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## An analysis of extensive and intensive trade margins for the Japan-Mexico FTA

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# Estimating the Impacts of FTA on Foreign Trade:
## An analysis of extensive and intensive trade margins for the Japan-Mexico FTA[*]

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**Abstract**

This paper examines the impacts of the Japan-Mexico free trade agreement (JMXFTA), which was enacted in 2005, on Japanese exports to Mexico. The authors construct a theoretical trade model of heterogeneous firms, which is based on the Melitz-Chaney model, and derive a theoretical relationship of the impacts of tariff changes on extensive and intensive trade margins. Applying this model, the authors estimate the impacts of JMXFTA on product-level extensive and intensive margins of Japan's exports to Mexico by using the most detailed commodity trade data. The results show that the tariff reduction caused by JMXFTA increases intensive margins while no clear evidence is found on the effect on extensive margins. This indicates that in the short-run, the JMXFTA exerts more favorable effect on existing exporters than on new export market entrants.

*Keywords*: Free trade agreements, Extensive and intensive trade margins, Tariffs

*JEL classification*: F14, F15



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## 1. Introduction

Japan has become active in establishing free trade agreements (FTAs) since the turn of the century. The first FTA for Japan was with Singapore, which became effective in November 2002. The second FTA was with Mexico, which became into action in April 2005. As of January 2014, Japan has enacted 13 FTAs and signed one FTA awaiting ratification. The main objective of FTAs for Japan is to expand exports to the FTA partners.

Since multilateral negotiations for trade liberalization under the General Agreement on Tariffs and Trade (GATT)/World Trade Organization (WTO) became stalled, increasing number of countries became interested in FTAs as a means to expand their exports, which would contribute to economic growth. It was in the early 1990s when the Uruguay Round of multilateral trade negotiations under the GATT were in deadlock that many countries began negotiating FTAs. The FTA frenzy continued even after the WTO was established in 1995 and after the first multilateral trade negotiations under the WTO, or the Doha Development Agenda (DDA), began in 2001, because DDA negotiations were making no progress due to the differences in the opinions of the WTO members on the DDA. Faced with increasing number of FTAs, which are discriminatory in the sense that FTA members benefit from preferential access to FTA members' market while non-FTA members suffer from discrimination in those markets, Japan became interested in FTAs in order to avoid discriminatory treatment in many countries in the world.

In light of increasing importance of FTAs for Japan's trade policy, this paper attempts to examine the impacts of Japan-Mexico FTA on Japan's exports to Mexico. This type of research is very important as it tries to confirm the expected impacts of FTAs. It is well known that FTAs would lead to an expansion of trade between FTA partners, or the trade creation effect of an FTA. Ando and Urata (2011) conducted a detailed analysis of the impacts of Japan-Mexico FTA (JMXFTA) on bilateral trade and found that bilateral trade of many products, which were protected but liberalized under the FTA, increased substantially[1]. This paper attempts to investigate the impacts of FTAs on trade from different perspectives, that is, extensive and intensive margins, in order to deepen our understanding of the issue by shedding new light[2].

Not so long ago, we took for granted that trade liberalization expands trade volumes and in turn leads to economic growth. However, since the last decade, some empirical as well as theoretical researches have shed light on the fact that trade liberalization affects trade *margins* in two different ways. A change in trade margin can be decomposed into two margins, the change in trade volume

[1] In their analysis of trade and regional trade agreements including FTAs and customs unions involving 67 countries for 27 years from 1980 to 2006, Urata and Okabe (2014) found positive or trade creation effect in many cases but not in all the cases. The presence of non-tariff barriers and/or difficulty in the use of FTAs seems to prevent the trade creation effect.

[2] Unless otherwise specified, the terms "extensive margin" and "intensive margin" refer to the product-level margins rather than the partner-level margins.

per existing traded good and the change in the number of traded goods. The former is referred to as the intensive margin and the latter as the extensive margin. The intensive margin brought out by trade liberalization simply means increasing production of a good that already has a comparative advantage while decreasing the production of a good with comparative disadvantage. On the other hand, the extensive margin indicates that the exporter starts to gain a comparative advantage in a new good. In other words, the exporter who expands its trade volume through the extensive margin experiences a change in production as well as trade structure. In this sense the effect caused by this change may be long-lasting.[3]

Although the impact of these two margins on economic growth is still being investigated, it is now widely recognized that distinguishing these margins is important when the effects of trade liberalization are considered. In particular the extensive margin has been paid little attention as a factor of trade expansion. The structure of the paper is as follows. Section 2 reviews the literature on the impacts of FTAs and trade liberalization on intensive and extensive trade margins. Section 3 presents the model used for our analysis of the impacts of the JMXFTA on extensive and intensive trade margins regarding Japan's exports to Mexico. Our model is based on Melitz-Chaney type heterogeneous firm trade, but it differs from their models in some points: our model addresses the different characteristics by sector, and our model incorporates transport costs and tariff barriers separately. This separation is important when we analyze the effect of tariff reduction. Section 4 provides an overall picture of Japan's exports to Mexico before and after the FTA. Section 5 provides the details of the data of tariffs and exports. Section 6 presents and discusses the results of the empirical analysis, and section 7 concludes the paper.

## 2. The Impacts of Trade Liberalization on Intensive and Extensive Trade Margins: Previous Studies

Let us begin with theoretical explanation of the importance of considering the extensive margins in the analysis of trade flows. Using heterogeneous firm framework, Chaney (2008) examines the importance of the elasticity of substitution between goods in determining the effect of trade barriers on export volumes, and shows that the magnitude of the elasticity of substitution affects export volume through the intensive and extensive margins differently. Helpman, Melitz and Rubinstein (2008) (hereafter HMR) argue the importance of the extensive margin in different way from Chaney. They theoretically and empirically show that the estimates in gravity equation would be biased if the extensive margin is omitted.

The question which margin is more affected by the trade liberalization is solely an empirical issue. Using more than 5,000 product categories, Hummels and Klenow (2005) identify that larger economies tend to export more than smaller economies and the extensive margin plays a

[3] Buono and Lalanne (2012) touch on this point.

crucial role of their export expansion. Also adopting the Feenstra methodology, Kehoe and Ruhl (2013) find that extensive margin contributed significantly to trade expansion between the US and its FTA countries. Dutt, Mihov, and van Zandt (2013) focus on the impact of WTO membership on the intensive and the extensive margins and find that the WTO membership raises the extensive margin but decreases intensive margin with country-level data in the panel gravity model. There are some other studies that show the significant impact of FTA on the extensive margin including Hillberry and McDaniel (2002) on the impacts of the North American Free Trade Agreement (NAFTA) on the NAFTA members' trade and Foster (2012) on the effects of preferential trade agreements (PTAs) on imports.[4] These studies seem to indicate that the extensive margin plays an important role in determining the size of trade in the case of policy change, as argued by Kehoe and Ruhl.

As seen from the discussions above, majority of the studies which we reviewed find that trade liberalization and FTAs lead to an expansion of extensive margins of trade. However, there are some studies, a few though, which find limited role of the extensive margin. Buono and Lalanne (2012) estimate the impact of the Uruguay round on French firms' export activities and find the tariff reduction resulted in noticeable export expansion, mainly through the expansion of intensive margins. This study uses firm-level data, unlike most other studies, which use trade data. Debaere and Mostashari (2010) analyze the sources of the changes in the extensive margins of the exports to the US by using disaggregated trade and tariff data, and find that tariff reduction has a limited impact on the extensive margin.

## 3. The Model

In this section we set up a model which is used for the empirical study in a later section. Our model has a similar structure to Chaney (2008) which theoretically incorporates intensive and extensive margins into heterogeneous firm model a la Melitz (2003). We assume that consumers of a country $i$ has the following utility function,

$$U_i = q_0^{\mu_0} \prod_{s=1}^{S} \left( \int_{\omega \in \Omega_s} q_s(\omega)^{\frac{\sigma_s - 1}{\sigma_s}} d\omega \right)^{\mu_s \frac{\sigma_s}{\sigma_s - 1}} .$$

There are $S$ industries, and a representative consumer in the country $i$ consumes a homogeneous good, $q_0$, and a continuum of differentiated goods $q_s(\omega)$, $\omega \in \Omega_\omega$. The homogeneous good is

[4] There are some studies which have different definition of extensive margin, such as Fellbermyr and Kohler (2006) and Evenett and Venables (2002). They define the extensive margin is the number of new market (country) although Evenett and Venables don't use the term "extensive". In addition, Amurgo and Pierola (2008) develop the method to separate two extensive margins (the numbers of new products and new markets).

assumed numeraire and freely traded between countries without any cost. The consumers spend a share μ for each good, such that $\mu_0 + \sum_{s=1}^{S} \mu_s = 1$. $\sigma_s$ is the elasticity of substitution between differentiated goods for sector *s*, and assumed $\sigma_s - 1 > 0$.

Maximizing the utility subject to the budget constraint gives the country $i'$ s demand for differentiated goods of sector *s*.

$$q_{si}(\omega) = \mu_s Y_i p_{si}(\omega)^{-\sigma_s} P_{si}. \tag{1}$$

$Y_i$ is country $i'$ s income and $\mu_s Y_i$ is the expenditure for the goods in sector *s*. $P_{si}$ is country $i'$ s composite price index in sector *s*, given by

$$P_{si} = \left( \int_{\omega \in \Omega_s} p_{si}(\omega)^{1-\sigma_s} d\omega \right)^{\frac{1}{\sigma_s - 1}}.$$

A firm in the country $i$ exports differentiated product to country $j$ covering transportation costs and import tariff incurred by country $j$. The transportation costs include freight and insurance which become greater as the distance between countries $i$ and $j$ becomes longer. We assume that the cost is in the form of iceberg that country $j$ receives one unit of a good in sector *s* if country $i$ ships $\tau_{sij}$ unit to country $j$. A tariff rate $t_{sj}$ is incurred by country $j$ for sector *s*. We assume that $\tau_{sij} > 1$ for $i \neq j$, and $\tau_{sii} = 1$, and $t_{sj} > 0$. There is an additional cost, $f_{sij}$, which must be borne by a firm when it exports,[5] given by $f_{sij} > 0$ for $i \neq j$, and $f_{sii} = 0$.

Assuming only labor is a factor of production, and the good $q_0$ is produced under constant returns to scale technology, while the differentiated products $q_s(\omega), s > 1$ are produced under increasing returns to scale technology. Consider the case that a representative firm in country $i$ exports a differentiated good to country $j$. Maximizing the profit subject to the budget constraint, we have the following optimal pricing rule which shows a constant mark-up over the marginal cost:

$$p_{sij}(\varphi) = \alpha \frac{w_i \tau_{sij}(1 + t_{sj})}{\varphi}, \tag{2}$$

where $\varphi$ is the firm's labor productivity, $w_i$ is country $i'$ $s$ wage rate which equals to the marginal cost, and $\alpha = \sigma_s/(\sigma_s - 1)$. As in HMR (2008), Chaney (2008), and others, we assume the

[5] To keep the model as simple as possible, we assume there is no fixed cost for entering the market. In other words, the firm has two choices, supplies to domestic market or supplies to both domestic market and country $j$.

productivity $\varphi$ follows Pareto distribution over the range of [1, +∞);

$$\Pr(\tilde{\varphi} < \varphi) = G(\varphi) = 1 - \varphi^{-\gamma_s},$$

where parameter $\gamma_s$ stands for the curvature of the density with $\gamma_s > \sigma_s - 1$. Using equations (1) and (2), we have the demand for differentiated goods produced in country $i$ and sold in country $j$ of sector $s$ as follows:

$$x_{sij}(\varphi) = p_{sj}(\varphi)q_{sij}(\varphi) = \mu_s Y_j \alpha^{1-\sigma_s} \left( \frac{w_i(1+t_{sj})\tau_{sij}}{\varphi} \right)^{1-\sigma_s} P_{sj}^{\sigma_s - 1}. \quad (3)$$

We next consider the heterogeneity of producers. To find the volume of differentiated goods exports from country $i$ to country $j$ in the heterogeneous firm model, we define the productivity threshold using the density function above. Since the firm's profit in the country $i$ from exporting differentiated goods to country $j$ is $\pi_{sij}(\varphi) = \left( p_{sj}(\varphi) - \frac{w_i(1+t_{sj})\tau_{sij}}{\varphi} \right) q_{sij}(\varphi) - f_{sij}$, the threshold is obtained to solve for $\varphi$ by setting $\pi_{sij}(\varphi) = 0$. We therefore obtain,

$$\bar{\varphi} = \alpha^{\alpha} \left( \frac{f_{sij}}{\mu_s Y_j} \right)^{\frac{1}{\sigma_s - 1}} \frac{w_i(1+t_{sj})\tau_{sij}}{P_{sj}}. \quad (4)$$

Equation (4) indicates that an increase in either export fixed cost ($f_{sij}$), marginal cost ($w_i$), tariff rate ($t_{sj}$), or transportation cost ($\tau_{sij}$) increase the threshold of export ($\bar{\varphi}$). On the other hand, an increase in either demand share ($\mu_s$), income ($Y_j$), or price index ($P_{sj}$) reduces $\bar{\varphi}$.

With this result, we calculate the number of exported goods which equals the number of exporters. Combining the maximum number of differentiated goods with Pareto distribution, we have the following:

$$E_{sij} = \int_{\bar{\varphi}}^{\infty} N_{si} dG(\varphi) = N_{si} \bar{\varphi}^{-\gamma_s}, \quad (5)$$

where $E_{sij}$ is the number of goods exported from country $i$ to country $j$, and $N_{si}$ is the maximum number of differentiated goods produced in sector $s$ in country $j$. Equations (4) and (5) indicate that $E_{sij}$ is a function of the maximum number of differentiated goods in sector $s$, the entry cost into export market, sector-wise income of country $j$, marginal cost, transportation costs, price index, and the tariff rate. Among these variables, an increase in either $f_{sij}$, $w_i$, $t_{sj}$, or $\tau_{sij}$ decrease $E_{sij}$, by raising $\bar{\varphi}$. On the other hand, an increase in variables such as $\mu_s$, $Y_j$, or $P_{sj}$ raises $E_{sij}$ through the reduction in $\bar{\varphi}$.

The extensive margin, we define, is a *change* in the number of exported differentiated goods by sector. In order to obtain the extensive margin of exports, we take logarithm and deference in terms of time of both side of equation (5).

On the other hand, the intensive margin of export is defined as a *change* in the average volume of exported differentiated goods by sector. To see this, we first calculate the total volume of trade in differentiated goods. This volume of exports[6] is calculated from the number of differentiated goods $N_{si}$ and the volume of exported goods for sector *s* which is described by equation (3). Then we have[7]

$$\begin{aligned} X_{sij} &= \int_{\bar{\varphi}}^{\infty} N_{si} x_{sij}(\varphi) dG(\varphi) \\ &= \mu_s Y_j \left( \frac{\alpha w_i (1 + t_{sj}) \tau_{sij}}{P_{sj}} \right)^{1-\sigma_s} \frac{\gamma_s}{\gamma_s - (\sigma_s - 1)} \bar{\varphi}^{\sigma_s - 1} N_{si} \bar{\varphi}^{-\gamma_s}. \end{aligned} \tag{6}$$

The term, $N_{si}\bar{\varphi}^{-\gamma_s}$, is the number of exports in differentiated goods defined by equation (5), and the $\bar{\varphi}$ is a threshold condition which is defined by equation (4).

The total volume of differentiated good exports can be divided into two parts: the number of exported differentiated goods and the average volume of the differentiated exports, or $X_{sij} = E_{sij} \times (X_{sij}/E_{sij})$. $E_{sij}$ is shown in equation (5), while the term $(X_{sij}/E_{sij})$ can be shown as follows:

$$I_{sij} = \mu_s Y_j \left( \frac{\alpha w_i (1 + t_{sj}) \tau_{sij}}{P_{sj}} \right)^{1-\sigma_s} \frac{\gamma_s}{\gamma_s - (\sigma_s - 1)} \bar{\varphi}^{\sigma_s - 1} \tag{7}$$

The extensive and the intensive margins are changes in volume of equations (5) and (7). Taking natural logarithm and difference with respect to time of both sides of the equation, we have $\Delta \ln X_{sij} = \Delta \ln E_{sij} + \Delta \ln( X_{sij}/E_{sij})$. We define that the extensive margin is the first term and the intensive margin is the second term of the right side of the equation.

Hence, from equation (7), the intensive margin of trade includes the entry cost into export

[6] The total volume of exports includes homogeneous good and differentiated goods. To make the model as simple as possible, we ignore the trade in homogeneous goods trade.
[7] The model analyzes the export from country $i$ to country *j*, only national income of country *j* appears in the equation which differs from Chaney's (2008) model.

market, sector-wise income of country $j$, marginal cost, transportation costs, price index, the tariff rate, and the threshold condition.

**Impact of FTA on extensive and intensive margins**

Next we analyze the effect of FTA on the intensive and the extensive margins. Let us first define the effect of FTA is the same as a decrease in tariff rate of country $j$. First we analyze the effect of FTA on the extensive margin. It is clear that from equations (4) and (5), the extensive margin is a function of a tariff rate, and a decrease in tariff rate reduces the threshold point, $\bar{\varphi}$, and in turn a decrease in $\bar{\varphi}$ raises the extensive margin since $-\gamma_s < 0$. We hereafter refer to this as a productivity effect.

Now note that the country $j'$ s income $Y_j$ is also a function of tariff rate $t_{sj}$ because $Y_j$ is expressed by $\sum_{s=1} w_{sj} L_j + \sum_{s=1} \left\{ \int_0^{\infty} \pi_{sji}(\varphi)\, dG(\varphi) + \int_{\bar{\varphi}}^{\infty} t_{sj} q_{sij}(\varphi)\, dG(\varphi) \right\}$.[8] The first term $(w_{sj} L_j)$ means the total labor income of country $j$, the first integral in the bracket expresses sum of firm's profit, and the second integral in the bracket stands for collected tariff revenue. An increase in tariff rate creates tariff revenue which tends to raise country $j'$ s income, $Y_j$. Since $\partial Y_j / \partial t_{sj} > 0$ from the equation of $Y_j$ above, a decrease in $t_{sj}$ reduces $Y_j$ and in turn raises $\bar{\varphi}$. This finally reduces $E_{sij}$. However, many researchers find the positive correlation between trade liberalization and national income such as Sachs and Warner (1995), Krueger (1997), and Frankel and Romer (1999), to name a few. If this is the case, the effect of the tariff reduction on the national income can be positive. The total effect of the FTA on the national income is therefore ambiguous. We hereafter refer to this as an indirect income effect.[9] The combined effect of the formation of the FTA on the extensive margin hence depends on the balance of strength between the two.

PROPOSITION 1: Extensive margin is positive if and only if the elasticity of income with respect to the tariff is smaller than $(\sigma_s - 1)$. $\varepsilon_{yt} < (\sigma_s - 1)$.

PROOF: Inserting equation (4) into equation (5) and taking natural logarithm of both sides of the equation, and taking derivative with respect to $\ln(1 + t_{sj})$, we have:

$$\frac{\partial \ln E_{sij}}{\partial \ln(1 + t_{sj})} = \gamma_s \left[ \frac{1}{\sigma_s - 1} \varepsilon_{yt} - 1 \right],$$

[8] However $P_{sj}$ is not a function of $t_{sj}$. Since $P_{sj}$ is a function of an optimum price of country $j$, $(p_{sj})$ which is a function of $t_{si}$.

[9] Chaney (2008), Crozet and Koenig (2010), and Arkolakis (2010) assume the income effect is independent of policy changes, which is different from our model.

where $\varepsilon_{yt} = \partial \ln Y_j / \partial \ln(1 + t_{sj})$, which means the elasticity of tariff with respect to the national income. If this equation is negative, the FTA expands the extensive margin of the trade. This is positive if and only if $\varepsilon_{yt} < (\sigma_s - 1)$. If this is the case, the FTA expands the extensive margin. ■

We next analyze the impact of FTA on the intensive margin. Since the intensive margin can be obtained by differencing the average volume of each export, we focus on the relation between the left and right sides of the equation (7). In the right side of equation (7), tariff rate appears four times: in the nominator in the parenthesis, $Y_j$, and two times in $\bar{\varphi}$. We name the effect of $t_{sj}$ in the nominator in the parenthesis and $Y_j$ as direct effect and direct income effect, respectively. The effects of $t_{sj}$ through $\bar{\varphi}$ are referred as the productivity and the indirect income effects, same as in the case of extensive margin. Taking care of the sign of the power of the parenthesis $(\sigma_s - 1 > 0)$, we derive the direct effect of tariff reduction: $\partial I_{sij} / \partial t_{sj} < 0$. Hence the effect of forming FTA increases the intensive margin. The direct income effect, on the other hand, shows the negative correlation between the intensive margin and the direct income effect.

PROPOSITION 2: (A) Intensive margin is positive if and only if the elasticity of income with respect to the tariff is smaller than $(\sigma_s - 1)$, that is $\varepsilon_{yt} < (\sigma_s - 1)$, when the productivity effects are ignored. (B) However if the productivity effect is included, the effect of tariff reduction on the intensive margin becomes neutral.[10]

PROOF:

(A) Taking derivative of equation (7) without the productivity term $(\bar{\varphi}^{\sigma_s - 1})$, we have the following result,

$$\frac{\partial \ln I_{sij}}{\partial \ln(1 + t_{sj})} = \varepsilon_{yt} - (\sigma_s - 1).$$

It should be negative if $\varepsilon_{yt} < (\sigma_s - 1)$. If this is the case, the FTA expands the intensive margin.

(B) Taking derivative of equation (7) with the productivity term $(\bar{\varphi}^{\sigma_s - 1})$, we have the following result,

$$\frac{\partial \ln I_{sij}}{\partial \ln(1 + t_{sj})} = \varepsilon_{yt} + (1 - \sigma_s) + (\sigma_s - 1)\left[-\frac{1}{\sigma_s - 1}\varepsilon_{yt} + 1\right] = 0.$$

■

[10] This result is similar to the effect of fixed cost on trade flows of Chaney (2008), p.1717.

It is easy to infer the impact of FTA on total exports $X_{sij}$ from these propositions. For the case without productivity effect, it becomes

$$[\varepsilon_{yt} - (\sigma_s - 1)]\left(1 + \frac{\gamma_s}{\sigma_s - 1}\right),$$

which is positive or negative depending on the sign of $\varepsilon_{yt} - (\sigma_s - 1)$. On the other hand, the effect with productivity path is just the same as the effect on extensive margin in proposition 1.

**4. Japan's Exports to Mexico**

Japan's exports to Mexico began to increase sharply in 2003 after experiencing a slow decline for several years (Figure 1). The rate of increase of Japan's exports to Mexico from 2003 to 2007 was very high as the magnitude of the exports increased 2.7 fold in 4 years, to register 1.1 trillion yen in 2007. A major reason for the rapid expansion of Japan's exports to Mexico is high economic growth achieved by the Mexican economy, which registered 4~5 percent growth rates for the 2003-2007 period. In addition, the Japan-Mexico Free Trade Agreement, which became effective in March 2005, appears to have also contributed to the rapid expansion of Japan's exports to Mexico. Japan's exports to Mexico dropped precipitously to 600 billion yen in 2009 as Mexico's GDP declined by 4.7 percent due to the negative impacts caused by the Global Financial Crisis in 2008. Japan's exports to Mexico recovered quickly in 2010, as the Mexican economy recovered quickly and strongly. Japan's exports to Mexico remained at around 800 billion yen from 2010 to 2013.

Japan's exports to Mexico are concentrated in machinery products. Specifically, the average shares of general, electric, and electronic machinery and transport machinery in Japan's total exports to Mexico for the 2000-2013 period were 44.4 and 28.6 percent, respectively. Other products which recorded relatively high shares include base metals, precision machinery, and chemical products and plastics, whose shares in total exports were 12.2, 6.9 and 4.9 percent, respectively. The combined share of these five products in Japan's total exports to Mexico was as high as 97 percent. It should be noted that these shares remained more or less the same throughout the 2000-2013 period.

Let us turn to a detailed examination of the patterns of Japan's exports to Mexico in terms of extensive and intensive margins in 2004 and 2006, for which we conduct a statistical analysis, in order to discern the impacts of the Japan-Mexico Free Trade Agreement on Japan's exports to Mexico. We selected the years 2004 and 2006 for our analysis because of the availability of the most detailed export data on the consistent classification basis (HS-9 digit).

Table 1 summarizes Japan's exports to Mexico in terms of yen value and the number of products at HS-9 digit level. The total number of products that Japan exported to the world in 2004 and 2006 amounted to 6,150 (Table 1). The number of products that are exported to Mexico in 2004 (pre-JMXFTA) and 2006 (post-JMXFTA) were 1,841 (1,493+348) and 1,859 (1,493+366), respectively. Interestingly, the total number of exported products from Japan to Mexico grew less than one percent during the period, despite a significant tariff reduction under the JMXFTA.

On the contrary, the value of Japan's total exports to Mexico increased 1.86-fold from 553 billion yen to 1,030 billion yen from 2004 to 2006 (Table 1). Of these, the value of the products that were exported both in 2004 and 2006 increased 1.85-fold from 540 billion yen to 1,002 billion yen (intensive margin). Whether this significant increase in Japanese export value was achieved by Mexico's tariff reduction under the JMXFTA is an empirical matter. The values of exports that were exported only in 2004 and only in 2006 were 12 billion yen and 28 billion yen, respectively. These values amount to meager 2.2 percent and 2.8 percent of the total export values for 2004 and 2006, respectively, indicating that the turnaround (entry and exit from the export market) in Japan's exports to Mexico occurred mostly for the products whose export values are quite small. In other words, exported products with large value tended to be exported in both years.

An examination of Japanese exports to Mexico by products reveals that the number of products classified under general and electrical equipment is by far the largest, as the number of products under these categories exported in 2004 and 2006 (for both years as well as just for one year) amounted to 724, or 32.8 percent of the total number of exported products (Tables 2). Other categories that registered a large number of exported products are base metals (360, 16.3%), chemical products (265, 12.0%), precision machinery (193, 8.7%), plastics & rubber (166, 7.5%), and textiles (166, 7.5%). These six industries as a group account for 84.9% of the total number of products. These are the industries that experienced a substantial turnaround of the products in terms of export status, i.e. exiting from as well as entering into the export market. Focusing on these six industries, we find different patterns of change in the export status of the products. For general and electric machinery, and precision machinery, the number of products exited from the export market is larger than the number of products entered into the export market, resulting in the decline in the number of exported products. By contrast, for base metals, chemical products, plastics & rubber, and textiles, the number of products entering the export market was larger than the number of products exiting from the export market, leading to an increase in the number of exported products. Besides these four industries, stone, cement, ceramic & glass, and transport machinery saw an increase in the number of exported products from 2004 to 2006.

The changing pattern of Japanese exports to Mexico in terms of export value shows quite a different picture compared to the pattern observed in terms of product numbers (Table 3). As for the products that were exported both in 2004 and 2006, a large increase in export value (intensive margin) was observed in general and electric machinery (227 billion yen), and in transport machinery (162 billion yen).[11] In terms of growth rate, pearls, precious stones/metals recorded a huge increase of 1,300 percent. Other than this industry, prepared foodstuffs, beverages & tobacco, stone, cement, ceramic & glass, animal/vegetable fats, oils & waxes, and transport machinery showed high increase of more than 200 percent. An investigation of the turnover of the exit from and entry into the Mexican market by product shows that the value of newly exported products in transport machinery in 2006 was large at 20 billion yen, accounting for as much as 70.5 percent of the total value of newly exported products. For the transport machinery, the value of exported products that exited from the export market was small at 300 million yen. The net increase resulting from the turnover was quite large at 19.7 billion yen. The values of newly exported products were quite large for base metals and general and electric machinery, respectively at 3.4 billion yen and 2.1 billion yen, but the values of the products exited from the exported market were significantly larger, respectively at 5.0 billion yen and 4.9 billion yen, resulting in the net decline in the turnover value.

## 5. Empirical Analysis

### 5.1 Empirical Framework

We estimate the impact of FTA on trade flows, in particular extensive and intensive margins by applying the model developed in section 3. Following HMR (2008), we assume $\tau_{sij} = d_{ij}e^{u_s}$, where $d_{ij}$ represents physical distance between countries $i$ and $j$, and $u_s$ is the error term with a mean of 0 and a variance of $\sigma^2$. In order to estimate of the effect of FTA on the extensive margin, we insert equation (4) in equation (5) and then take logarithm of equations (5),

$$\ln E_{sij} = \beta_E + \frac{\gamma_s}{\sigma_s - 1}\ln\mu_s Y_j - \gamma_s \ln(1 + t_{sj}) - \frac{\gamma_s}{\sigma_s - 1}\ln f_{sij} - \gamma_s \ln w_{si} - \gamma_s \ln d_{ij} + \gamma_s \ln P_{sj} + u_s,$$

where $\beta_E = \ln N_s - \gamma_s \alpha \ln\alpha$ which is constant over time. It is often observed that productivity difference, strength of labor unions, inertia of mobility, and others lead to different wage rates over industries. We assume, therefore, the marginal product of labor differs over sectors. The extensive margin can be obtained by taking the difference in terms of time of the equation.

$$\Delta\ln E_{sij} = \frac{\gamma_s}{\sigma_s - 1}\Delta\ln\mu_s Y_j - \gamma_s \Delta\ln(1 + t_{sj}) - \frac{\gamma_s}{\sigma_s - 1}\Delta\ln f_{sij} - \gamma_s \Delta\ln w_{si} + \gamma_s \Delta\ln P_{sj} + \Delta u_s. \quad (8)$$

We apply the same procedure to equation (7) to get the estimated equation for the intensive margin for the case of no-productivity path (assuming $\bar{\varphi} = 1$).

[11] It is worth noting that prior to the JMXFTA, automobile producers who did not have any production sites in Mexico had to bear 50 percent of import tax. See Ando and Urata (2011).

$$\ln I_{sij} = \beta_I + \ln\mu_s Y_j - (\sigma_s - 1)\left[\ln\left(1 + t_{sj}\right) + \ln f_{sij} + \ln w_{si} + \ln d_{ij} - \ln P_{sj}\right] + u_s,$$

where $\beta_I = \ln\frac{\gamma_s}{\gamma_s - (\sigma_s - 1)} - (\sigma_s - 1)\ln\alpha$ which is constant over time. The intensive margin is obtained from time-differencing the equation,

$$\Delta\ln I_{sij} = \Delta\ln\mu_s Y_j - (\sigma_s - 1)\left[\Delta\ln\left(1 + t_{sj}\right) + \Delta\ln f_{sij} + \Delta\ln w_{si} - \Delta\ln P_{sj}\right] + \Delta u_s. \quad (9)$$

Equations (8) and (9) are different from theoretical gravity equations developed by, for example, Chaney (2008), Anderson and van Wincoop (2003), and HMR. (2008).[12] The most important difference from them is the inclusion of the sector level income effect, ie., $\Delta\ln\mu_s Y_j$. Since we focus on the impact of FTA by sector, the term of sector specific demand plays an important role although all previous studies ignore it.[13] The second important difference is the presence of the policy variable $t_{sj}$. We explicitly separate the policy variable of trade liberalization $t_{sj}$ from the transportation costs $\tau_{sij}$. This separation is particularly important for a policy analysis because the transportation costs $\tau_{sij}$ contains a physical distance between the two countries which is not a policy variable.

In the empirical analysis, country $j$'s imports from the world for the goods in sector $s$ ($M_{sj}$) are used as a proxy for the sector level expenditure for the goods in the sector ($\mu_s Y_j$). The utilization rate of FTA preferential tariffs is assumed to be 100%. In other words, exporters in country $i$ always make use of preferential tariff rates granted by country $j$ whenever possible. We also assume that fixed cost in each sector ($f_{sij}$) and distance between countries $i$ and $j$ ($d_{ij}$) are constant over time.

Consequently, the equations to be estimated are given by:

$$\Delta\ln E_{sij} = \beta_1^{ex}\Delta\ln T_{sj} + \beta_2^{ex}\Delta\ln M_{sj} + \beta_3^{ex}\Delta\ln w_{is} + \beta_4^{ex}\Delta\ln P_{sj} + u_s, \quad (8)'$$
$$\Delta\ln I_{sij} = \beta_1^{in}\Delta\ln T_{sj} + \beta_2^{in}\Delta\ln M_{sj} + \beta_3^{in}\Delta\ln w_{is} + \beta_4^{in}\Delta\ln P_{sj} + u_s, \quad (9)'$$

where $T_{sj} = 1 + t_{sj}$. Expected signs for these variables are $\beta_1 < 0$, $\beta_2 > 0$, $\beta_3 < 0$, and $\beta_4 > 0$ for both extensive and intensive margin equations..

[12] Exactly speaking, our estimation equation is not a gravity model because it includes only one country income, not two, and the dependent variable is not the bilateral trade flows but one way exports from country $i$ to country $j$.

[13] HMR (2008) and Chaney (2008), for example, include exporter's and importer's total demands (GDPs) in the estimation, not industry specific demands.

### 5.2 Data and Variables

The data on our dependent variables, the extensive ($E$) and intensive margins ($I$) of Japan's exports to Mexico, are taken from the Ministry of Finance (MOF) of Japan's *Trade Statistics of Japan*, which records trade flows for Japan at the most detailed 9-digit tariff line level, and then aggregated to the 6-digit commodity level. We focus on the year 2004 and 2006, one year prior to and after the enactment of JMXFTA. The data for both years are based on version 2002 of the Harmonized Commodity Description and Coding System (HS code). For some commodities, however, minor revisions of commodity definition at the 9-digit level have been made by the Government of Japan between the two years. In such case, we use concordance tables published by the MOF in order to connect the two point datasets. Data on intensive margin are deflated and converted from Japanese yen to U.S. dollars. Both GDP deflator and exchange rate are obtained from the World Bank's *World Development Indicator*.

Our tariff data ($T$) are taken from the UNCTAD TRAINS database through the *World Integrated Trade Solution* (WITS) website. $\Delta \ln T$ is calculated by taking the difference between log of Mexico's Most-Favored Nation (MFN) applied tariffs in 2004 and log of its preferential tariffs vis-à-vis Japan in 2006 under the JMXFTA. It should be noted that between 2004 and 2006, Mexico has implemented unilateral liberalization by reducing its MFN tariffs vis-à-vis WTO member countries. In fact, Mexico's simple average MFN applied tariff rate dropped from 17.5% in 2004 to 13.6% in 2006, whereas its preferential tariff rates against Japan was 7.8% in 2006 (Table 4). This suggests that while $\Delta \ln T$ actually represents tariff-saving effect that Japanese exporters have enjoyed after the enactment of the JMXFTA, it does not necessarily represent the *preferential margin* for Japanese exporters. We therefore construct an alternative variable $\Delta \ln Tpr$, which is the difference between log of Mexico's MFN tariffs in 2006 and log of its preferential tariffs applied on imports from Japan in 2006.

Data on Mexico's imports from the world ($M$) are taken from the *Trade Map*, developed by the UNCTAD/WTO International Trade Center (ITC). Data on Japan's wage rates by sector ($w$) are drawn from the UNIDO's *International Yearbook of Industrial Statistics* for manufacturing sector and from the OECD's *STAN Structural Analysis Database* for agricultural, forestry, fishing, and mining sector, and converted from ISIC revision 3 product classifications to version 2002 of HS code, using a converter provided by the WITS. We also obtain the data on price index by sector in Mexico ($P$) from the OECD's *STAN*. The summary statistics for the variables, which will be included in our estimation in the next subsection, are shown in Table 5.

### 5.3 Results

Using Monte Carlo simulations, Silva and Tenreyro (2006) showed that under heteroskedasticity, parameters of log-linearized models estimated by OLS are severely biased, and proposed to use Pseudo Poisson Maximum Likelihood (PPML) estimator in estimating the gravity equations, in order to deal with the zero trade issues. However, we use OLS estimator because all the variables in the estimation equations (8)' and (9)' including dependent variables $\Delta lnE$ and $\Delta lnI$ are time difference variables rather than level variables, meaning $\Delta lnE = 0$ and $\Delta lnI = 0$ in an sector do not necessarily mean the level of export in the sector equals zero.

Table 6 reports the results from our baseline OLS models estimating the impacts of tariff reduction under the JMXFTA on Japan's exports. Separate regressions are presented for two alternative tariff variables $dlnT$ and $dlnTpr$ for two different dependent variables – extensive margin (*dlnE*) and intensive margin (*dlnI*). Results in columns (1) and (5) of Table 6 show that the estimated coefficients for tariff reduction $dlnT$ are not statistically significant in either extensive or intensive margin regressions. On the other hand, column (6) indicates that if we use $dlnTpr$ as an independent variable, the tariff coefficient in the intensive margin regression becomes negative and statistically significant at the 10% level, whereas that in the extensive margin regression is statistically insignificant (column (2)). The coefficients for sector-level income, wage rate, and price index in column (6) have the expected signs and are all statistically significant.

In Table 6, regression equations (3), (4), (7) and (8) focus on the sample of machinery products. Machinery is the major export items of Japan and many of which are considered to be differentiated products, therefore machinery exports are expected to react readily with the tariff changes. Machinery products include all the goods classified as part of general machinery (HS 84), electric machinery (HS 85), transport equipment (HS 86-89), and precision machinery (HS 90-92). In the intensive margin equation (columns 7 and 8), the signs of coefficients of two tariff variables show negative and statistically significant at 5% level. On the other hand, tariff coefficients of the same tariff variables in the extensive margin regression are not statistically significant (columns 3 and 4). It is interesting to note that the sizes of the coefficients of tariffs in machinery (columns 7 and 8) are larger than the sizes of coefficients of tariffs in total export cases (columns 5 and 6). This result support, as we expected, the idea that machinery exports are more sensitive to the tariff changes rather than other export sectors. Other variables such as the proxy for industry demand (*dlnM*), composite price index (*dlnP*) are correlated positively with intensive margins while the wage rate (*dlnw*) correlates negatively with intensive margin. These all results in intensive margin case support our hypotheses based on our theoretical model.

As a robustness check, we estimate product-specific fixed effects models. To do this, we create and use a two-year panel dataset with level variables, rather than using a cross-section dataset with time difference variables. In particular, we introduce two tariff variables $dlnT_{jpn}$ and $dlnT_{mfn}$ in our estimation models, in order to capture the effects of Mexico's preferential tariff reduction vis-à-vis Japan while controlling the effects of Mexico's unilateral liberalization vis-à-vis WTO members as discussed in section 5.2. The results are shown in Table 7. Year fixed effects are included in the regressions (10), (12), (14), and (16). The coefficients for preferential tariff ($dlnT_{jpn}$) in the intensive margin regressions remain negative and statistically significant at the 10% level for all-products sample (column (13) and (15)), and at the 5% level for machinery products sample (column (14) and (16)). On the contrary, tariff coefficients in the extensive margin regressions are unstable and not statistically significant.

## 6. Summary and Conclusion

This paper examines the impacts of JMXFTA on Japanese exports to Mexico. We construct a theoretical trade model of heterogeneous firms, which is based on the Melitz-Chaney model, and derive the theoretical relationship of the impacts of tariff changes on extensive and intensive trade margins. Applying this model, the authors estimate the impacts of JMXFTA on product-level extensive and intensive margins of Japan's exports to Mexico by using the most detailed commodity trade data.

We find that, in contrast to most previous studies, intensive margin rather than extensive margin plays an important role in explaining the increase in trade volume caused by the FTA. The reasons for this result appear to be twofold: First, our estimation uses the most detailed HS 9-digit product level data rather than firm level data or country level data, which were used by many previous studies adopting the Melitz and Chaney's heterogeneous firm models. Those models assume that each heterogeneous firm produces each differentiated product. However, one cannot distinguish the intensive margin from extensive margin from only the information of the firm-level-export data. For example, if a firm increases its export volume after tariff reduction, we never know whether the firm expands export of goods it has previously exported or starts to export a new good. According to the theory, the existing firms can never be new-goods-exporters. In other words, the model predicts that if the existing firm increases its export after the policy change, the export expansion is through the intensive margin, while if a new firm emerges (starts to export) after the policy change, it is counted as the extensive margin, even if the new firm exports the same product exported by the existing firm. Many of the literatures mentioned above often use firm-level-export data and assume that the number of firms is a proxy for the extensive margin. However, the number of firms does not equal to the number of products. The definition of extensive margin is the number of new goods (not firms) introduced into the market. The number of firms, therefore, cannot be a proxy for the extensive margin. In this paper, we correct this misalignment between the theory and the empirical study.

Second, we use data of the year 2006, only one year after the enactment of JMXFTA. It might be more time-consuming for exporters, even for existing exporters, to start exporting totally new goods than trying to expand trade volume of existing traded goods, as they may have to bear fixed costs including costs for searching and understanding information on preferential tariffs and rules of origin, as well as costs for meeting rules of origin requirements. These transaction costs would be much higher in the case of potentia*l n*ew exporters who do not have any experiences of utilizing preferential tariffs or who are unaware that FTAs can be utilized as a corporate strategic tool. If this were the case, a possible policy implication would be to reduce fixed costs, which potential FTA users might face after the conclusion of new FTAs, through introducing less restrictive rules of origin or providing user-friendly information for potential new FTA users. These policy initiatives would contribute to trade expansion especially through extensive margins.

To conclude, we would like to touch upon two future research agendas. First, although our study mainly focused on the impacts of JMXFTA on exports from Japan to Mexico, the impacts of other FTAs such as NAFTA, should be also taken into account when estimating impacts of JMXFTA on Japan's exports. Second, the impacts of domestic policies in Mexico such as PROSEC (the Program of Sectoral Promotion) in automotive industry should be considered, as it might also affect bilateral trade and investment flow between the two countries.

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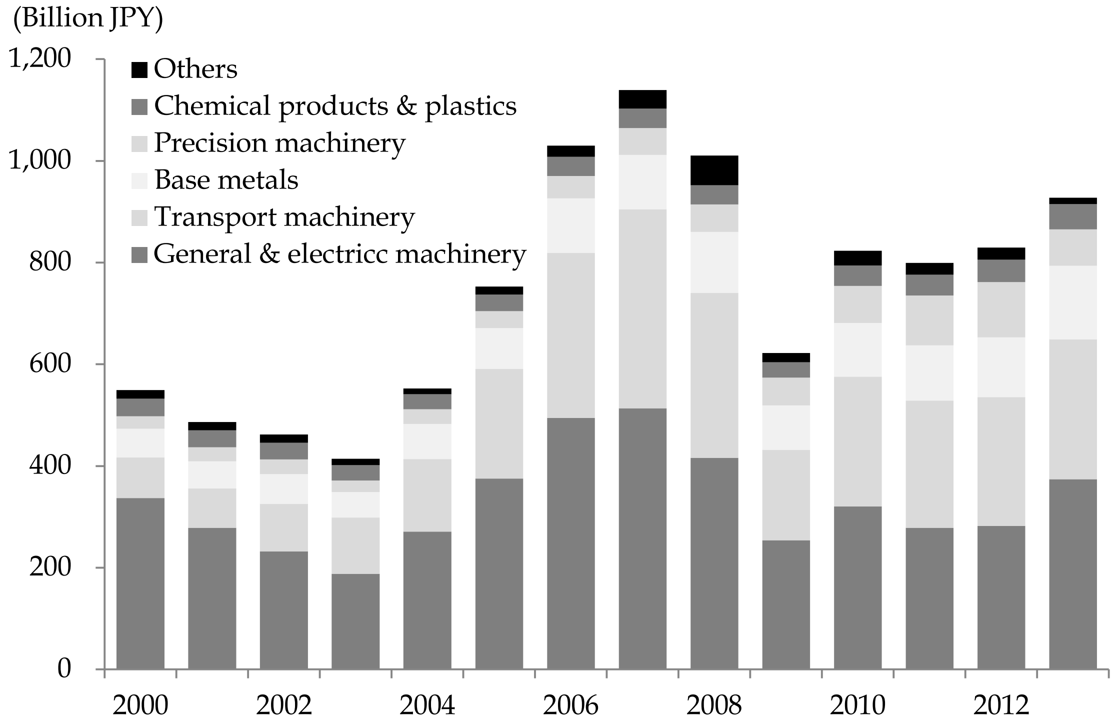
Figure 1: Japan's Exports to Mexico by Major Products




*Source*: *Trade Statistics of Japan,* Ministry of Finance.

Table 1: Patterns of Japanese Exports to Mexico in 2004 and 2006

| Category | Export Value in 2004 | | Export Value in 2006 | | No. of products |
|---|---|---|---|---|---|
| | billion JPY | % | billion JPY | % | HS 9-digit |
| Continuously exported products (yy) | 540.4 | 97.8% | 1,001.5 | 97.2% | 1,493 |
| Disappearing products (yn) | 12.2 | 2.2% | 0.0 | 0.0% | 348 |
| Newly exported products (ny) | 0.0 | 0.0% | 28.4 | 2.8% | 366 |
| Never exported products (nn) | 0.0 | 0.0% | 0.0 | 0.0% | 3,943 |
| Total | 552.6 | 100.0% | 1,030.0 | 100.0% | 6,150 |

Source: Computed from *Trade Statistics of Japan.*
*Notes*: yy: exported in 2004 and 2006, yn: exported in 2004 only, ny: exported in 2006 only, nn: never exported.

*Source*: Computed from *Trade Statistics of Japan,* Ministry of Finance.

Table 2: Patterns of Japanese Exports to Mexico by Products in 2004 and 2006 (No. of Products)

| HS Section | Category | | | | | Total |
|---|---|---|---|---|---|---|
| | yy | yn | ny | *yy+yn+ny* | nn | (HS 9-digit) |
| 1. live animals/animal products | 0 | 2 | 2 | *4* | 183 | 187 |
| 2. vegetable products | 2 | 0 | 2 | *4* | 222 | 226 |
| 3. animal/vegetable fats, oils, & waxes | 3 | 0 | 0 | *3* | 46 | 49 |
| 4. prepared foodstuffs, beverages, & tobacco | 15 | 5 | 8 | *28* | 185 | 213 |
| 5. mineral products | 5 | 6 | 5 | *16* | 142 | 158 |
| 6. products of the chemical or allied industries | 171 | 43 | 51 | *265* | 564 | 829 |
| 7. plastics & rubber | 121 | 19 | 26 | *166* | 105 | 271 |
| 8. raw hides and skins, leather | 4 | 2 | 1 | *7* | 88 | 95 |
| 9. wood, cork, & straw | 2 | 2 | 3 | *7* | 81 | 88 |
| 10. wood pulp wood, paper | 35 | 8 | 7 | *50* | 117 | 167 |
| 11. textiles | 72 | 44 | 50 | *166* | 921 | 1,087 |
| 12. footwear, umbrellas, etc. | 0 | 1 | 1 | *2* | 60 | 62 |
| 13. stone, cement, ceramic, & glass | 38 | 10 | 18 | *66* | 95 | 161 |
| 14. pearls, precious stones/metals | 2 | 6 | 1 | *9* | 55 | 64 |
| 15. base metals | 228 | 63 | 69 | *360* | 409 | 769 |
| 16. machinery and electrical equipment | 547 | 100 | 77 | *724* | 327 | 1,051 |
| 17. transport equipment | 43 | 6 | 13 | *62* | 136 | 198 |
| 18. optical, precision, & medicalinstruments | 157 | 23 | 13 | *193* | 106 | 299 |
| 19. arms and ammunition | 0 | 0 | 2 | *2* | 17 | 19 |
| 20. miscellaneous | 48 | 7 | 14 | *69* | 81 | 150 |
| 21. art/antiques | 0 | 1 | 3 | *4* | 3 | 7 |
| Total | 1,493 | 348 | 366 | *2,207* | 3,943 | 6,150 |

*Notes*: yy: exported in 2004 and 2006, yn: exported in 2004 only, ny: exported in 2006 only, nn: never exported.

*Source*: Authors' calculation from *Trade Statistics of Japan*, Ministry of Finance.

Table 3: Patterns of Japanese Exports to Mexico by Products in 2004 and 2006 (Export value, million yen)

| HS Section | yy | | | | yn | | ny | | nn | |
|---|---|---|---|---|---|---|---|---|---|---|
| | yy04 | yy06 | *yy06-yy04* | *yy06/yy04* | yn04 | yn06 | ny04 | ny06 | nn04 | nn06 |
| 1. live animals/animal products | 0 | 0 | *0* | | 12 | 0 | 0 | 21 | 0 | 0 |
| 2. vegetable products | 2 | 3 | *2* | *1.8* | 0 | 0 | 0 | 1 | 0 | 0 |
| 3. animal/vegetable fats, oils, & waxes | 6 | 13 | *7* | *2.1* | 0 | 0 | 0 | 0 | 0 | 0 |
| 4. prepared foodstuffs, beverages, & tobacco | 114 | 349 | *235* | *3.1* | 5 | 0 | 0 | 6 | 0 | 0 |
| 5. mineral products | 81 | 107 | *26* | *1.3* | 905 | 0 | 0 | 24 | 0 | 0 |
| 6. products of the chemical or allied industries | 11,980 | 13,702 | *1,722* | *1.1* | 272 | 0 | 0 | 801 | 0 | 0 |
| 7. plastics & rubber | 17,191 | 22,497 | *5,306* | *1.3* | 138 | 0 | 0 | 641 | 0 | 0 |
| 8. raw hides and skins, leather | 4 | 5 | *1* | *1.3* | 2 | 0 | 0 | 0 | 0 | 0 |
| 9. wood, cork, & straw | 15 | 8 | *-7* | *0.5* | 4 | 0 | 0 | 11 | 0 | 0 |
| 10. wood pulp wood, paper | 1,159 | 1,714 | *555* | *1.5* | 90 | 0 | 0 | 82 | 0 | 0 |
| 11. textiles | 1,494 | 2,145 | *651* | *1.4* | 250 | 0 | 0 | 234 | 0 | 0 |
| 12. footwear, umbrellas, etc. | 0 | 0 | *0* | | 2 | 0 | 0 | 1 | 0 | 0 |
| 13. stone, cement, ceramic, & glass | 3,634 | 10,833 | *7,198* | *3.0* | 18 | 0 | 0 | 607 | 0 | 0 |
| 14. pearls, precious stones/metals | 17 | 238 | *221* | *13.6* | 21 | 0 | 0 | 1 | 0 | 0 |
| 15. base metals | 64,006 | 103,873 | *39,867* | *1.6* | 5,009 | 0 | 0 | 3,456 | 0 | 0 |
| 16. machinery and electrical equipment | 265,806 | 492,696 | *226,890* | *1.9* | 4,917 | 0 | 0 | 2,094 | 0 | 0 |
| 17. transport equipment | 142,533 | 304,195 | *161,662* | *2.1* | 309 | 0 | 0 | 20,059 | 0 | 0 |
| 18. optical, precision, & medicalinstruments | 28,766 | 43,338 | *14,572* | *1.5* | 182 | 0 | 0 | 326 | 0 | 0 |
| 19. arms and ammunition | 0 | 0 | *0* | | 0 | 0 | 0 | 4 | 0 | 0 |
| 20. miscellaneous | 3,636 | 5,807 | *2,171* | *1.6* | 24 | 0 | 0 | 17 | 0 | 0 |
| 21. art/antiques | 0 | 0 | *0* | | 0 | 0 | 0 | 53 | 0 | 0 |
| Total | 540,444 | 1,001,524 | *461,080* | *40.9* | 12,160 | 0 | 0 | 28,440 | 0 | 0 |

*Notes*: yy: exported in 2004 and 2006, yn: exported in 2004 only, ny: exported in 2006 only, nn: never exported.
*Source*: Computed from *Trade Statistics of Japan*, Ministry of Finance.

Table 4: Simple Average Tariff Rates by Product Categories

| | MFN 2004 | MFN 2006 | JMXFTA 2006 | Margin 1 | Margin 2 |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (3) - (1) | (3) - (2) |
| ALL | 17.5% | 13.6% | 7.8% | -9.7% | -5.8% |
| Manufacturing | 16.1% | 13.2% | 7.4% | -8.7% | -5.7% |
| Machinery | 13.9% | 10.5% | 6.0% | -7.8% | -4.5% |
| Final | 14.5% | 10.9% | 6.3% | -8.2% | -4.5% |
| Parts & Components | 12.8% | 10.0% | 5.6% | -7.2% | -4.4% |

*Notes*: Definitions for "final" and "parts & components" goods are based on Kimura and Obashi (2010).
*Source*: Authors' calculation from UNCTAD TRAINS database.

Table 5: Summary Statistics

| Variable | Obs | Mean | S.D. | Min | Max |
|---|---|---|---|---|---|
| *dlnE* | 1,244 | -0.0069 | 0.1876 | -1.0986 | 1.0986 |
| *dlnI* | 1,244 | 0.1139 | 1.4124 | -8.4345 | 7.8301 |
| *dlnT* | 5,223 | -0.0825 | 0.0976 | -1.2809 | 0.2469 |
| *dlnTpr* | 5,223 | -0.0520 | 0.0803 | -0.5423 | 0.0024 |
| *dlnM* | 4,947 | 0.2031 | 0.8933 | -9.5795 | 7.8843 |
| *dlnw* | 5,223 | 0.0516 | 0.0568 | -0.2125 | 0.4592 |
| *dlnP* | 5,218 | 0.0930 | 0.0767 | -0.1225 | 0.4602 |

Table 6: Impacts of JMXFTA on Extensive and Intensive Margins (OLS)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | Extensive Margin (*dlnE*) | | | | Intensive Margin (*dlnI*) | | | |
| | OLS | OLS | OLS | OLS | OLS | OLS | OLS | OLS |
| *dlnT* | -0.0435 | | -0.0566 | | -0.922 | | -1.798** | |
| | (0.0916) | | (0.131) | | (0.626) | | (0.906) | |
| *dlnTpr* | | 0.00508 | | 0.0441 | | -1.288* | | -2.114** |
| | | (0.117) | | (0.168) | | (0.719) | | (0.940) |
| *dlnM* | -0.0150 | -0.0142 | -0.0381** | -0.0369** | 0.332*** | 0.327*** | 0.379*** | 0.375*** |
| | (0.0133) | (0.0133) | (0.0181) | (0.0179) | (0.102) | (0.102) | (0.126) | (0.124) |
| *dlnw* | -0.0354 | -0.00986 | -0.206 | -0.143 | -1.590* | -1.445* | -3.603*** | -3.166*** |
| | (0.130) | (0.122) | (0.139) | (0.132) | (0.826) | (0.755) | (1.383) | (1.208) |
| *dlnP* | 0.0279 | 0.0308 | 0.247** | 0.241** | 1.041** | 1.114** | 1.722** | 1.842** |
| | (0.0693) | (0.0692) | (0.106) | (0.106) | (0.496) | (0.494) | (0.755) | (0.760) |
| Product Coverage | ALL | ALL | Machinery | Machinery | ALL | ALL | Machinery | Machinery |
| Observations | 1,242 | 1,242 | 579 | 579 | 1,242 | 1,242 | 579 | 579 |
| R-squared | 0.001 | 0.001 | 0.022 | 0.022 | 0.024 | 0.025 | 0.036 | 0.036 |

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

Table 7: Impacts of JMXFTA on Extensive and Intensive Margins (Fixed-effects model)

| | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) |
|---|---|---|---|---|---|---|---|---|
| | Extensive Margin (*lnE*) | | | | Intensive Margin (*lnI*) | | | |
| VARIABLES | FE | FE | FE | FE | FE | FE | FE | FE |
| *lnT jpn* | 0.00889 | -0.123 | 0.0357 | -0.169 | -1.292* | -1.441* | -2.133** | -2.293** |
| | (0.115) | (0.114) | (0.161) | (0.171) | (0.718) | (0.813) | (0.946) | (1.095) |
| *lnT mfn* | -0.213 | -0.252 | -0.375 | -0.462 | 1.505 | 1.462 | 1.358 | 1.290 |
| | (0.237) | (0.239) | (0.324) | (0.317) | (1.413) | (1.404) | (1.717) | (1.701) |
| *lnM* | -0.0143 | -0.00978 | -0.0369** | -0.0284 | 0.327*** | 0.332*** | 0.375*** | 0.381*** |
| | (0.0134) | (0.0132) | (0.0181) | (0.0180) | (0.102) | (0.103) | (0.125) | (0.127) |
| *lnw* | -0.0640 | 0.0438 | -0.255* | -0.00131 | -1.388* | -1.267 | -3.423** | -3.224** |
| | (0.127) | (0.141) | (0.137) | (0.132) | (0.843) | (0.892) | (1.406) | (1.573) |
| *lnP* | 0.0151 | 0.101 | 0.225** | 0.296*** | 1.131** | 1.228** | 1.803** | 1.859** |
| | (0.0715) | (0.0794) | (0.110) | (0.112) | (0.504) | (0.576) | (0.760) | (0.767) |
| Constant | 0.817 | -0.0856 | 2.700** | 0.555 | 13.10* | 12.09 | 30.28*** | 28.60** |
| | (1.050) | (1.164) | (1.128) | (1.083) | (7.053) | (7.489) | (11.72) | (13.17) |
| Year Dummy | NO | YES | NO | YES | NO | YES | NO | YES |
| Product Coverage | ALL | ALL | Machinery | Machinery | ALL | ALL | Machinery | Machinery |
| Observations | 3,026 | 3,026 | 1,323 | 1,323 | 3,026 | 3,026 | 1,323 | 1,323 |
| R-squared | 0.002 | 0.008 | 0.026 | 0.040 | 0.025 | 0.025 | 0.036 | 0.036 |
| No. of Group | 1,784 | 1,784 | 744 | 744 | 1,784 | 1,784 | 744 | 744 |
| sigma_u | 0.307 | 0.304 | 0.393 | 0.376 | 2.331 | 2.305 | 2.256 | 2.236 |
| sigma_e | 0.133 | 0.133 | 0.129 | 0.128 | 0.992 | 0.992 | 0.977 | 0.978 |
| rho | 0.842 | 0.840 | 0.904 | 0.897 | 0.847 | 0.844 | 0.842 | 0.840 |

*Notes*: Robust standard errors are in parentheses. ***, **, and * indicate 1%, 5%, and 10% significance respectively. “Machinery” includes all the goods classified as part of general machinery (HS84), electric machinery (HS85), transport equipment (HS86-89), and precision machinery sectors (HS90-92).