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Did Anti-dumping Duties Really Restrict Import?: Empirical Evidence from the US, the EU, China, and India

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This paper studied the effects of anti-dumping measures on the imports to investigate whether the trade restriction effect of an anti-dumping duty is dominant. Our results indicate that a 1% increase in the anti-dumping duties decreases the import of the targeted product by about 0.43~0.51%. The actual statistics, however, show that the total import of the targeted products increased by about 30 percent while an anti-dumping duty was in force. That indicates that an anti-dumping duty is just a temporary import relief. This paper also investigated whether an anti-dumping duty is terminated in the case that the injury would not be likely to continue or recur if the duty were removed. The hazards model estimates show that increase in market share, MFN tariff rate, and dumping margin decrease the hazard of termination of an anti-dumping duty, but the increase in value added increases the hazard of termination. Generally speaking, this result indicates that the WTO member countries have regulated the overuse of an anti-dumping measure. The findings of this paper show that there is a country- and industry-wise heterogeneous characteristic in the effect as well as termination of an anti-dumping duty.

Keywords: Anti-dumping Duty, Trade Restriction Effect, Termination of an Anti-dumping Duty, Two-stage Model, Cox Proportional Hazards Model
JEL Classification: F10, F13, F14

I. INTRODUCTION

Since the global economic crisis of 2008, international trade communities have expressed concern about the rise of protectionism, as protectionist measures such as import restriction and tariff increase have been historically prevalent in the

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period of an economic slowdown.[1] Moreover, US President Donald Trump maintained a protectionist stance throughout his campaign. Specifically, he claimed that foreign countries were driving US products out of the domestic market by dumping underpriced products into the US market. He announced that he would use the powers of his presidency to increase tariff rates and accused China and Mexico of unfair trade practices.

Previous research has focused on the effects that anti-dumping duties have on import. Vandenbussche and Zanardi (2010) studied the effects of anti-dumping duties on bilateral trade from the period of 1980 to 2000, using the gravity model. They found that anti-dumping duties have a chilling effect on total import volume but that the effect varies by industry. Besedes and Prusa (2016) estimated the import reduction effects of anti-dumping duties using a random effects probit model. Their research indicated that the effects of US anti-dumping duties on trade are greater during the stage of investigation and preliminary decision than after actually reaching a final decision. They also found that it is difficult for the target countries to recover the previous level of trade after the termination of an anti-dumping duty. Bellora and Jean (2016) investigated the possible effects of anti-dumping cases on import volume and unit value in the event that the European Union granted market economy status (MES) to China. The study used European trade and tariff data from 1988 to 2015, indicating that European import from China would increase by 3.9% to 5.3%.

Lee (2009) compared the import reduction effects against the target countries and the import diversion effects on the third countries, showing that anti-dumping duties have import restricting effects. The study applied a random-effect GLS regression and a dynamic panel data methodology based on the Helpman, Melitz, and Rubinstein (2008) model to US data from 1990 to 1996. Park (2009) studies the effect of anti-dumping duties on import using Chinese data from 2002 to 2004, employing the Generalized Method of Moments (GMM) estimator. The results show that anti-dumping protection has significant trade depressing and trade diversion effects.

Most previous studies focus on only the import restriction effect of anti-dumping measures, dealing with a single country (Besedes and Prusa, 2016; Bellora and Jean, 2016; Lee, 2009; Park, 2009; Prusa, 1996; Blonigen, 2006). They fail to

[1] Refer to Choi (2016).

provide comparable results on the economic effects of an anti-dumping duty. In addition, they do not deal with recent trends, such as how investigations of anti-dumping duties have become prevalent in both developed and developing countries. Considering the ever-increasing political demands in the economic sector for an anti-dumping duty in major economies, we need to investigate whether this would be a protectionist measure or trade remedy.

In this respect, this paper will provide the answers to the following open questions. First, is the argument that anti-dumping duties exert a dominant trade restriction effect valid for all of the major countries? This paper investigates the effects of anti-dumping measures on the imports applying a two-stage methodology to the data on the US, the EU, China and India.

Second, are anti-dumping duties terminated in the case that "the injury would not be likely to continue or recur if the duty were removed"?[2] This paper analyzes the determinants of termination of an anti-dumping duty using the Cox proportional hazards model, thereby reviewing whether it is operated as a trade remedy measure within a certain period of time. This is the first study, to the best of our knowledge, to investigate the determinants of the termination of an anti-dumping duty.

Third, is there any country- and industry-wise heterogeneous characteristic in the effect and termination of an anti-dumping duty? This paper identifies whether the economic effects of anti-dumping measures depend on country and industry, using a two-way fixed effects model.

This paper is organized as follows. In Section 2, we review the WTO statistics on anti-dumping investigations in recent years. In Section 3, we investigate how dominant the trade effect of an anti-dumping duty is in the US, the EU, China, and India applying a two-stage approach. Section 4 analyzes what terminates an anti-dumping duty using Cox proportional hazards model. Section 3 and 4 also discuss the country- and industry-wise heterogeneous results using an interaction term between an independent variable and a dummy variable. Section 5 concludes.

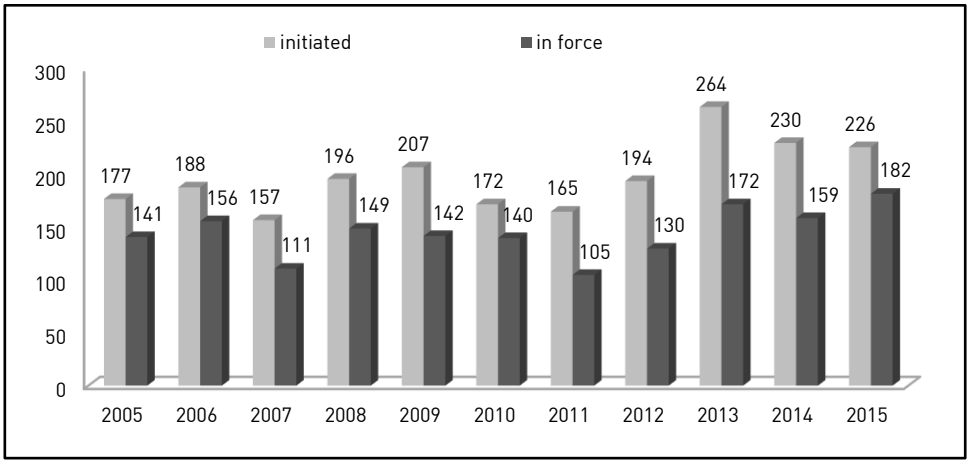
[2] Refer to WTO (2016b), Article 11.2.

II. RECENT TREND OF ANTI-DUMPING MEASURE

Trade remedy measures such as anti-dumping measures are widely known to be consistent with the WTO rules to cure unfair trade practices. However, they were also reputed to be "grey-area measures" in the sense that they were not efficiently controlled by the international trade regime before the Uruguay Round agreements came into effect in 1995. They have become WTO-consistent measures only since the WTO member countries agreed upon the WTO Anti-Dumping Agreement.

WTO statistics indicate that anti-dumping measures have been widely used to protect domestic industries in recent years. The number of initiated anti-dumping measures amounted to 177 in 2005 while 141 measures were in force. In 2015, the number of initiated anti-dumping measures amounted to 226 while 182 measures were in force.[3]

Figure 1. Anti-dumping Measures Initiated and in Force from 2005 to 2015



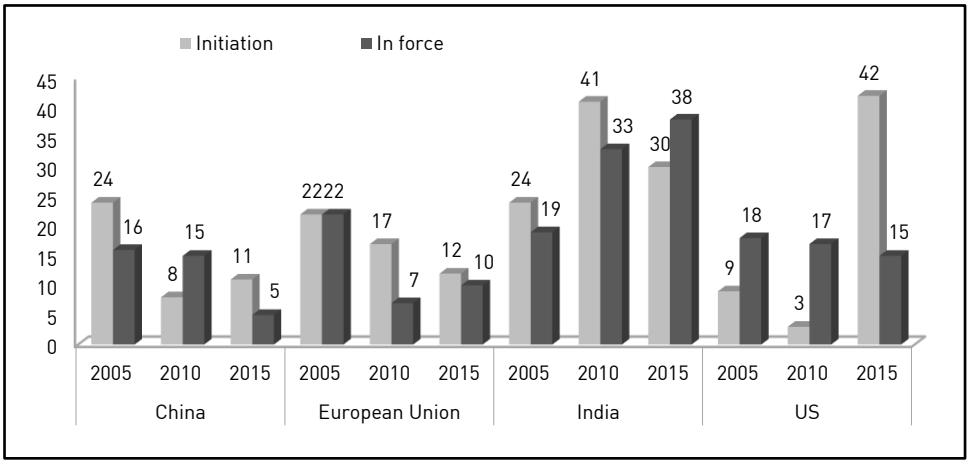
Source: WTO (2016a)

Before 1995, when the WTO anti-dumping agreement was in force, developed countries were the main users of such anti-dumping measures. Following the

[3] This paper uses the statistics provided by the WTO I-TIP Goods on non-tariff measures (NTMs).

introduction of anti-dumping regulations after 1995, however, the developing countries became the frequent users. The four countries of India, the European Union, the United States, and China were shown to be the most frequent initiators of anti-dumping measures.[4] The number of investigations in 2005 by India and China amounted to 24 each, followed by the European Union (22) and the US (9). In 2015, the number of US investigations amounted to 42, followed by India (30), the European Union (12), and China (11).

Figure 2. Anti-dumping Measures Initiated and in force by Major Country



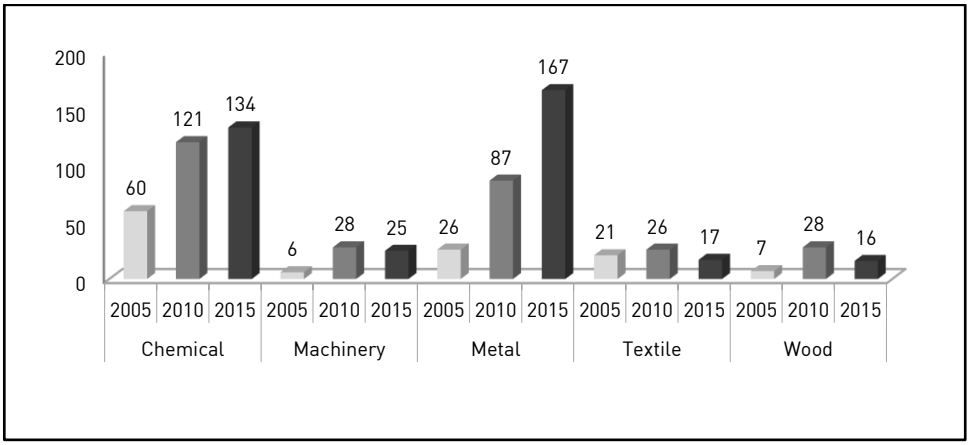
Source: WTO (2016a)

When we review the total sum of anti-dumping measures initiated and in force by industry,[5] the chemical and metal sectors turn out to be the main targets of anti-dumping measures along with the machinery, textile, and wood sectors. The number of anti-dumping measures initiated and in force targeting the metal sector amounted to 87 in 2005, followed by the chemical (60), textile (21), wood (7), and machinery (6) sectors. In 2015, however, the metal sector became the most frequent target (167), followed by the chemical (134), machinery (25), textile (17), and wood (16) sectors.

[4] We choose the four representative frequent user countries.

[5] The chemical sector covers the chemical (S06), the plastics, and the rubber industries (S07); Textile sector covers the textile (S11) and the footwear industries (S12) in the WTO I-TIP Goods database.

Figure 3. Anti-dumping Measures Initiated and in Force by Sector



Source: WTO (2016a)

III. EFFECT OF ANTI-DUMPIG DUTIES ON IMPORT

1. Model

This paper sets up the following basic estimation equation[6] in order to investigate the trade impacts of anti-dumping duties (Novy, 2013; Baier and Bergstrand, 2009; Baier et al., 2014; Helpman et al., 2008).

$$\log(IM_{k,l,i,t}) = \alpha + \beta_1 \log(DIST_{k,l}) + \beta_2 contig_{k,l} + \beta_3 comlang_{k,l} + \beta_4 colony_{k,l} +$$

$$\beta_5 AD_{k,l,i,t} + \beta_6 \log(M\_DIST_{k,l}) + \beta_7 \log(M\_contig_{k,l}) + \varepsilon_{k,l,i,t} \quad (3\text{-}1)$$

where IM denotes the import value of country k from county l for product i in year t; DIST represents the distance from country k to country l; contig, comlang, and colony represent the dummy variables for border contiguity, common language, and colonial relationship between the two countries, respectively; AD represents an anti-dumping duty.

[6] This paper excludes the GDP variable from the estimation equation. Refer to Helpman et al. (2008).

In this paper, we control for the bilateral resistance using the exporter and importer fixed effects. In addition, this paper accounts for the multilateral resistance suggested by Baier and Bergstrand (2009) and Bair et al. (2014) as follows.

$$M\_DIST = (\frac{1}{2N})\left(\sum_{j=1}^{N} DIST_{kj} + \sum_{j=1}^{N} DIST_{lj}\right)$$

$$M\_contig = (\frac{1}{2N})\left(\sum_{j=1}^{N} contig_{kj} + \sum_{j=1}^{N} contig_{lj}\right)$$

where N represents the number of countries.

To get consistent estimates, we need to address the endogeneity bias because the anti-dumping duties are affected by the import value. In addition, there is also the problem of sample selection related to cases where there is no import. This paper employs a two-stage estimation procedure in order to deal with the above-mentioned problems (Helpman et al., 2008; Santos Silva and Tenreyro, 2015; Lee, 2009; Choi et al., 2011). This paper defines the following latent variable for the first stage.

$$\omega_{k,l,i,t} = \delta_0 + \delta_1 \log(MFN\_TAR_{k,i,t}) + \delta_2 SHR\_IM_{k,l,i,t} + \delta_3 \log(VA_{k,i',t}) + \theta_{k,l,i,t} \qquad (3\text{-}2)$$

where MFN_TAR represents an applied MFN tariff rate of country k for product i, SHR_IM denotes the import market share of product i to the total import of country k, and VA represents the value added of industry i'[7] of country k. In the first stage of probit estimation, it is important to select the explanatory variables as the instrumental variables. This paper includes such explanatory variables as MFN tariff rate, import market share, and value added.[8]

We define the variable T which has a value of 1 when a country imposes anti-dumping duties and has a value of 0 when it does not impose them. We also define the probability of $p_{k,l,i,t}$ such that the country k imposes the anti-dumping duties against import of product i from country l at year t.

[7] This paper assumes that the product i belongs to the industry i'.

[8] Lee (2009) used the market share, tariff, capital/labor ratio, and trade balance among others. Refer to Lee (2009), p.11.

$p_{k,l,i,t}$ = Probability (T = 1 | observed variables)

$$= \varphi\{\kappa_0^* + \kappa_1^* \log(MFN\_TAR_{k,i,t}) + \kappa_2^* SHR\_IM_{k,l,i,t} + \kappa 3^* \log(VA_{k,i',t})\} \quad (3\text{-}3)$$

where $\varphi(\cdot)$ represents a cumulative density function with normal distribution, and the superscript * denotes the estimate of a parameter. We need to address the sample selection bias because our dataset covers the products which have been the targets of the anti-dumping duties. To this end, we obtain the conditional expected value of $\varepsilon_{k,l,i,t}$ in equation (3-1) when T = 1. The estimate of error term in equation (3-2), $\theta^* \equiv \theta/\sigma_\theta$, has normal distribution and $\widehat{\overline{\theta^*}} = \psi(\widehat{\theta^*})/\Phi(\widehat{\theta^*})$ is the consistent estimator of $\overline{\theta^*}$. We will add $\widehat{\overline{\theta^*}}$ as an independent variable into the estimation equation, thereby addressing the sample selection problem.

We need to address the endogeneity bias because the anti-dumping duties affect the import and are affected by the import itself. We estimate the independent variable, which seems to have endogeneity bias, using the instrument variables in the first step and then implement the estimation process using the estimate in the second step. In the second stage, this paper uses the estimate ($\widehat{\omega^*}$) in equation (3-2), the multinomial expansion of Helpman et al. (2008), the probability of anti-dumping duties ($p_{k,l,i,t}$), and the Mills ratio ($\widehat{\theta^*}$).

$$\begin{aligned}\log(IM_{k,l,i,t}) = {} & \alpha + \beta_1 \log(DIST_{k,l}) + \beta_2 contig_{k,l} + \beta_3 comlang_{k,l} + \beta_4 colony_{k,l} + \beta_5 AD_{k,l,i,t} + \\ & \beta_6 \log(M\_DIST_{k,l}) + \beta_7 \log(M\_contig_{k,l}) + \beta_8 p_{k,l,i,t} + \beta_9 \widehat{\omega^*} + \beta_{10} \widehat{\omega^*}^2 + \\ & \beta_{11} \widehat{\omega^*}^3 + \beta_{12}(\widehat{\theta^*}) + \varepsilon_{k,l,i,t} \end{aligned} \quad (3\text{-}4)$$

The error term in equation (3-4) is defined as follows.

$$\varepsilon_{k,l,i,t} = \mu_{k,l,i} + \lambda_t + \upsilon_{k,l,i,t} \quad (3\text{-}5)$$

where $\mu_{k,l,i}$ represents the unobserved individual effects of country k and product i; λ_t represents the time effect; $\upsilon_{k,l,i,t}$ is the remaining disturbance. $\mu_{k,l,i}$ is a time-invariant value; λ_t varies with time; $\upsilon_{k,l,i,t}$ is an ordinary disturbance which varies with country, product, and time.

For the panel data analysis, previous literature employs a one-way model for fixed effects and random effects, depending on the assumption that either

individual effects or time effects exist. This paper will employ a two-way model assuming that both individual and time effects exist.[9]

2. Data

This paper uses data on anti-dumping measures by the United States, the European Union, China, and India taken from the World Bank TTBD (Temporary Trade Barrier Database).[10] To investigate the effects of anti-dumping duties on imports, this paper uses the granular trade and tariff data on products which are submitted by the major countries to the Integrated Database of the WTO Secretariat. The US, the EU and China submitted 8 digit trade and tariff data to the IDB, and India reported 6 and 8 digits trade and tariff data. When we look into the TTBD, the four major countries reported various digits of anti-dumping products, as such: the US (6, 8, and 10 digit), the European Union and China (6 and 8 digit), and India (4, 6, 7, 8, and 12 digits). This paper investigates the effect of an anti-dumping duty on the import of the above-mentioned countries from the target countries. We concord the anti-dumping data to the tariff and trade data from 1996 to 2015, using the UN correspondence tables for the HS classifications including HS2012-HS2007, HS2012-HS2002, HS2012-HS1996, HS2007-HS2002 and HS2002-HS1996.

Table 1. Summary Statistics

Variable	Number of Observations	Mean	Standard Deviation	Minimum Value	Maximum Value
Log (import)	47,618	14.46	2.94	0.25	24.20
Distance	96,584	7,369.11	3,789.16	548.39	17,614.30
Contiguity	96,584	0.15	0.35	0	1.00
Common Language	96,584	0.34	0.47	0	1.00
Colony	96,584	0.20	0.40	0	1.00
Anti-dumping Duty	50,573	46.15	65.20	0	1,069.00

Source: Author's calculation.

[9] Jochmans (2015) reports the estimates on distance, border, language, colonial past, and free trade agreement using a two-way model for gravity. Refer to Jochmans (2015), p. 21.

[10] Refer to Bown (2016).

The data on the gravity variables including distance, border, cultural contiguity, colonial relationship are obtained from the CEPII database, while the GDP data was retrieved from the World Bank database. For the industry data, we collect the data on value added, fixed capital formation, labor employment from the Socio Economic Accounts (SEA) of the World Input Output Database (Timmer et al., 2015).

3. Estimation Results

We implement the probit analysis in the first step to deal with the instrumental variables. This paper uses the MFN tariff rates along with the market share, capital/labor ratio, and value added of an industry. The market share and MFN tariff rate are the granular data in HS 8 digit while the data on capital/labor ratio and value added are collected on an industry level.

When we review the results for the probit analysis in Table 2, the market share, MFN tariff rate, and value added turned out to be statistically significant while the capital/labor ratio is not significant. The signs of parameters are consistent with our expectations that the larger import market share a target product takes, the higher the probability of anti-dumping duties is.

Table 2. Probit Regression

Dependent Variable: Probability of Anti-dumping Duties

	(1)	(2)	(3)	(4)
Intercept	0.10 (7.44)***	0.08 (4.51)***	1.43 (19.31)***	0.30 (2.63)**
Market Share	0.24 (6.81)***	0.35 (9.71)***	0.28 (9.08)***	0.26 (6.15)***
Log (MFN Tariff)	0.19 (27.90)***			0.18 (20.21)***
Log (Capital/Labor Ratio)		-0.00 (0.44)		
Log (Value Added)			-0.11 (17.88)***	-0.02 (2.12)*
Number of Observations	23,324	26,747	35,526	17,626
Log Likelihood	893.74	95.78	457.98	746.44

Source: Author's calculation.

Note (1): The numbers in parentheses denote the t-statistics. ***, **, and * represent the levels of 0.1 percent, 1 percent, 5 percent, respectively.

The MFN tariff rate is expected to increase the probability of anti-dumping duties as the higher MFN tariff rate is, the more the protection of a product is strengthened. Previous studies used the data on antidumping duties only to estimate the effect on import, but did not use the MFN tariff data. This paper captures the relative effects of anti-dumping duties because the third countries pay the MFN applied tariff. On the other hand, the increase in the value added of an industry is expected to decrease the probability of anti-dumping duties. A sign of the parameter for capital/labor ratio is expected to depend on the industrial structure of a country, which turned out to be statistically insignificant. For the second-stage estimation, this paper uses the estimate of the probability of anti-dumping duties using such independent variables as market share, MFN tariff rate, and value added. We also use the estimate of ω and the multinomial expansion by Helpman et al. (2008), which can be derived from the results of Table 2.

This paper employs the two-way fixed effects model to estimate the equation (3-4). Table 3 reports the results for the two-way random effects and fixed effects models. The two-way random effects model indicates that distance and common language have positive effects on bilateral import which are consistent with the expectations of a general gravity model. The variables including contiguity and colony have negative effect on import partly because this paper treats the 29 EU countries as one trading unit. The signs of parameters for multilateral distance (M_DIST) and contiguity (M_contig) turned out to be statistically significant. When we implement the two-stage process to address the sample selection and endogeneity biases, the gravity variables and multilateral resistance variables including log (M_DIST) and M_contig turned out to be consistent with our expectations and statistically significant except for the colony dummy variable. The endogeneity bias terms in polynomial forms ($\widehat{\omega^*}$, $\widehat{\omega^*}^2$, $\widehat{\omega^*}^3$), and the inverse Mills ratio ($\widehat{\theta^*}$) turned out to be statistically significant, which means that a two-stage process is appropriate to address the two biases. The sign for probability of anti-dumping duties ($p_{k,l,i,t}$) turned out to be consistent with our expectation that the bilateral import from the target country decreases with the probability that it will be a target of anti-dumping duties. The t-statistic for $p_{k,l,i,t}$, however, turned out to be statistically insignificant.

Table 3. Two-Way Random and Fixed Effects Regression

Dependent Variable: Log (import)

	Random Effects		Fixed Effects	
	(1)	(2)	(3)	(4)
Intercept	39.72 (2.84)	927.63 (4.38)*	264.38 (6.49)***	1,233.73 (0.03)
Log (Distance)	-0.45 (8.19)***	-0.50 (7.35)***	-0.58 (9.58)***	-0.63 (8.30)***
Contiguity	-0.94 (10.83)***	-1.04 (9.2)***	-0.84 (9.30)***	-1.03 (8.68)***
Common Language	0.27 (3.24)*	0.47 (4.86)***	0.24 (2.81)**	0.45 (4.51)***
Colony	-0.19 (1.93)	-0.22 (1.52)	-0.13 (1.31)	-0.26 (1.72)
Log (Anti-Dumping Duties)	-0.44 (18.77)***	-0.50 (15.4)***	-0.43 (18.65)***	-0.51 (15.59)***
Log (M_DIST)	-2.29 (1.49)	-1.83 (1.27)	-26.55 (5.99)***	-28.16 (4.60)***
M_contig	10.47 (1.30)	24.71 (2.14)	-198.92 (5.62)***	-1,281.24 (0.00)
$\widehat{\omega^*}$		-1756.46 (4.44)***		-1,829.54 (4.62)***
$\widehat{\omega^*}^2$		1323.81 (4.68)***		1,374.34 (4.85)***
$\widehat{\omega^*}^3$		-364.75 (4.91)***		-377.56 (5.07)***
Mills ratio ($\widehat{\theta^*}$)		-192.75 (3.96)***		-201.80 (4.14)***
Probability of Anti-dumping Duties ($p_{k,l,i,t}$)		8.51 (1.55)		9.42 (1.72)
Number of Observations	24,661	9,966	24,661	9,966
Log Likelihood	119,915	46,723	119,574	46,462

Source: Author's calculation.

Note (1): The numbers in parentheses denote the t-statistics. ***, **, and * represent the levels of 0.1 percent, 1 percent, 5 percent, respectively.

A two-way fixed effects model reports the estimates for the individual effects including distance, contig, comlang, and colony, differently from a one-way fixed

effects model. The results are similar to the random effects model. But the multilateral resistance variables including log (M_DIST) and M_contig turned out to be statistically significant, differently from the two-way random effects model. The t-statistic for the probability of anti-dumping duties ($p_{k,l,i,t}$) is statistically significant at the level of 10 percent, and consistent with our expectations. This result indicates that the two-way fixed effects model explains the determinants of the bilateral import better than the two-way random effects model. The magnitude of the parameter of log of anti-dumping duties turned out to be -0.43 to -0.51 in equation (3) and (4) of Table 3. That means that a 1% increase in the anti-dumping duties decreases the import from the targeted countries by about 0.43-0.51%.

This result demonstrates the characteristic of the anti-dumping duties as protection measures (Vandenbussche and Zanardi, 2010). If import diversion effects on the third country are greater than import reduction effects on the target country, then an anti-dumping duty possibly does not decrease the total imports from all trading partners. According to the Integrated Database of the WTO Secretariat, however, the actual statistics show that the total import of the targeted products increased by about 30 percent while an anti-dumping duty was in force. That indicates that an anti-dumping duty is just a temporary import relief.

However, the economic rationale behind the policy effectiveness depends on country and industry. In this context, this paper studies how heterogeneous the effect of an anti-dumping duty is at the country and industry levels. Table 4 shows the results on the effect of anti-dumping duties by countries, indicating that the magnitude of import restriction effect is different by countries. In the case of the US, it ranges from -0.27 to -0.30 while the magnitudes for the European Union, China, and India turned out to be -0.38 to -0.50, -1.22 to -1.40, -0.49 to -0.52, respectively. This means that the import restriction effects are the greatest in the case of China, followed by India, the EU, and the US.

Table 5 indicates that the magnitude of the parameter of log (anti-dumping duties)*(industry dummy) is the greatest in case of metal (-0.24 to -0.43) followed by wood (-0.16 to -0.51), chemical (-0.21 to -0.27), and textile (-0.15 to -0.23). On the other hand, the sign for the machinery industry turned out to be positive, which is not consistent with our expectations. This implies that the anti-dumping measures do not affect the trade in machinery possibly because the machinery industry is located in the upstream part of global value chains (Bown and McCulloch, 2012).

Table 4. Import Effect by Country Using Two-Way Model

Dependent Variable: Log (import)

	Random Effects		Fixed Effects	
	(1)	(2)	(3)	(4)
Intercept	43.29 (2.81)	284.73 (6.93)***	1,300.86 (0.03)	1,307.06 (0.04)
Log (distance)	-0.45 (8.14)***	-0.59 (9.74)***	-0.62 (8.13)***	-0.62 (8.15)***
Contiguity	-0.86 (9.57)***	-0.72 (7.71)***	-0.90 (7.31)***	-0.90 (7.32)***
Common Language	0.25 (2.97)**	0.21 (2.49)*	0.41 (4.09)***	0.41 (4.07)***
Colony	-0.22 (2.23)*	-0.17 (1.64)	-0.21 (1.41)	-0.22 (1.43)
Log (Anti-dumping Duties) *USA Dummy	-0.29 (9.44)***	-0.27 (8.74)***	-0.30 (5.49)***	-0.30 (5.51)***
Log (Anti-dumping Duties) *EU Dummy	-0.50 (10.32)***	-0.49 (9.99)***	-0.38 (4.76)***	-0.38 (4.74)***
Log (Anti-dumping Duties) *China Dummy	-1.22 (13.26)***	-1.25 (13.47)***	-1.40 (13.69)***	-1.40 (13.69)***
Log (Anti-dumping Duties) *India Dummy	-0.49 (11.44)***	-0.52 (12.07)***	-0.52 (11.06)***	-0.52 (11.07)***
Log (M_DIST)	-2.60 (1.56)	-28.86 (6.45)***	-28.21 (4.58)***	-28.58 (4.64)***
M_contig	9.26 (0.66)	-190.32 (5.33)***	-1490.32 (0.00)	-1480.17 (0.00)
$\widehat{\omega^*}$			-1945.42 (4.93)***	-1959.62 (4.96)***
$\widehat{\omega^*}^2$			1468.16 (5.19)***	1472.20 (5.21)***
$\widehat{\omega^*}^3$			-404.69 (5.45)***	-404.34 (5.45)***
Mills ratio ($\widehat{\theta^*}$)			-217.56 (4.48)***	-216.12 (4.45)***
Probability of Anti-dumping Duties ($p_{k,l,i,t}$)				8.94 (1.64)
Number of Observations	24,661	24,661	9,966	9,966
Log Likelihood	119,818	119,640	46,372	46,369

Source: Author's calculation.

Note (1): The numbers in parentheses denote the t-statistics. ***, **, and * represent the levels of 0.1 percent, 1 percent, 5 percent, respectively.

Table 5. Import Effect by Industry Using Two-Way Model

Dependent Variable: Log (import)

	Random Effects		Fixed Effects	
	(1)	(2)	(3)	(4)
Intercept	47.56 (2.81)	-19.37 (0.00)	12.58 (0.00)	78.73 (0.01)
Log (distance)	-0.58 (11.59)***	-0.65 (12.01)***	-0.64 (8.99)***	-0.64 (8.97)***
Contiguity	-0.34 (4.37)***	-0.28 (3.58)**	-0.46 (4.39)***	-0.51 (4.81)***
Common Language	0.47 (5.96)***	0.46 (5.69)***	0.64 (6.56)***	0.67 (6.83)***
Colony	-0.37 (4.32)***	-0.36 (4.12)***	-0.13 (1.01)	-0.09 (0.74)
Log (Anti-dumping Duties) *Textile Dummy	-0.15 (7.24)***	-0.15 (7.16)***	-0.19 (7.08)***	-0.23 (8.31)***
Log (Anti-dumping Duties) *Wood Dummy	-0.16 (3.54)**	-0.16 (3.40)**	-0.47 (5.33)***	-0.51 (5.80)***
Log (Anti-dumping Duties) *Chemical Dummy	-0.21 (14.83)***	-0.21 (14.97)***	-0.25 (14.11)***	-0.27 (15.18)***
Log (Anti-dumping Duties) *Metal Dummy	-0.43 (39.80)***	-0.43 (39.81)***	-0.24 (12.34)***	-0.27 (13.44)***
Log (Anti-dumping Duties) *Machinery Dummy	0.19 (6.95)***	0.19 (6.91)***	0.20 (5.11)***	0.18 (4.43)***
Log (M_DIST)	-3.13 (1.68)	-14.55 (3.78)**	-13.24 (2.35)*	-13.74 (2.44)*
M_contig	14.84 (1.53)	9614.64 (0.01)	430.67 (0.00)	604.94 (0.00)
$\widehat{\omega^*}$			128.67 (0.36)	2.46 (0.01)
$\widehat{\omega^*}^2$			-7.47 (0.03)	85.40 (0.34)
$\widehat{\omega^*}^3$			-20.73 (0.31)	-45.60 (0.68)
Mills ratio ($\widehat{\theta^*}$)			41.94 (0.097)	27.98 (0.65)
Probability of Anti-dumping Duties ($p_{k,l,i,t}$)				1.30 (5.90)***
Number of Observations	30,916	30,916	12,658	12,658
Log likelihood	15,003	149,645	59,760	59,725

Source: Author's calculation.

Note (1): The numbers in parentheses denote the t-statistics. ***, **, and * represent the levels of 0.1 percent, 1 percent, 5 percent, respectively.

IV. SURVIVAL ANALYSIS OF ANTI-DUMPING DUTIES

1. Introduction

As an anti-dumping duty has a restriction effect on import, it is a protection measure. But the trade remedy measures such as anti-dumping duties and safeguard are consistent with the WTO agreement, and they are supervised according to the WTO Anti-Dumping Agreement that "an anti-dumping duty shall remain in force only as long as and to the extent necessary to counteract dumping which is causing injury."[11] Article 11.2 of the WTO Anti-Dumping Agreement also stipulates that "the authorities shall review the need for the continued imposition of the duty after a reasonable period of time has elapsed." Article 11.3 stipulates that "any anti-dumping duty shall be terminated on a date not later than five years from its imposition unless the authorities determine that the expiry of the duty would be likely to lead to continuation or recurrence of dumping and injury."

Article 11 is a legal framework to address the overuse of an anti-dumping measure. If Article 11 is followed by the member countries in the letter and spirit of the WTO agreement, then the operation of anti-dumping duties can be effectively controlled by the international trading system which aims to prevent protectionist trade actions. This paper studies the determinants of the survival/hazard of an anti-dumping duty using the independent variables related to continuation or recurrence of dumping and injury, such as value added, market share, MFN tariff rate, and dumping margin, among others.

2. Model and Data

This paper investigates what terminates the anti-dumping duties. According to Article 11 of the WTO Anti-Dumping Agreement, "an anti-dumping duty shall be terminated unless the expiry of the duty would be likely to lead to continuation or recurrence of dumping and injury." This implies that the termination of an anti-dumping duty is highly dependent on the variables related to continuation or recurrence of dumping and injury. This paper focuses on the variables related to

[11] Refer to WTO (2016b), Article 11.1.

continuation or recurrence of injury such as value added, market share, MFN tariff rate, and dumping margin.

This paper uses a survival/hazard model to explain the duration period of an anti-dumping duty. If the survival model explains the duration period of an anti-dumping duty, then it implies that the authorities have regulated the overuse of the anti-dumping duty. At the same time, though, it also indicates that an anti-dumping duty can be operated as a trade remedy with the temporary effects of import restriction. Specifically, this paper uses a Cox proportional hazards model to investigate the likelihood that an anti-dumping duty will be terminated in the next very small period of time, and what the determinants are for the survival/hazard of an anti-dumping duty. The dependent variable (duration of an anti-dumping duty) is assumed to have a continuous probability distribution.

$$F(t / X) = probability\ (Duration \leq t) = \int_0^t f(s)ds \tag{4-1}$$

where duration represents the duration of an anti-dumping duty, X represents the independent variables, and t represents a specific time.

Then the survival function, *S(t)*, is the probability that the duration is greater than t, as follows.

$$S(t / X) = 1 - F(t / X) = probability\ (Duration > t) \tag{4-2}$$

The hazard function describes the risk that an anti-dumping duty is terminated in the interval at time t as follows. It is the probability function conditional on an anti-dumping duty remaining in force until time t. This paper employs the Cox proportional hazards model as follows.

$$h(t / X) = \frac{f(t/X)}{1 - F(t / X)} = = \frac{f(t/X)}{S(t / X)}$$
$$= \mathrm{h(t)} \exp(\beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n) \tag{4-3}$$

The hazard function describes the instantaneous risk that an anti-dumping duty is terminated in the interval at time t, as follows. It is the probability function conditional on an anti-dumping duty remaining in force until time t, which has the survival function as the denominator. If the sign of the parameter, β_i, turns out to be positive, then this means that the greater the value of β_i is, the smaller

the risk of the termination of an anti-dumping duty becomes. Specifically, this paper sets up the following Cox proportional hazards model (Smith et al., 2003; Besedes and Prusa, 2016).

$$\text{duration survival\_dummy}(0) = \exp\left[\left[\beta_1\, rate\ of\ change\ in\ value\ added + \beta_2\, rate\ of\ change\ in\ market\ share + \beta_3\, rate\ of\ change\ in\ MFN\ tariff\ rate + \beta_4 \log(dumping\ margin)\right]\right] \quad (4\text{-}4)$$

This paper focuses on the period from 2002 to 2015, when anti-dumping measures were prevalently used by many countries. Data was collected on anti-dumping measures by the four countries of the US, the EU, China, and India from the World Bank Database. Data on HS 8 digit trade and MFN tariff in the IDB was used, and the Socio Economic Accounts (SEA) of the World Input Output Database was used to create the industry-level data on value added.

Table 6. Summary Statistics for Survival Analysis

	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Survival Dummy	3,559	0.25	0.43	0	1.00
Duration	3,559	4.65	2.90	0	12.00
Rate of Change in Value Added	2,166	0.29	0.48	-0.27	2.98
Rate of Change in Market Share	2,093	7.44	107.45	-0.99	4,239.78
Rate of Change in MFN Tariff Rate	1,694	-0.08	0.32	-1.00	2.00
Log (Anti-dumping Duty)	2,803	3.43	1.02	0.80	6.10

Source: Author's calculation.

The duration is calculated by subtracting the year when an anti-dumping duty is imposed from the year of termination. This paper assigns a value of 1 to the event that an anti-dumping duty is terminated, and a value of 0 to the event that it remains in force until 2015. Thus the survival dummy variable has a value of 0 or 1. It calculates the rate of change in value added, market share, and MFN tariff rate during the period when an anti-dumping duty was in force. The market share is calculated by dividing the bilateral import to total import. The dumping margin is represented by an anti-dumping duty rate.

3. Estimation Results

The signs of all parameters turned out to be consistent with the expectations (see Table 7). A sign for the rate of change in value added turned out to be positive, which means that the increase in value added increases the hazard of termination for an anti-dumping duty. In other words, an anti-dumping duty would have a shorter duration and there would be higher probability of termination for an anti-dumping duty, if value added improves. The signs for market share, MFN tariff rate, and dumping margin (anti-dumping duty rate) turned out to be negative. It indicates that an anti-dumping duty would have a longer duration and there would be smaller probability of termination for an anti-dumping duty, if the market share and the MFN tariff rate of target product increase. It also shows that the probability of termination would be smaller, if a dumping margin was high.

Table 7. Hazards Regression Using Pooled Data

Dependent Variable: Hazard Function (Cox Model)

	(1)	(2)	(3)	(4)	(5)
Rate of Change in Value Added	0.26 (7.56)**	0.97 (1080.47)***	0.89 (61.69)***	0.93 (97.55)***	0.86 (55.48)***
Rate of Change in Market Share	-0.01 (3.26)***		-0.00 (0.36)		-0.00 (0.42)
Rate of Change in MFN Tariff Rate		-1.00 (12.08)**	-0.70 (3.99)*	-0.99 (11.03)**	-0.75 (4.49)*
Log (Anti-dumping Duty)				-0.00 (0.01)	-0.19 (2.99)
Number of Observations	1,601	1,050	754	926	662
Log Likelihood	5,101.9	1,867.5	1,202.4	1,858.5	1,191.7

Source: Author's calculation.

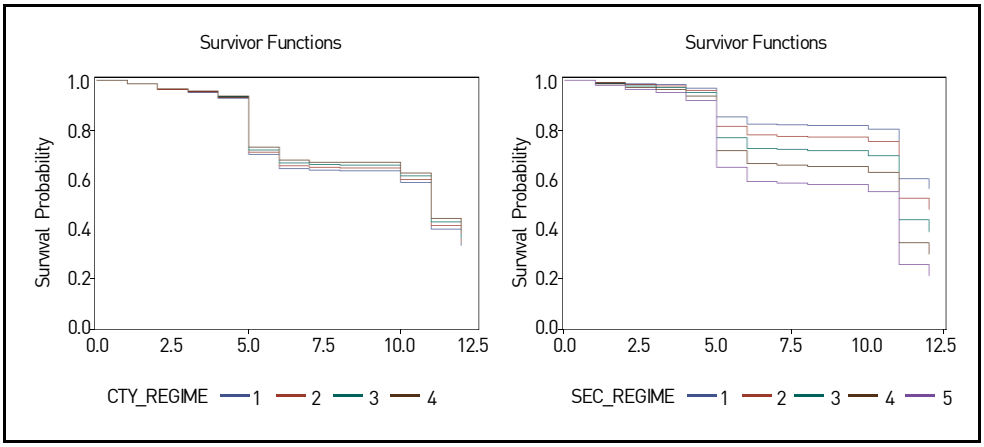
Note: The numbers in parentheses denote the chi-square statistics. ***, **, and * represent the levels of 0.1 percent, 1 percent, 5 percent, respectively.

Generally speaking, this result indicates that the WTO member countries have regulated the overuse of an anti-dumping measure, following Article 11 of WTO Agreement. According to the WTO agreement, "any anti-dumping duty shall be terminated on a date not later than five years from its imposition, unless the

authorities determine its extension,"[12] and these anti-dumping duties are reviewed every five years in the case of the US, the EU, China, and India.[13]

The survivor functions in Figure 4 show how long an anti-dumping duty remains in force. The left-hand and right-hand side figures depict the survivor function of countries and industries, respectively. The left-hand side figure reveals that an anti-dumping duty remains in force in the India for the longest period, followed by China, the US, and the EU, while the right-hand side figure shows that the duration period is the longest in the textile industry, followed by the chemical, wood, metal, and machinery industry.

Figure 4. Survivor Function by Country and Sector Regimes



Source: Author's calculation.

Note: CTY_REGIME represents USA (1), European Union (2), China (3), and India (4), respectively, while SEC_REGIME denotes Textile (1), Chemical (2), Wood (3), Metal (4), and Machinery (5) sector, respectively.

This paper focuses on the country-wise heterogeneous characteristics, using the interaction terms of an independent variable and a country dummy variable such as (rate of change in value added)*(US dummy) to implement a survival analysis at the country level (see Table 8). The sign for the interaction term of rate of change in market share and country dummy turns out to be consistent with

[12] Ibid., Article 11.3.

[13] The number of the terminated anti-dumping cases in case of the US, the EU, China, and India takes 16%, 39%, 41%, and 31% out of the total number of investigation cases, respectively.

our expectations, but the estimate is statistically insignificant for all countries. The results for value added, MFN tariff rate, and anti-dumping duty rate were mixed in terms of the signs and statistical significance.

Table 8. Cox Proportional Hazards Regression by Country

	(1)	(2)	(3)	(4)
Rate of Change in Value Added	-3.74	0.32	4.32	3.92
*US Dummy	(15.17)***	(0.04)	(15.27)***	(3.53)
Rate of Change in Value Added	0.35	-	-2.10	-
*EU Dummy	(0.46)		(16.87)***	
Rate of Change in Value Added	0.34	0.90	0.20	-0.51
*China Dummy	(16.36)***	(84.96)***	(3.00)	(14.06)**
Rate of Change in Value Added	-1.59	-4.29	2.45	-3.49
*India Dummy	(17.18)***	(67.07)***	(54.525)***	(30.76)***
Rate of Change in Market Share	-0.00			
*US Dummy	(0.01)			
Rate of Change in Market Share	-0.00			
*EU Dummy	(0.06)			
Rate of Change in Market Share	-0.04			
*China Dummy	(0.68)			
Rate of Change in Market Share	-0.03			
*India Dummy	(2.17)			
Rate of Change in MFN Tariff Rate		-1.15		-1.76
*US Dummy		(4.70)*		(7.57)**
Rate of Change in MFN Tariff Rate		-		-
*EU Dummy				
Rate of Change in MFN Tariff Rate		0.76		4.55
*China Dummy		(3.53)		(73.03)***
Rate of Change in MFN Tariff Rate		-10.10		-10.24
*India Dummy		(166.64)***		(119.45)***
Anti-dumping Duty Rate			-0.76	-0.14
*US Dummy			(70.63)***	(1.00)
Anti-dumping Duty Rate			-0.05	-
*EU Dummy			(0.87)	
Anti-dumping Duty Rate			-0.13	1.29
*China Dummy			(2.70)	(61.87)***
Anti-dumping Duty Rate			-0.94	0.02
*India Dummy			(90.35)***	(0.02)
Number of Observations	1,601	3,559	1,961	926
Log Likelihood	5,037.6	1,764.8	7,057.4	1,632.9

Source: Author's calculation.

Note (1): The numbers in parentheses denote the chi-square statistics. ***, **, and * represent the levels of 0.1 percent, 1 percent, 5 percent, respectively.

This result seems to be partly because the authorities consider various factors except the value added, the market share, the MFN tariff rate, and the dumping margin in their determination of termination. Thus it becomes a complicated issue to find a noticeable characteristic that can be applied to all countries. They could possibly be utilizing the value added, market share, MFN tariff rate, and dumping margin as just auxiliary references in their review processes.

It also reveals that there are no transparent and legal criteria available to terminate an anti-dumping duty. The current WTO Anti-Dumping Agreement deals with many articles related to (i) evidence of dumping actions by the exporters, (ii) material injuries to domestic industries, and (iii) causal relationship between dumping actions and industry injuries. In order to terminate an anti-dumping duty in the case that "the injury would not be likely to continue or recur if the duty were removed,"[14] WTO members need to improve the review process of examining whether "the continued imposition of the duty is necessary to offset dumping."[15]

V. CONCLUDING REMARKS

This paper studied the effects of anti-dumping measures on the imports to investigate how dominant the trade restriction effect of an anti-dumping duty is in the US, the EU, China, and India from 1996 to 2015. Our results indicate that a 1% increase in the anti-dumping duties decreases the import of the targeted product by about 0.43~0.51%. The actual statistics, however, show that the total import of the targeted products increased by about 30 percent while an anti-dumping duty was in force. That indicates that an anti-dumping duty is just a temporary import relief. In this respect, we need to check if an anti-dumping duty has been controlled by the WTO rules.

To this end, this paper investigated whether an anti-dumping duty is terminated in the case that "the injury would not be likely to continue or recur if the duty were removed."[16] The increase in market share, MFN tariff rate, and dumping margin turns out to decrease the hazard of termination of an anti-dumping duty, but

[14] Ibid., Article 11.2.
[15] Ibid., Article 11.2.
[16] Ibid., Article 11.2.

the increase in value added increases the hazard of termination. Generally speaking, this result indicates that the WTO member countries have regulated the overuse of an anti-dumping measure, following Article 11 of WTO Agreement. It also implies that anti-dumping duties have been used as a tool for trade remedy.

The findings of this paper show that there is a country- and industry-wise heterogeneous characteristic in the effect as well as termination of an anti-dumping duty. Specifically, the import reduction effects are the greatest in the case of China, followed by India, the EU, and the US. The industry-wise results imply that the anti-dumping measures in the machinery sector do not affect trade transactions, partly because it is located in the upstream part of global value chains. These results require a cautious reasoning because there was a significant financial turbulence during the tested period. Generally speaking, however, our findings confirm that anti-dumping protection has a heterogeneous effect on domestic firms (Konings and Vandenbussche, 2013). In the case of the survival analysis by country, it is complicated to find a noticeable characteristic to be applied to all countries. This seems to be possibly because the authorities consider many economic as well as political factors to identify recovery from industrial injury.

To conclude, an anti-dumping duty is not necessarily a protectionist measure if it is effectively controlled by the WTO rules. In this sense, the WTO member countries need to introduce a more transparent mechanism and due process, in order to impose anti-dumping duties not as a protectionist measure but as a trade remedy. Specifically, WTO members need to improve the review process and terminate anti-dumping duties in the letter and spirit of the WTO agreement.

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