see http://vietnam.usembassy.gov/uploads/images/LyF8aTkwwk2Jr3-pvrFMKA/bta-crsrpt020909.pdf

In the process of extensive economic reform, the Government of Vietnam is strongly committed to the multilateral trading system and considers it the main focus of Vietnam's economic integration policies. As a result, Vietnam gained World Trade Organization (WTO) membership on 11 January 2007. This marked a breakthrough in Vietnam's trade policy. Vietnam agreed to comply with key WTO Agreements such as the Agreements on Trade-Related Aspects of Intellectual Property Rights, Technical Barriers to Trade, the Application of Sanitary and Phytosanitary Measures, and customs valuation from the date of accession without recourse to any transitional period. Regarding the tariff commitments, at the time of Vietnam's accession in 2007, the simple average of its bound rates was covered by 10,600 tariff lines at 17.4 percent for all products, 25.2 percent for agricultural products, and 16.1 percent for industrial products. Once all tariff concessions have been phased-in fully by 2019, Vietnam's bound rates should average 11.4 percent for all goods, 21.0 percent for agricultural products, and 12.6 percent for industrial products.[52]

Together with its ASEAN partners, Vietnam has also engaged in trade liberalization arrangements in Asia and the Pacific. ASEAN and China launched negotiations resulting in the signature of a trade in goods agreement in November 2004,

[52] http://www.mof.gov.vn/portal/page/portal/mof_vn/1371620/1371622/1371631/45916532?p_page_id=2202417&pers_id=45917882&item_id=46123480&p_details=1 (in Vietnamese)

and an agreement on trade in services in 2007. Since then, Korea, Japan, Australia and New Zealand, and India have completed negotiations to establish free-trade areas with ASEAN.

To complement the multilateral trading systems, Vietnam has also been actively involved in bilateral free trade agreements with several important partners. Vietnam and Japan initiated the negotiations on an Economic Partnership Agreement in 2007. As a result of nine rounds of negotiations, the Vietnam – Japan Economic Partnership Agreement was concluded on December 25th, 2008. This is a comprehensive agreements on trade in goods, trade in services, investment and economic cooperation, and becomes Vietnam's first bilateral FTA. Under this framework, Vietnam's tariff liberalization should be covered by 87.66 percent on a trade value basis, and Japan should eliminate its tariffs on 94.53 percent of trade value within 10 years of implementation. This agreement entered into force from October 1st, 2009.[53]

Vietnam also concluded an FTA with Chile on November 11th, 2011. The Vietnam – Chile FTA, which took effect in 2013, focuses on the elimination of tariffs on goods which both sides have interest in exporting. Under this agreement, Chile

[53] http://www.trungtamwto.vn/node/4353 (in Vietnamese)

should eliminate tariffs on 99.62 percent of its total tariff lines within 10 years of implementation. In return, Vietnam also has to eliminate tariffs on 83.89 percent of its tariff lines within 10 years, and an additional 4.66 percent of tariff lines within 15 years of implementation.[54]

After two years of negotiations, Vietnam signed an FTA with Korea on May 5th, 2015. The Vietnam – Korea FTA has comprehensive provisions on trade in goods, trade in services (including telecommunications services, financial services and movement of natural persons), investment, intellectual property, SPS, TBT, rules of origin, customs facilitation, competition and economic cooperation. Vietnam's exports will be given opportunities due to market access commitments by Korea. Specifically, Korea will eliminate its tariffs on 97.2 percent of its import value (based on 2012 data) and its tariff reductions will be covered by 95.4 percent of its tariff lines, including agricultural, fishery products, textile and garments, wood products, machinery and equipment, etc. On a reciprocal basis, Vietnam's tariff elimination will be covered by 89.2 percent of its tariff lines, on about 92.7 percent of its import value.[55]

Vietnam has taken advantage of these arrangements to promote exports of its

[54] http://www.mof.gov.vn/portal/page/portal/mof_vn/1539781?pers_id=2177088&item_id=83889508&p_details=1 (in Vietnamese)
[55] http://www.moit.gov.vn/vn/tin-tuc/5109/le-ky-chinh-thuc-hiep-dinh-thuong-mai-tu-do-viet-nam--han-quoc-(vkfta).aspx (in Vietnamese)

competitive product lines in agriculture, fisheries, textiles, footwear and furniture. The exports of main commodities such as aquacultural products, textiles and garment and furniture have increased rapidly about 1.8, 4.7 and 9.0 times from 1,816.4, 1,975.4 and 343.6 million USD in 2001 to 5,016.9, 11,209.8 and 3,444.5 million USD in 2010, respectively.[56] The FTA utilization ratios differ among the FTAs, but have generally been on the rise. Based on the use of the preferential certificates of origin, the Vietnamese authorities estimate that 31.3% of Vietnam's exports to its FTA partners benefited from the trade preferences by the end of 2011. Agriculture is an important part of the economy of Vietnam where, in 2012, it represented about 17 percent of GDP and 47 percent of employment.[57] However, the export shares of some nonmanufacturing sectors have been decreasing. As seen from Figure 1, the export share of forestry products, fishery products and metal ore mining industry fell from 0.18, 2.28 and 0.35 percent in 2001 to 0.06, 0.11 and 0.17 percent in 2010, respectively. The share of oil and gas extraction also decreased sharply from 21.44 percent in 2001 to 7.00 percent in 2010.

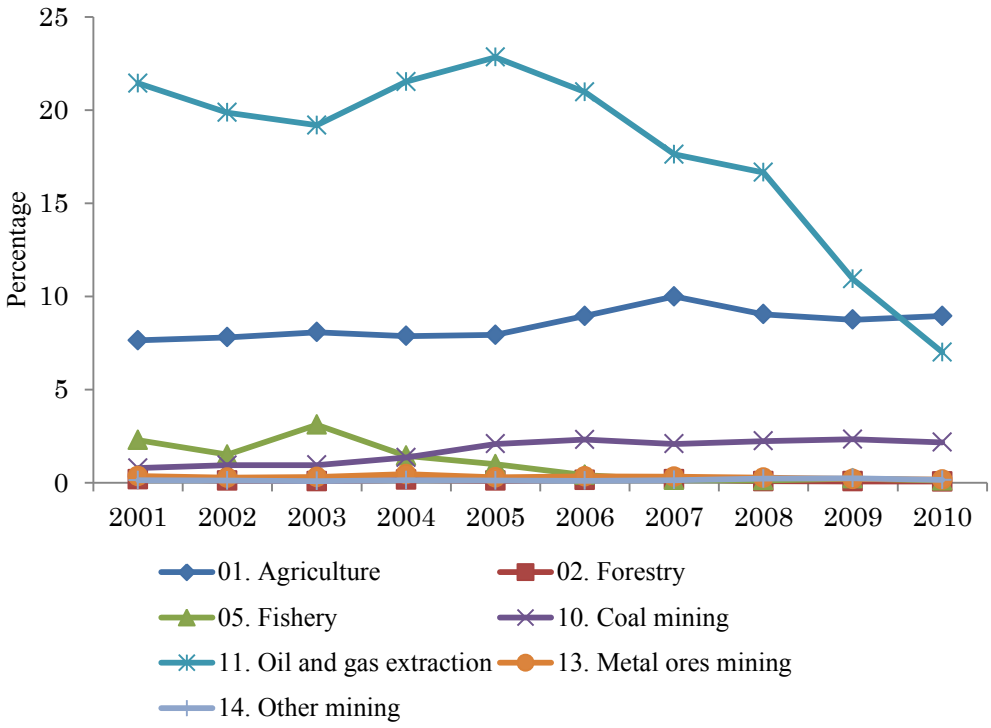
Labor-intensive and low-valued-added manufacturing (textiles and apparel

[56] For more details, see the statistics at http://www.gso.gov.vn/default.aspx?tabid=720 (in Vietnamese).
[57] Trade Policy Review Report No.WT/TPR/S/287, August 13, 2013. Viewed at https://www.wto.org/english/tratop_e/tpr_e/s287_e.pdf.

products, machinery) and food items remain Vietnam's main exports, while the country is steadily making inroads into high value-added products.[58] As one can see from Figure 2, the export share of radio and television manufacturing industry is among the highest growth from 1.33 percent in 2001 to 5.23 percent in 2010. Textile industry, electrical machinery manufacturing industry, rubber and plastics industry and chemical industry have showed the upward trend with increases from 3.01, 2.32, 1.11 and 1.46 percent in 2001 to 7.32, 4.51, 2.75 and 2.25 percent in 2010. These two figures indicate that Vietnam's export structure has shifted more weights from nonmanufacturing to manufacturing industries.

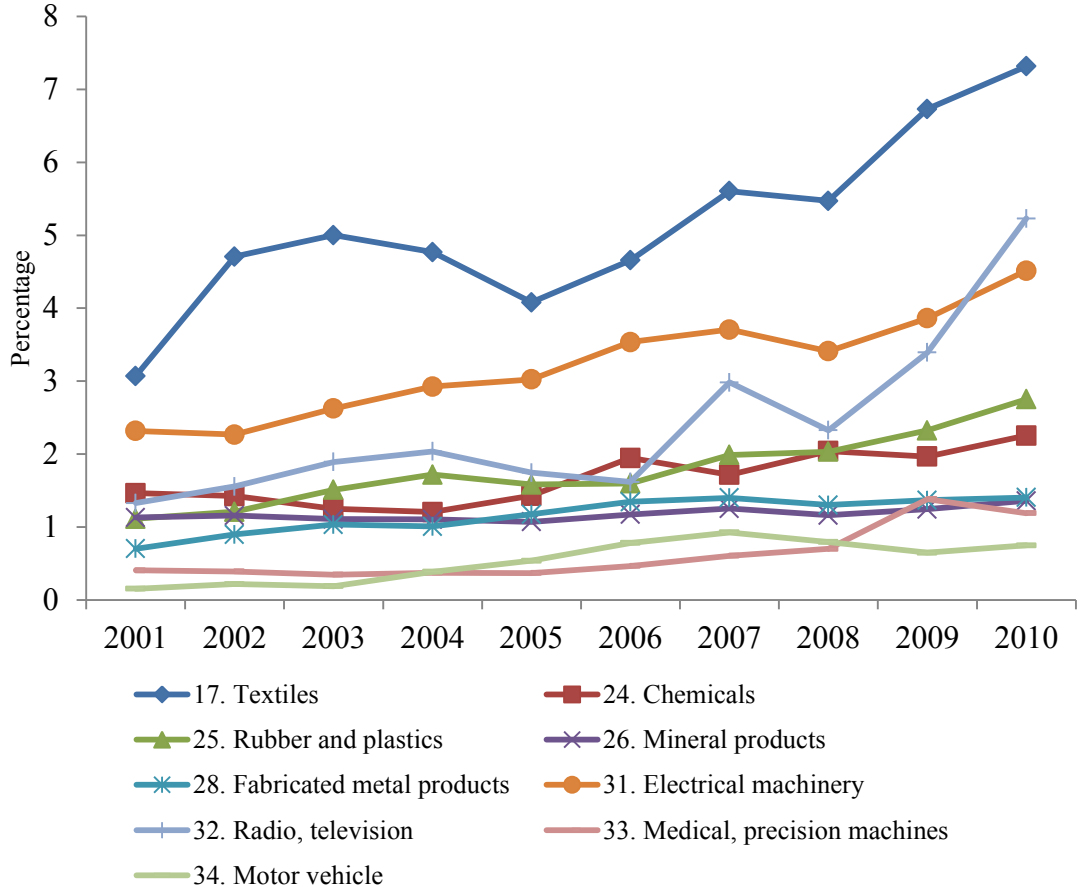
[58] World Bank (2011), Taking Stock - An Update on Vietnam's Recent Economic Developments, prepared for the Annual Consultative Group Meeting for Vietnam Ha Tinh, June 8-9, 2011. Viewed at: http://siteresources.worldbank.org/INTVIETNAM/Resources/TakingStockEng.pdf.

Figure 3.1: Export shares in total export for two-digit ISIC nonmanufacturing industries



Source: Author's own calculations based on trade data from UNCOMTRADE

Figure 3.2: Export shares in total export for selected two-digit ISIC manufacturing industries



Source: Author's own calculations based on trade data from UNCOMTRADE

3.3.Measuring Export Sophistication

In this paper, I use a measure of export sophistication developed by Hausmann et al. (2007) to measure the quality of exports and its variations over time and to examine the impact of trade liberalization on export sophistication. The intuition behind this measure is that, when exporting a good, countries reveal their productivity levels,

like the concept of revealed comparative advantage.[59] Admittedly, this measure still has a limitation in that it does not take into account the quality differences within a product category when measuring goods' productivity levels. To address this problem, Minondo (2010) computes a quality-adjusted PRODY and EXPY to examine the relationship between the productivity level of exports and economic growth. He argues that the limitation of the SITC classification, which Hausmann et al. (2007) uses to compute PRODY and EXPY, is that products are not as finely disaggregated as in the Harmonized System (HS) classification. Bearing in mind the limitation of this index, this paper employs the indicator developed by Hausmann et al. (2007) to measure the sophistication level of a country's industry exports by using the six-digit level HS classification to compute the productivity associated with a commodity.

In this measure, each good k that a country can potentially produce and export has an intrinsic level of sophistication PRODY(k), which is the weighted average of the income levels of good k's exporters, where the weights correspond to the revealed comparative advantage of each country j in good k. They call this measure the productivity level of product k.

[59] Lall, Weiss and Zhang (2006) also develop a similar index which is called the "sophistication level of exports". They also argue that it is not a specific technology level, but that it captures many other factors affecting export location, and care is needed in interpreting results. However, if Hausmann et al's proposition, "countries become what they export", is really true, the key determinants of export sophistication should be a fruitful avenue for academic research and important implications for policy makers in developing countries.

$$PRODY(k) = \sum_j \frac{\left(\frac{x(jk)}{X(j)}\right)}{\sum_j \left(\frac{x(jk)}{X(j)}\right)} Y(j) \qquad (3.1)$$

where x(jk) is exports of product k by country j, and X(j) is total exports of country j to the world. So x(jk)/X(j) is the share of commodity k in the country's overall export basket, and Σj(x(jk)/X(j)) is the sum of the value shares across all countries j exporting product k, and Y(j) is per capita GDP in country j. Equation (1) thus weighs a country's per capita GDPs by the country's revealed comparative advantage in product k.

One of useful features of PRODY(k) is that it can be easily aggregated to the industry and country levels. At the industry level, I construct the sophistication level of industry exports as follows:

$$PRODY(ij) = \sum_k \frac{x(jk)}{X(ij)} PRODY(k) \qquad (3.2)$$

where PRODY(ij) is the sophistication level of exports of country j's industry i. The weight is the share of export value of good k in total exports of industry i of country j.

At the country level, the sophistication level of country j's exports, denoted by EXPY(j), is then computed as the average level of sophistication of its export basket. This measure is the weighted sum of the sophistication levels associated with each exported good k, PRODY(k), with the weights being the shares of each good in the

country's total exports. This thus reflects the degree of specialization of a country in high-PRODY goods.

$$EXPY(j) = \sum_{k} \frac{x(jk)}{X(j)} PRODY(k) \qquad (3.3)$$

where x(jk) is exports of product k by country j, PRODY(k) is the productivity level of good k, and X(j) is total exports of country j to the world. The weights are the shares of each good in the country's total exports. This implies, by construction, that rich countries export “rich country” goods and poor countries export “poor country” goods. By developing this measure of export sophistication, Hausmann et al. (2007) empirically tests the relationship between a country’s export sophistication level and subsequent economic growth. Their findings imply that a country with the higher level of sophistication of export baskets grows faster. They express this relationship by stating that “countries become what they export”.

Extending their work, this paper pursues an analysis of the changing export structure and the impact of trade liberalization on Vietnam’s industry export sophistication. First, I compute the measure of product level sophistication PRODY(k) for the period of 2001-2010. The data come from two sources. Trade data are taken from the United Nations Commodity Trade Statistics (UNCOMTRADE) Database

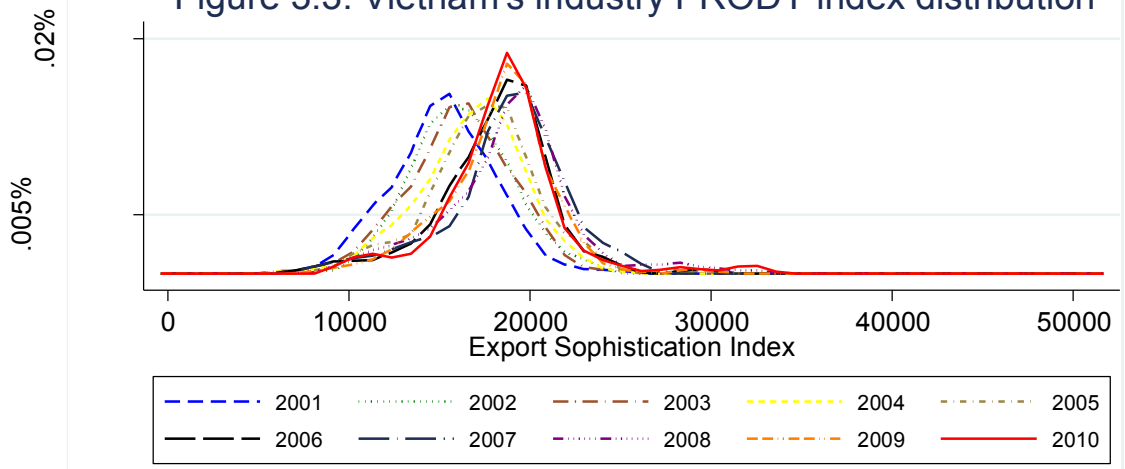
covering over 5000 products at the Harmonized System 6-digit level for the period 2001-2010. The export value is measured in current U.S. dollars. The real per capita GDP data come from the World Development Indicators (WDI) database over 2001-2010. Due to the data availability, a sample of 149 countries is used to calculate the product-specific productivity levels, i.e., PRODY. The purchasing power parity (PPP) adjusted real per capita GDP is used as also discussed in Hausmann et al. (2007) paper.

Then, the PRODY is used to calculate the industry-level sophistication PRODY(ij) for each of the two-digit level ISIC (International Standard Industrial Classification) industries for Vietnam. To see the dynamic properties of this measure, I estimate the kernel densities of the PRODY distributions for the period of 2001-2010. Figure 3.3 shows how the PRODY distribution changes over time. A series of Kolmogorov-Smirnov tests are undertaken to check if the distributions are significantly different from one another or not.[60] The results of these tests are also reported in this figure. The combined statistics of all the two-sided tests for each pair of the year 2001 are smaller than the default significance level of 0.05. Thus, the null hypothesis that the two samples have the same distributions is rejected, meaning that the distribution of the

[60] I wish to thank an anonymous referee for suggesting this test.

year 2001 is significantly different from the remaining years. Similarly, the distributions of 2002 and 2003 are similar, but significantly different from others. The distributions of 2004 and 2005 are also identical, but significantly different from others. And the years 2006, 2007, 2008, 2009 and 2010 have significantly similar distributions. As can be also seen from Figure 3.3, the distribution schedule shifts rightward continuously from 2001 to 2006 and then have a very similar shape from 2007 to 2010, implying that the degree of Vietnam's industry export sophistication is increasing over time. By exporting goods, Vietnam reveals its improved productivity associated with its industry exports.

Figure 3.3: Vietnam's industry PRODY index distribution



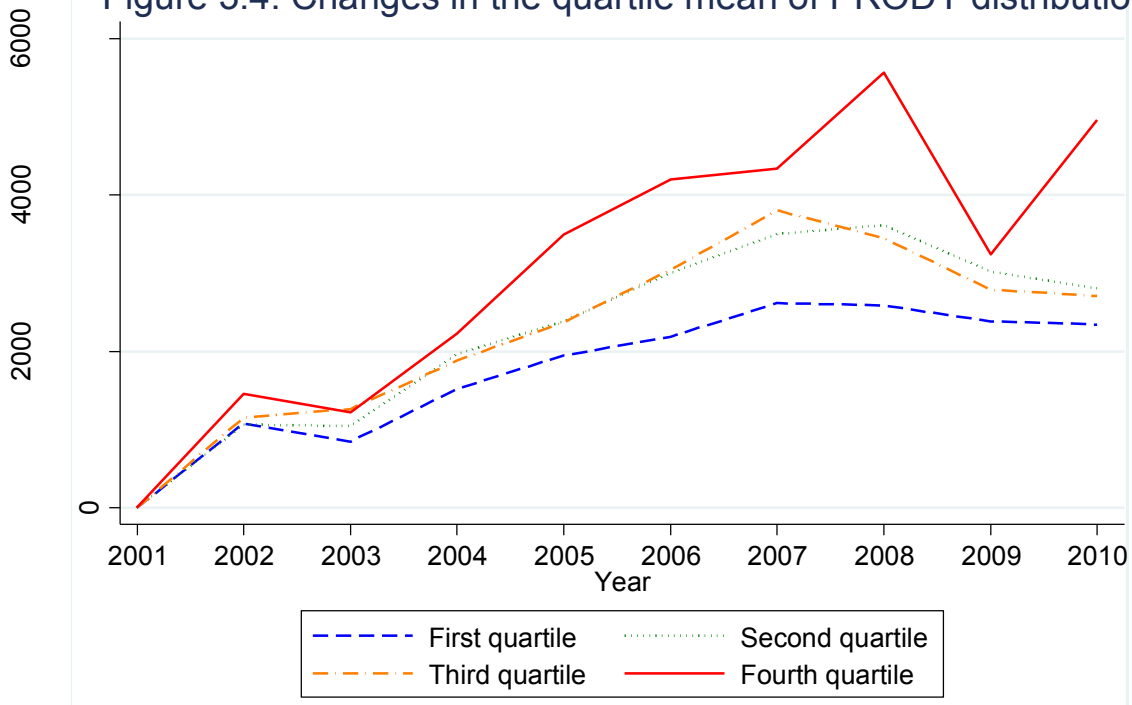
Note: Results of two-sample Kolmogorov-Smirnov tests
Year 2001 2002 2003 2004 2005 2006 2007 2008 2009
2002 0.036
2003 0.011 0.890
2004 0.000 0.011 0.036
2005 0.000 0.002 0.000 0.232
2006 0.000 0.000 0.000 0.000 0.007
2007 0.000 0.000 0.000 0.000 0.000 0.071
2008 0.000 0.000 0.000 0.000 0.000 0.071 0.692
2009 0.000 0.000 0.000 0.000 0.002 0.002 0.071 0.011
2010 0.000 0.000 0.000 0.000 0.002 0.799 0.071 0.132 0.890
Only the approximate asymptotic p-value for the combined K-S test is reported.

The descriptive statistics of Vietnam's industry PRODY indices are presented in Figure 3.4. All four quartiles show steady upward trends over the period 2001-2008, and then decrease afterward. The first quartile of productivity level distribution with the mean of 15,466 in 2007 includes agriculture-related industries such as the ISIC 0111, 0113 (growing of cereals, fruits and nuts), 1520, 1531, 1532 (manufacturing of dairy products, grain mill products and starch products) and 2925 (manufacturing of machinery for food and beverage). The second quartile is comprised of ISIC 2320, 2421, 2520 and 2930 (manufacturing of refined petroleum products, agricultural chemicals, plastic products and domestic appliances). The mean ranges from 15,466 in 2001 to 19,280 in 2008. Some light and heavy industries, which are distributed in the third quartile of the productivity distribution, include ISIC 1600, 1730, 2102, 2811 and 2899 (manufacturing of tobacco products, knitted fabrics, paperboard, structural metal products and other fabricated metal products). The highest quartile of the PRODY distribution with a mean of more than 20,000 is the manufacturing of electric motors, generators (ISIC 3110), accumulators (ISIC 3140), coke oven products (ISIC 2310), refractory ceramic products (ISIC 2629) and the processing of nuclear fuels (ISIC 2330).

As discussed in Amiti and Weinstein (2009), in the 2008 financial crisis, real

world exports plunged 17 percent while GDP fell 5 percent. The falling of world exports and GDP in this period makes all PRODY's smaller. The upward trend in all the four quartiles over the period 2001-2008 reveals that the degree of Vietnam's industry export sophistication increases steadily from 2001 to 2008. Alternatively, the distribution of industry export sophistication indices becomes more dispersed until 2008 and then compresses as the fourth quartile mean decreased sharply in the period 2008-2009, and then disperses again from 2009 due to the abrupt rise in the fourth quartile mean.

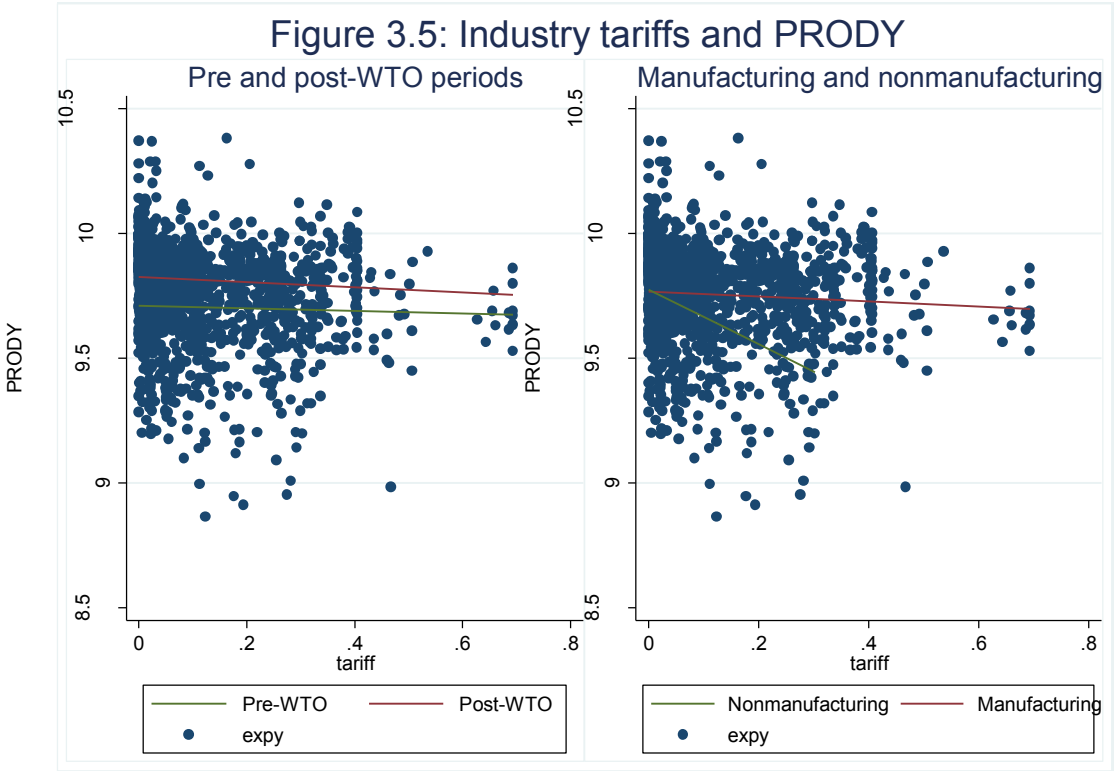
Figure 3.4: Changes in the quartile mean of PRODY distribution



Notes: All series are normalized to be zero in 2001.

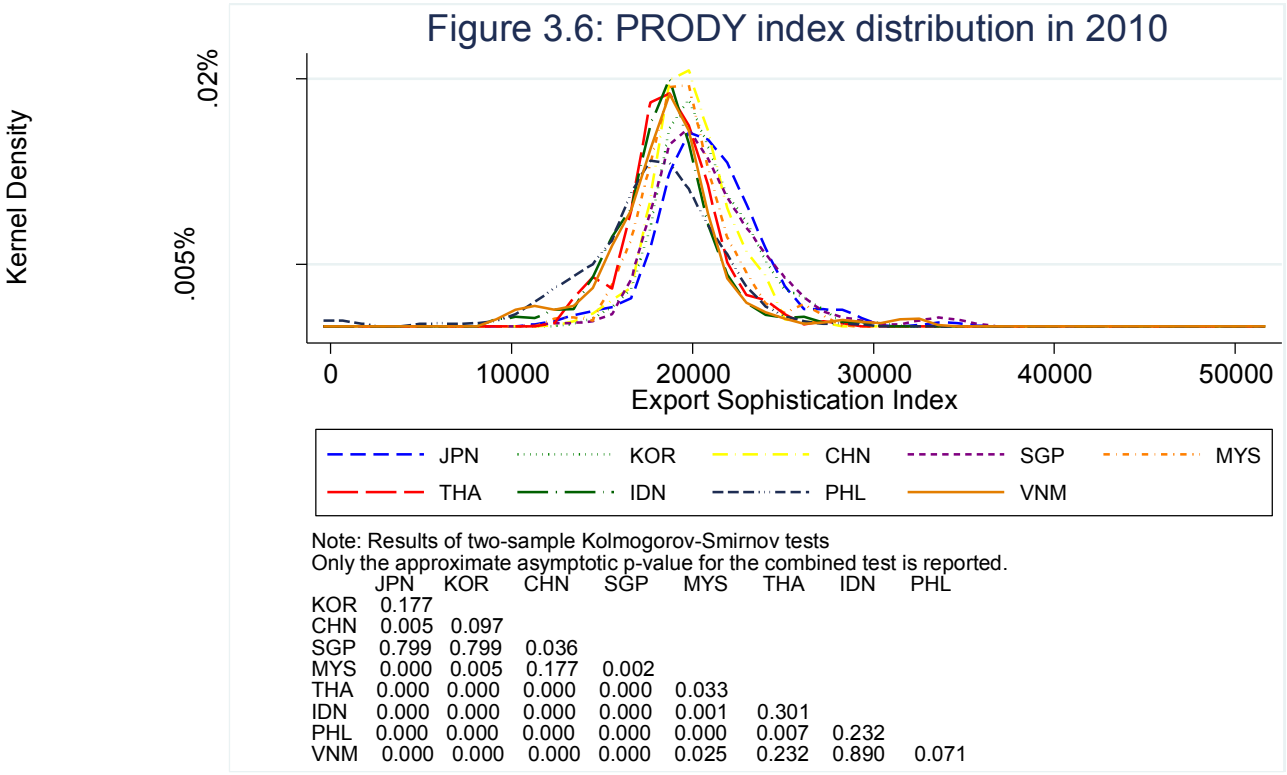
With the trends observed above, I plot the relationship between industry tariffs

and its export sophistication level in Figure 3.5. The upper and lower lines in the left panel are the linear fits for the period of post and pre-WTO accession, respectively. The long and short lines in the right panel are the linear fits for manufacturing and nonmanufacturing industries, respectively. As can be seen from the figure, there is an apparent structural break between manufacturing and nonmanufacturing industries, while there is a likely structural break before and after the WTO accession.



In order to compare Vietnam's export structure with other Asian countries, I also estimate the kernel densities of PRODY distributions in 2010 and plot it in Figure 3.6. To check if the distributions are significantly different from one another, a series of Kolmogorov-Smirnov tests are also conducted. According to the combined statistics

presented in this figure, Japan, Korea and Singapore have the same distribution and their distributions are significantly different from other Asian countries. The fact that China and Malaysia have the same distribution and are significantly different from other ASEAN countries is also consistent with the K-S statistics. Malaysia competes more intensively with China than other four ASEAN countries. The results of these tests also show that Thailand, Indonesia, Philippines and Vietnam have a similar distribution, meaning that Vietnam's export structure is much more similar to that of Indonesia, Philippines and Thailand in 2010. This leads to an implication that these ASEAN countries compete extensively with each other. These results are generally consistent with the findings of Thorbecke and Pai (2015) who examine the sophistication of East Asian exports.



Note: Results of two-sample Kolmogorov-Smirnov tests
Only the approximate asymptotic p-value for the combined test is reported.

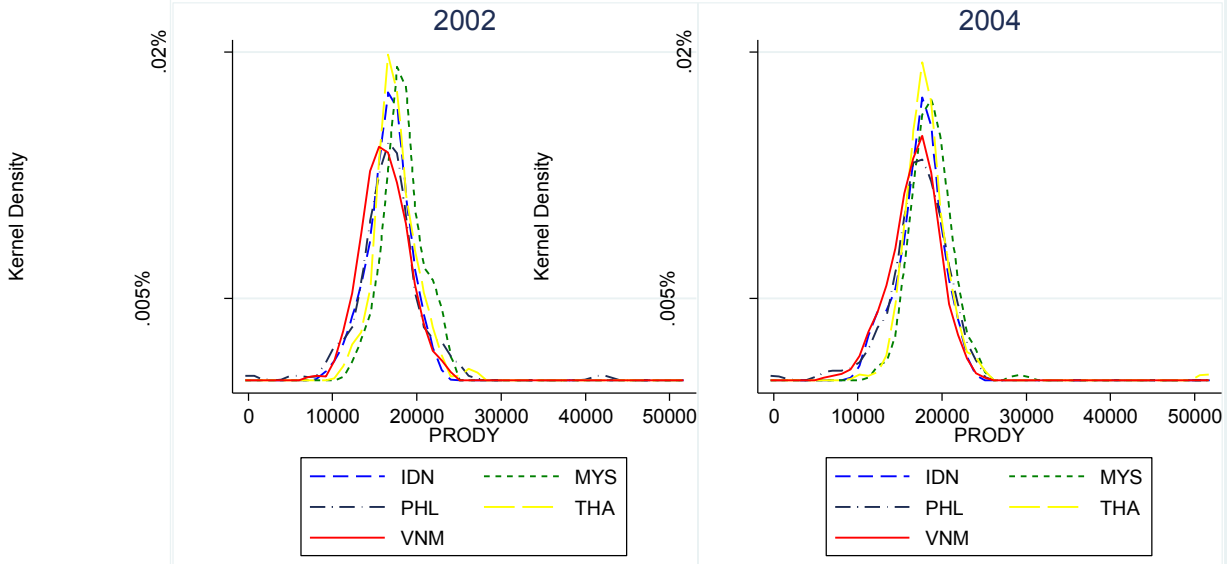
	JPN	KOR	CHN	SGP	MYS	THA	IDN	PHL
KOR	0.177							
CHN	0.005	0.097						
SGP	0.799	0.799	0.036					
MYS	0.000	0.005	0.177	0.002				
THA	0.000	0.000	0.000	0.000	0.033			
IDN	0.000	0.000	0.000	0.000	0.001	0.301		
PHL	0.000	0.000	0.000	0.000	0.000	0.007	0.232	
VNM	0.000	0.000	0.000	0.000	0.025	0.232	0.890	0.071

Figures 3.7 and 3.8 indicate the variations in Vietnam's export structure compared with other competing ASEAN countries before and after Vietnam's WTO accession in 2007. Several Kolmogorov-Smirnov tests are also conducted to check for the significant difference in distribution. Based on the results of the K-S tests presented in Figure 7, the null hypotheses that Vietnam has the same distribution as Malaysia and Thailand in both 2002 and 2004 are rejected. In contrast, the null hypotheses cannot be rejected when comparing with Indonesia and the Philippines. This means that Vietnam's export structure was a complement to that of Malaysia and Thailand, but was also a substitute for that of Indonesia and the Philippines in this period of pre-WTO

accession. However, the results of the K-S tests presented in Figure 8 show that Vietnam's export structure is significantly different from that of Malaysia, but is significantly similar to that of Thailand, Indonesia and the Philippines in both 2008 and 2010. This implies that Vietnam's export structure was similar to that of not only Indonesia and the Philippines, but also Thailand after Vietnam joined the WTO. This leads me to believe that Vietnam has competed more and more extensively with other more developed ASEAN countries.

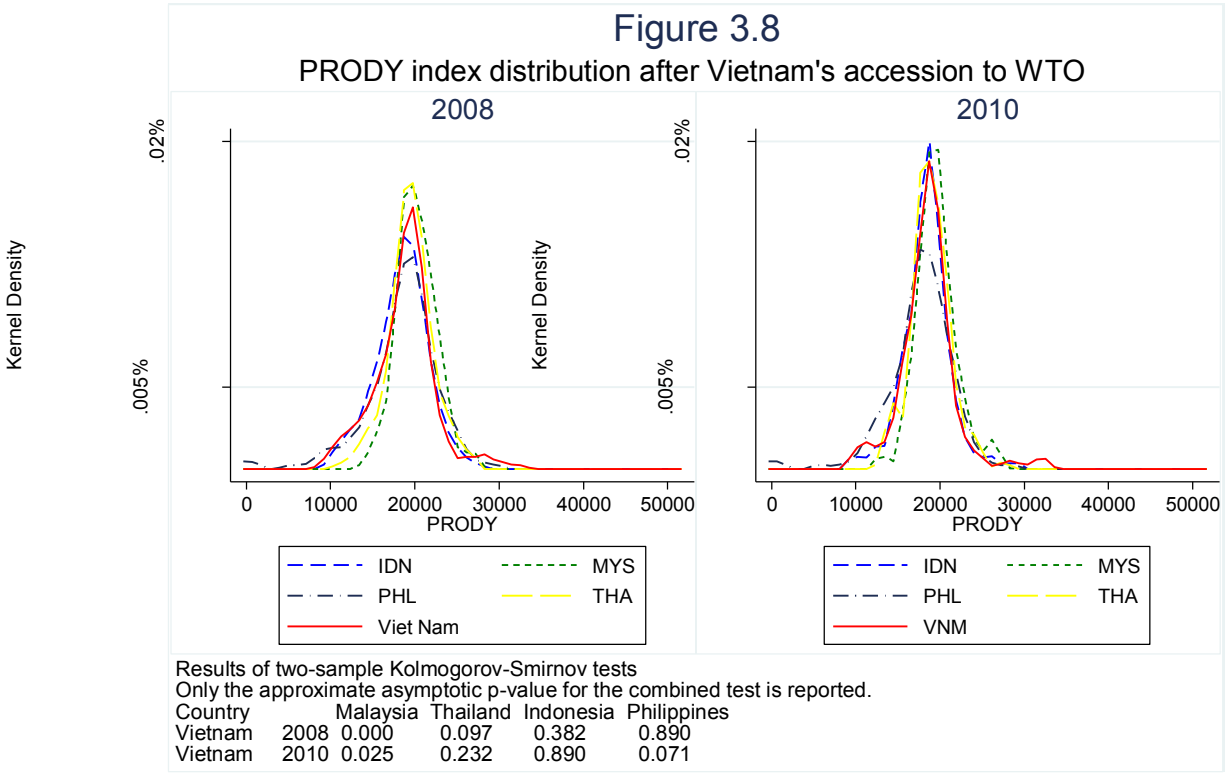
Figure 3.7

PRODY index distribution before Vietnam's accession to WTO



Note: Results of two-sample Kolmogorov-Smirnov tests
Only the approximate asymptotic p-value for the combined test is reported.

Country		Malaysia	Thailand	Indonesia	Philippines
Vietnam	2002	0.000	0.000	0.051	0.382
Vietnam	2004	0.000	0.002	0.097	0.301



3.4.Empirical Specifications

In examining the effects of trade liberalization on sophistication of Vietnam's industry exports, it is important to select an estimation method which addresses three interrelated challenges: unobserved industry heterogeneity, dynamic effects and potential simultaneity. The introduction of lagged dependent variables as the explanatory variables makes OLS, fixed effects, random effects, and feasible generalized least squares (FGLS) techniques yield biased and inconsistent estimates (Nickell 1981; Sevestre and Trognon 1985; Baltagi 2001; Harris and Mátyás 2004). To deal with this problem, the most favored approaches to date that give unbiased and

consistent results are Instrumental Variable (IV) and Generalized Method of Moments (GMM). The two-stage least squares (TSLS) techniques with IV regression could potentially deal with these estimation challenges. However, this TSLS method requires that the instrumental variables should be strictly identified and used in the estimation. Due to the data limitations, it is impossible for me to adopt the IV approach.

This paper therefore uses a system GMM estimator, developed by Blundell and Bond (1998), which is more appropriate for a short panel dataset than the static or first differenced GMM estimator developed by Arellano and Bond (1991) as Blundell and Bond (1998) show that the differenced GMM might be subject to a large downward finite-sample bias, particularly when the number of time periods available is small.

The system GMM approach for DPD can deal with three interrelated challenges: unobserved industry heterogeneity, dynamic effects and potential simultaneity. Thus, the econometric specification can be written as:

$$PRODY_{i,t} = \alpha(L)PRODY_{i,t-1} + \beta_1\tau_{i,t} + \beta_2(\tau_{i,t} * mfg_i) + \beta_3(\tau_{i,t} * wto_t) + \beta_4 growth_{i,t} + \beta_5 im\_fta_{i,t} + \eta_i + T_t + \vartheta_{i,t} \quad (3.4)$$

where, i and t denote the four-digit level ISIC industry and time, respectively. $PRODY_{i,t}$ is the Export Sophistication Index as calculated in the equation (2). $\tau_{i,t}$ is the weighted

average of applied MFN tariff rates[61]. mfg_i is the manufacturing industry dummy. wto_t is the WTO admission dummy which takes the value of one if the year is 2007 and after, and otherwise the value of zero.[62] $growth_{i,t}$ is the annual growth rate of world trade.[63] $im\_fta_{i,t}$ is the log transformed intensive margin of Vietnam's imports from its FTA partners to control for the possible intermediate inputs resultant from the conclusion of bilateral and regional FTAs.[64] η_i is the time-invariant unobserved industry-specific fixed effect. T_t is the time dummies and $\vartheta_{i,t}$ is the error term that includes all unobserved influences of export sophistication. $\alpha(L)$ is a vector of

[61] The source of tariff data for this study is the World Bank's World Integrated Trade Solution database (WITS).

[62] Two Chow tests (Chow, 1960) were performed to detect the possibility of structural change, starting in 2007 when Vietnam become a WTO member, as well as regime change between manufacturing sectors and nonmanufacturing sectors. The results of both tests indicate that there were structural changes in the model starting in 2007, and between manufacturing and nonmanufacturing sectors. This enables me to include dummy variables for the WTO accession and manufacturing industries. Although the WTO accession is likely the most important among Vietnam's trade liberalization schemes, it is still true that there may be other confounding effects operating around 2007.

[63] $PRODY_{i,t}$ is a log-transformed variable. Tariff rates are approximated as $\tau_{i,t} \cong \ln(1+\tau_{i,t})$ and world trade growth is also approximated as $growth_{i,t} \cong \ln(\frac{growth_{i,t}}{growth_{i,t}} - 1)$.

[64] Vietnam's FTA partners include the other ASEAN member countries, Japan, Korea, China, Australia, New Zealand and India. Following Hummels and Klenow (2005), I compute the intensive margin as follows:

$$\mathrm{IM_{ijt}} = \frac{\sum_{s \in S_{ijt}} \mathrm{Exports_{ijt}}}{\sum_{s \in S_{ijt}} \mathrm{Exports_{kjt}}}$$

where i denotes the Vietnam's FTA partners, k denotes the "rest of the world" by including all exporters to Vietnam except for i. S_{ijt} is the set of products s in which the exporter i exports to Vietnam in year t. S is the set of the four-digit ISIC commodities. IM_{ijt} measures the intensive margin between i and j in time t by comparing exports from i to j in time t with exports from the rest of the world to j in time t in the sectors s in which i exports to j in time t. IM_{ijt} is positive and can be above or below 1. The extensive margin of Vietnam's imports from its FTA partners is also calculated using this approach. However, it does not change over time and remains at the maximum value of 1. Thus, it was not included in the regression equation.

polynomials in the lag operators.

3.5.Empirical Results

I apply the system GMM method proposed by Blundell and Bond (1998) for dynamic panel data models to yield unbiased and consistent results. In the system GMM model, I treat the lags of dependent variable and world trade growth as endogenous variables.[65] The preferred specification in this paper contains two lags of dependent variables and its system GMM estimates are presented in Table 3.1. The system GMM assumes that the twice-lagged residuals are not autocorrelated. Thus, the test for autocorrelation in the error terms, which is also a test for the validity of instruments, should be conducted. According to Arellano and Bond (1991), the GMM estimator requires that there is first-order serial correlation *(m_1 test)* but that there is no second-order serial correlation *(m_2 test)* in the residuals. One needs to reject the null hypothesis in the m_1 test but *not* to reject it in the m_2 test to get appropriate diagnostics. As can be seen from Table 3.1, those tests support the validity of the model specification. The Hansen J-statistic tests the null hypothesis of correct model specification and valid overidentifying restrictions. The rejection of the null hypothesis

[65] In this paper, I implement the *xtabond2* user written command in STATA 10 (Roodman, 2006) to estimate the model.

means that either or both assumptions are questionable. As argued in Baum (2006), the Hansen J-test is the most commonly used diagnostic in GMM estimation for assessment of the suitability of the model. The Hansen test of overidentifying restrictions does not reject the null at any conventional level of significance (p=0.20). It therefore indicates that the model has valid instrumentation.

The coefficients of two lags of the dependent variable are statistically significant and positive as expected. As suggested by Roodman (2006), the check for the "steady state" assumption suggested by Roodman (2006) can be used to investigate the validity of instruments in system GMM. The estimated coefficient on the lagged dependent variable in the model should indicate convergence by having a value less than (absolute) unity (Roodman, 2007), otherwise system GMM is invalid. In my specification, the estimated coefficients on the first and second lags of dependent variable are 0.43 and 0.10, respectively. Therefore, the steady-state assumption holds. This again indicates the validity of instruments in system GMM. Bond (2002) suggests additional detection of the dynamic panel estimate's validity by checking if the estimated coefficient on the lagged dependent variable lies between the values obtained from OLS and FE estimators. The following values are obtained: OLS=0.54 > system GMM=0.43 > FE=0.23 for the first lag and OLS=0.21 > system GMM=0.10 >

FE=-0.07 for the second lag of dependent variable.[66] Thus, this condition is also confirmed in my specification.

The variable of world trade growth rate by industry is introduced to capture the changes in world demand for industry output. The coefficient of world trade growth rate is positive, but not statistically significant, indicating that the world trade demand does not have any impact on the sophistication level of Vietnam's industry exports. In contrast, the variable of the intensive margin of Vietnam's imports from its FTA partners is included in the regression to control for the possible growth of imported intermediate inputs from its FTA partners as a result of signing the FTAs. The coefficient is positive and statistically significant at a 1% level, implying that an increase in the intensive margin of Vietnam's imports from FTA partners contributes to a higher degree of Vietnam's industry export sophistication.

The tariff coefficient is negative and statistically significant at the 5% level as expected and has a value of -0.60. The interaction with manufacturing industry dummy is statistically significant at the 5% level and has a positive value of 0.54. The interaction with the WTO dummy has a negative value of -0.02, but is not significant. The overall effect of tariffs is (-0.60+0.54)=-0.06 on the manufacturing industry. This

[66] The OLS, FE and GMM estimates are summarized in Appendix A3.

means that tariff reductions have a positive impact on the sophistication level of Vietnam's industry exports and its impact is stronger on nonmanufacturing than on manufacturing industry exports. Alternatively, the more involved in trade liberalization, the more improved was Vietnam's productivity associated with a nonmanufacturing sector than a manufacturing sector.

By construction, the measure developed by Hausmann et al. (2007) indicates that manufacturing goods should have higher productivity scores than nonmanufacturing goods. As the nonmanufacturing industries lie in the first quartile of PRODY distribution, implying the lowest PRODY score, the heavier the weights of developing countries, the lower the productivity associated with a country's exports (or an industry's exports). The export share of Vietnam's nonmanufacturing industry is decreasing, as seen in Figure 1, consequently the industry PRODY (or EXPY) increases. Similarly, an increase in the export share of the manufacturing industry of poorer countries such as Vietnam should lower the EXPY (or industry PRODY). This supports the fact that in line with trade liberalization, more weights are transferred from nonmanufacturing to manufacturing industry exports, thus leading to a higher degree of nonmanufacturing and a lower degree of manufacturing industry export sophistication. To some extent, this result is consistent with the findings of Weldemicael (2014) who

examines the relative importance of technology and trade costs on export sophistication and welfare in a general equilibrium framework. He finds that more sophisticated commodities are less sensitive to trade costs including tariffs.

Unexpectedly, the interaction between tariff and WTO accession dummy is not statistically significant. This implies that the WTO membership does not have any significant additional impact on the productivity level associated with Vietnam's industry exports. It is also the fact that the bound tariff rates were reduced significantly from 17.5 percent at the time of accession in 2007 to 11.4 percent by 2019 on average for all products. However, according to the Trade Policy Review WT/TPR/S/287 (page 46) prepared by the WTO, in some instances, Vietnam implemented tariff reductions ahead of the committed schedule. In addition, the difference between the initial bound and applied MFN rate was 5 percentage points or more, for some 2,600 tariff lines in 2007.[67] Although Vietnam's WTO accession is likely the most important among trade liberalization policies, these foregoing reductions of the applied rate, the differences between the bound and applied tariff rates and other confounding effects of other preceding schemes such as AFTA and the Vietnam – U.S. bilateral trade agreement may mitigate the additional effects of the WTO accession.

[67] For more details, see the Trade Policy Review No. WT/TPR/S/287 at https://www.wto.org/english/tratop_e/tpr_e/s287_e.pdf.

Table 3.1: Trade liberalization and export sophistication

(one-step system GMM method)

Dependent variable: Export Sophistication Index (PRODY)	
Explanatory variables	Coefficients
L(1).PRODY	0.43 (0.05) ***
L(2).PRODY	0.10 (0.05) *
Tariff	-0.60 (0.27) **
Tariff*WTO	-0.02 (0.05)
Tariff*Manufacturing	0.54 (0.26) **
World trade growth	0.01 (0.03)
Intensive margin of imports	0.01 (0.04) ***
Set of time dummy variables	Included
No. of observations	1038
No. of groups (i.e. industries)	130
No. of instruments	106
Arellano-Bond test for AR(1) in first differences	z = -5.96
H0: There is no first-order serial correlation in residuals	Pr > z = 0.000
Arellano-Bond test for AR(2) in first differences	z = 0.29
Ho: There is no second-order serial correlation in residuals	Pr > z = 0.773
Hansen J-test of overidentifying restrictions	chi2 (88) = 98.71
H0: Model specification is correct and all overidentifying restrictions are correct (exogenous)	Prob > chi2 = 0.204
Difference-in-Hansen tests of exogeneity of GMM instrument subsets:	chi2(17)=12.16
Hansen test excluding System GMM instruments	Prob>chi2=0.790
H0: GMM differenced- instruments are exogenous	

Difference-in-Hansen tests of exogeneity of GMM instrument subsets: *H0: system-GMM instruments are exogenous and they increase Hansen J-test*	chi2(71)=86.55 Prob>chi2=0.101
Difference-in-Hansen tests of exogeneity of standard "IV" instrument subsets: *H0: GMM instruments without "IV" instruments are exogenous*	chi2(11)=7.45 Prob>chi2=0.762
Difference-in-Hansen tests of exogeneity of standard "IV" instrument subsets: *H0: Standard "IV" instruments are exogenous and they increase Hansen J-test*	chi2(77)=91.27 Prob>chi2=0.127

Note: ***, ** and * denote the 1%, 5% and 10% significance levels, respectively. Robust standard errors are in parentheses.

3.6.Concluding Remarks

Vietnam has progressively deepened its global economic integration over the last two decades. Import tariffs were lowered dramatically under the multilateral and bilateral trading frameworks that Vietnam participated in. How did this trade liberalization policy affect its export structure? This paper describes Vietnam's export structure by using trade data from 2001 to 2010. It is shown that more weights in total exports were attached to manufacturing than to nonmanufacturing industries during this period. This measure also indicates that Vietnam's export structure became much more similar to that of the other more developed ASEAN countries such as Thailand after its

accession to the WTO.

This paper also econometrically examines the impact of trade liberalization policy on the sophistication of Vietnam's industry exports. Employing a system GMM approach, the results suggest that trade liberalization had a positive impact on the sophistication level of Vietnam's industry export baskets. The productivity associated with Vietnam's industry exports is larger in nonmanufacturing than in manufacturing industries as a result of trade liberalization. However, the accession to the WTO does not make any additional impact on the sophistication level of Vietnam's industry exports. This may be attributable to the fact that in some instances, Vietnam implemented tariff reductions ahead of the committed timetable as well as the confounding effects of other preceding trade liberalization schemes.

Trade liberalization policies can be controversial, as it is often feared that the opening up market access to foreign competitors may place domestic firms at a disadvantage. While some firms may have suffered from trade liberalization policies, this paper finds that trade policies have been an important policy tool to improve the country's export quality, thus enhancing the competitiveness of industries. Though the WTO membership impact is not statistically significant, this study provides support for the trade liberalization policies that Vietnam has pursued. Together with opening up its

market, vertical foreign direct investment (FDI) is one of the two main channels of technology spillovers. FDI inflows may lead to large imports of intermediate inputs with high technology contents, thus raising the degree of export sophistication in developing countries. Accordingly, a fruitful avenue for further research would include the additional effects of the FDI channel.

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Appendix 1.1

Table A1.10: Trade Liberalization Level in EPA Negotiations

EPA Partner Country		Tariff elimination level (trade value basis)
Singapore (SG)	Japanese side	94.7%
	Singaporean side	100.0%
Mexico (MX)	Japanese side	86.8%
	Mexican side	98.4%
Malaysia (MY)	Japanese side	94.1%
	Malaysian side	99.3%
Philippines (PH)	Japanese side	91.6%
	Philippines side	96.6%
Chile (CL)	Japanese side	90.5%
	Chilean side	99.8%
Thailand (TH)	Japanese side	91.6%
	Thai side	97.4%
Brunei (BR)	Japanese side	99.99%
	Brunei side	99.9%
Indonesia (ID)	Japanese side	93.2%
	Indonesian side	89.7%
ASEAN	Japanese side	93.2%
Vietnam (VN)	Japanese side	94.9%
	Vietnamese side	87.7%
Switzerland (CH)	Japanese side	99.3%
	Swiss side	99.7%
India (IN)	Japanese side	97.5%
	Indian side	90.3%
Peru (PE)	Japanese side	99.7%
	Peru side	99.9%

Source: Ministry of Foreign Affairs of Japan

Appendix 1.2

Table A1.11: Main Contents Covered by EPAs

EPA Partners	SG	MX	MY	CL	TH	BN	ID	PH	ASEAN	CH	VN	IN	PE
Date of Coming into Effect (YY.MM.DD)	02.11.30	05.04.01	06.07.13	07.09.03	07.11.01	08.07.31	08.07.01	08.12.11	08.12.01	09.09.01	09.10.01	11.08.01	12.03.01
Tariff Elimination Level (Bilateral Trade Value Basis) in Chapter on Trade in Goods (%)	98	96	97	92	95	99.9	92	94	92	99.3	92	93.7	99.8
Customs Procedures	○	○	○	○	○	○	○	○	-	○	○	○	○
SPS/TBT	-	-[8]	○	○	-	-	-	-	○	○	○	○	○
Mutual Recognition	○	-	-	-	○	-	-	○	-	-	-	-	-
E-commerce Transaction	-	-	-	-	-	-	-	-	-	○	-	-	-
Trade in Services	○	○	○	○	○	○	○	○	○[4]	○	○	○	○
Movement of Natural Persons	○	○	-	○	○	-	○	○	-	○	○	○	○
Investment	○	○	○	○	○	○	○	○	○[4]	○	-[1]	○	-[1]
Government Procurement	○	○	-	○	○	-[5]	○	○	-	○	-[3]	○	○
Intellectual Property Rights	○	-	○	○	○	-[6]	○	○	-	○	○	○	○
Competition Policy	○	○	○	○	○	-	○	○	-	○	○	○	○
Business Environment Improvement	-	○	○	○	-	○	○	○	-	○[2]	○	○	○
Bilateral Cooperation	-	○	○	-	○	○	○	○	○	-	○	○	○
Energy and Natural Resources	-	-	-	-	-	○[7]	○	-	-	-	-	-	-

Source: Ministry of Foreign Affairs of Japan

[1]Bilateral Investment Treaty was incorporated in and became one part of EPA.

[2]Chapter "Strengthening Economic Relations" was established.

[3]Provisions on transparency, fair and efficient measures in terms of government procurement are stipulated in Chapter "Business Environment Improvement".

[4]Further negotiations about concrete provisions should be continued.

[5]Provisions on transparency, fair and efficient measures in terms of government procurement are stipulated in Chapter "Business Environment Improvement".

[6]Provisions related to intellectual property rights are stipulated in Chapter "Business Environment Improvement".

[7]This chapter is intended for energy only.

[8]This is stipulated as a separate section in the Chapter "Trade in Goods".

Appendix 2.1

2.A. Additional Regression Results[68]

To correct for possible endogeneity of the left-hand side variable, we conduct the same regressions, but apply a two-stage least squares approach. The lag of the Boone measure was used as an instrument in EQ. A6, EQ. A7, EQ. A9, and EQ. A10. In addition, four firm dummies were used in EQ. A7, EQ. A8, EQ. A10 and EQ. A11, and four interaction terms were used in EQ. A8 and EQ. A11. The results are presented in Tables A2.1 and A2.2. The signs and significance of the Boone measure estimates are quite consistent with those found for all three models using the least squares method. The adjusted R-squared value is much higher than in the no fixed effects model. Wald tests are conducted for the EQ. A7 and EQ. A10 to verify that the null hypothesis that four firm intercepts are simultaneously equal is rejected based on F-statistics with a p-value of 0.00. Again, this confirms the importance of the firm-specific effect when estimating the Boone measure's impact on market share. In EQ. A11, we add four variables to see the interaction between firm effects and the Boone measure. Only the coefficients of the cross terms between Yokohama, Toyo dummies and the Boone measure are statistically significant and negative as expected. The others are insignificant. Based on Wald tests,

[68] The additional examinations are conducted for the normalized observations in EQ. 6, EQ. 7, EQ. 8, EQ. 9, EQ. 10 and EQ. 11.

both null hypotheses concerning the four firm intercepts and firm-specific slopes are rejected.

Table A2.1: Log Normalized Profits on Log Normalized MC proxy (TSLS, 1976-2010)

Independent Variables	EQ. A6	EQ. A7	EQ. A8
C	-0.33 (0.10) ***	-	-
Log Relbm	-2.65 (0.46) ***	0.81 (0.48) *	-
Bridgestone	-	1.01 (0.09) ***	0.90 (0.07) ***
Sumitomo	-	-0.68 (0.13) ***	-0.60 (0.08) ***
Yokohama	-	-0.36 (0.06) ***	-0.42 (0.05) ***
Toyo	-	-1.06 (0.11) ***	-0.59 (0.24) **
Log Relbm*br	-	-	0.21 (0.30)
Log Relbm*sri	-	-	3.16 (1.29) **
Log Relbm*yrc	-	-	0.09 (0.31)
Log Relbm*toyo	-	-	-1.27 (1.00)
Adj. R squared	0.28	0.88	0.88
S.E. Regression	0.62	0.25	0.25

Standard errors are in parentheses.
*, **, and *** indicate significance at 10%, 5% and 1% level, respectively.
Newey-West HAC standard errors & covariance, (lag truncation = 5)
Number of observations: 140 (35 years, 4 firms)
Relbm is the proxy for normalized marginal cost.
Instruments: LogRelbm(-1) (for EQ. A3); LogRelbm(-1), br, sri, yrc and toyo (for EQ. A4); br, sri, yrc, toyo, br*LogRelbm(-1), sri*LogRelbm(-1), yrc*LogRelbm(-1) and toyo*LogRelbm(-1) (for EQ. A5)

Table A2.2: Log Market Share on Log Normalized MC proxy (TSLS, 1976-2010)

Independent Variables	EQ. A9	EQ. A10	EQ. A11
C	-1.70 (0.06) ***	-	-
Log Relbm	-2.74 (0.28) ***	-0.75 (0.34) **	-
Bridgestone	-	-0.86 (0.07) ***	-0.72 (0.04) ***
Sumitomo	-	-1.92 (0.05) ***	-1.93 (0.04) ***
Yokohama	-	-1.77 (0.03) ***	-1.77 (0.03) ***
Toyo	-	-2.10 (0.08) ***	-1.65 (0.22) ***
Log Relbm*br	-	-	0.08 (0.20)
Log Relbm*sri	-	-	-0.95 (0.81)
Log Relbm*yrc	-	-	-0.76 (0.25) ***
Log Relbm*toyo	-	-	-2.72 (0.96) ***
Adj. R squared	0.57	0.95	0.95
S.E. Regression	0.39	0.14	0.13

Standard errors are in parentheses.
*, **, and *** indicate significance at 10%, 5% and 1% level, respectively.
Newey-West HAC standard errors & covariance, (lag truncation = 5)
Number of observations: 140 (35 years, 4 firms)
Relbm is the proxy for normalized marginal cost.
Instruments: LogRelbm(-1) (for EQ. A9); LogRelbm(-1), br, sri, yrc and toyo (for EQ. A10); br, sri, yrc, toyo, br*LogRelbm(-1), sri*LogRelbm(-1), yrc*LogRelbm(-1) and toyo*LogRelbm(-1) (for EQ. A11)

Appendix 2.2

Chow tests for the panel dataset

The year 2003 is crucial for the Japanese tire industry. Indeed, the number of competitors goes down. We perform a Chow test (Chow, 1960) to detect the possibility of regime change, starting in 2003.

Our econometric specification for the Chow tests is in log-log form as follows:

$$\frac{\pi_{it}}{\bar{\pi}_t} = \alpha + \beta\left(\frac{mc_{it}}{\overline{mc}_t}\right) + \varepsilon_{it} \quad (3)$$

The first regression using all the dataset (with 140 observations) produced a Residual Sum of Squares, RSSr = 50.83.

Next, two regressions were run on two sub-samples of the data from 1976 to 2002 and from 2003 to 2010. The regression was on the sub-sample from 1976 to 2002 (with 108 observations), giving a Residual Sum of Squares, RSS1 = 24.01.

The final regression was on the sub-sample from 2003 to 2010 (32 observations), producing a Residual Sum of Squares, RSS2 = 26.03.

We compute the F-statistic as: $\frac{[\mathrm{RSS_r}-(\mathrm{RSS_1}+\mathrm{RSS_2})]/\mathrm{k}}{[\mathrm{RSS_1}+\mathrm{RSS_2}]/(\mathrm{n}-2\mathrm{k})} = 1.07$, where n=140 and k=2.

Finally, as the critical value for F(2, 136)=4.76 (at 1% level), we do not reject the null hypothesis of structural stability. We conclude that there is no evidence of structural change from 2003, using model (3).

Similarly, the year 2005 was also critical for the Japanese tire industry. It was the end of the '*dangou*' system mentioned in Section 2.3. We perform a Chow test to detect the possibility of regime change, starting in 2005. So we divide our dataset into two sub-samples from 1976 to 2004 and from 2005 to 2010, and calculate the Residual Sum of Squares (RSS1) for the sub-sample from 1976 to 2004 (with 116 observations) and RSS2 for the sub-sample from 2005 to 2010 (with 24 observations). We obtain RSS1=30.29 and RSS2=19.93, respectively. With n=140 and k=2, $F = \frac{[50.83-(30.29+19.93)]/2}{[30.29+19.93]/(140-4)} = 0.83$. As the critical value for F(2, 136)=4.76 with significance at 1% and 0.83<4.66, we do not reject the null hypothesis of structural stability. There was no structural change from 2005, using the model (3).

The same specification is also applied to the market share:

$$Market\ share_{it} = \alpha + \beta\left(\frac{mc_{it}}{\overline{mc}_t}\right) + \varepsilon_{it} \quad (6)$$

First, the regression using the whole dataset (with 140 observations) yielded a Residual Sum of Squares, RSSr=20.34.

Second, the regression was on the sub-sample from 1976 to 2002 (with 108 observations), giving a Residual Sum of Squares, RSS1=14.74.

Third, the final regression was on the sub-sample from 2003 to 2010 (with 32 observations), producing a Residual Sum of Squares, RSS2=4.60.

Fourth, we compute the F-statistic for model (6) as: $F = \frac{[20.34-(14.74+4.60)]/2}{[14.74+4.60]/(140-4)} = 3.52$, where n=140 and k=2.

Finally, as the critical value for F(2, 136)=4.76 with significance at 1%, we do not reject the null hypothesis of structural stability. We conclude that there was no structural break from 2003.

In the case that our dataset is divided into two sub-samples from 1976 to 2004 and from 2005 to 2010, we calculate the Residual Sum of Squares (RSS1) for the sub-sample from 1976 to 2004 (with 116 observations) and RSS2 for the sub-sample from 2005 to 2010 (with 24 observations). We obtain RSS1=16.38 and RSS2=3.12, respectively. With n=140 and k=2, $F = \frac{[20.34-(16.38+3.12)]/2}{[16.38+3.12]/(140-4)} = 2.93$. As the critical value for F(2, 136)=4.76 with significance at 1% and 2.93<4.76, we do not reject the null hypothesis of structural stability. There was no structural change from 2005, using the model (6).

We repeat the same exercise for the model (3) with firm-fixed effects (intercept only):

$$\frac{\pi_{it}}{\bar{\pi}_t} = \beta\left(\frac{mc_{it}}{\overline{mc}_t}\right) + \sum \lambda_i Dummies_{it} + \varepsilon_{it}$$

For the whole dataset and sub-samples from 1976 to 2002 and from 2003 to 2010, we get RSSr=8.25, RSS1=0.81 and RSS2=1.42, respectively.

Next, we compute the F-statistic as: $F = \frac{[8.25-(0.81+1.42)]/5}{[0.81+1.42]/(140-10)} = 70.19$, where n=140 and k=5.

As the critical value for F(5, 130)=3.16 with significance at the 1% level, we reject the null hypothesis of structural stability.

Finally, we conclude that there was a structural break in the model with firm-fixed effects after 2002.

For the sub-samples from 1976 to 2004 and from 2005 to 2010, we also obtain RSS1=2.59 and RSS2=0.85, respectively. The computed F-statistic value becomes 36.35. As the F-statistic is larger than the critical value at the 1% level, we reject the null hypothesis and conclude that there was a structural change in the model with firm-fixed effects after 2004.

We repeat the same exercise for the model (6) with firm-fixed effects (intercept only):

$$Market\ share_{it} = \beta\left(\frac{mc_{it}}{\overline{mc}_t}\right) + \sum \lambda_i Dummies_{it} + \varepsilon_{it}$$

For the whole sample and two sub-samples from 1976 to 2002 and from 2003 to 2010, the regressions produced RSSr=2.54, RSS1=1.75 and RSS2=0.12, respectively.

Next, we compute the F-statistic as: $F = \frac{[2.54-(1.75+0.12)]/5}{[1.75+0.12]/(140-10)} = 9.32$, where n=140 and k=5.

As the critical value for F(5, 140)=3.16 with significance at the 1% level, we reject the null hypothesis and conclude that there was a structural change in this model after 2002.

For the sub-samples from 1976 to 2004 and from 2005 to 2010, the regressions also

yielded RSS1=1.96 and RSS2=0.06, respectively. The computed F-statistic value becomes 6.69. As the critical value for F(5, 140)=3.16 (1% level), we reject the null hypothesis and conclude that there was a structural break in this model after 2004.

So, it is only when we introduce firm-fixed effects that we observe structural changes.

Appendix 3

Table A3: Trade liberalization and export sophistication

Dependent variable: Export Sophistication Index (PRODY)			
Explanatory variables	Coefficients		
	OLS	FE	GMM
L(1).PRODY	0.54 (0.30) ***	0.23 (0.03) ***	0.43 (0.05) ***
L(2).PRODY	0.21 (0.30) ***	-0.07 (0.03) **	0.10 (0.05) *
Tariff	-0.35 (0.13) ***	-0.30 (0.46)	-0.60 (0.27) **
Tariff*WTO	-0.01 (0.07)	-0.01 (0.06)	-0.02 (0.05)
Tariff*Manufacturing	0.30 (0.13) **	0.43 (0.47)	0.54 (0.26) **
World trade growth	-0.01 (0.04)	-0.01 (0.04)	0.01 (0.03)
Intensive margin of imports	0.01 (0.01) ***	0.01 (0.01)	0.01 (0.04) ***
Set of time dummy variables	Included	Included	Included
No. of observations	1038	1038	1038
No. of groups (i.e. industries)	130	130	130

Notes: ***, ** and * denote the 1%, 5% and 10% significance levels, respectively. Robust standard errors are in parentheses.