Antidumping Policies in Intermediate Good Markets

Ping-Shin Kuo

Department of Economics, National Dong Hwa University, Hualien, Taiwan

Yan-Shu Lin

Department of Economics, National Dong Hwa University, Hualien, Taiwan

and

Cheng-Hau Peng[†]

Department of Economics, Fu Jen Catholic University, Taipei, Taiwan

(This version: 2016/1/13)

Abstract

This paper employs a vertically-related model to examine the protection and welfare effects of antidumping (AD) duty and price undertaking policies on intermediate good markets. We assume that the intermediate products are identical but the final products are horizontally differentiated. Findings show that, comparing to free trade, imposing AD duty on intermediate good market increases the profits of the domestic upstream firm and industry and welfare at the expense of profit of the domestic downstream firm, consumer surplus and world welfare. By contrast, a price undertaking policy always hurts domestic downstream firm, it benefits the domestic upstream firm, industry, consumers, welfare and world welfare if the degree of product differentiation of the final products is large. It is also found that an AD duty is superior (inferior) to a price undertaking policy in terms of world welfare and industrial profitability if the degree of product differentiation is small (large). However, an AD duty is more desirable than a price undertaking from the perspective of the domestic government. Finally, if the foreign upstream firm can choose between the two policies, it always prefers price undertaking to AD duty.

Keywords: Antidumping policies, Vertically-related markets, Social Welfare

JEL Classification: F12, F13

[†] Correspondence: Department of Economics, Fu Jen Catholic University, 510 Chung Cheng Road, Hsinchuang District, New Taipei City 24205, Taiwan. Tel: +886-2-2905-2876; E-mail: chpon@mail.fju.edu.tw .

Antidumping Policies in Intermediate Good Markets

1. INTRODUCTION

Antidumping (AD) polices have been a highly widespread form of trade protection due to the regulations of World Trade Organization (WTO) on the traditional trade barriers in past decades (for surveys, see Miranda *et al*, 1998; Blonigen and Prusa, 2003). The number of countries that enacted an AD law reached 98 by the end of 2003, with the list including developed and developing countries as well as countries in transition (Prusa, 2005; Zanadi, 2006). [1] This number will only increase, furthermore, as countries such as Georgia, Macedonia, and Vietnam are drafting an AD law. As a result, the welfare implication of AD policies has also become an important issue for international trade (Shin, 1998; Prusa, 2000, 2005; Zanardi, 2004, 2006; and Blonigen, 2003).

Literature in AD policies is vast. Reitzes (1993) discusses the welfare effects of an antidumping policy under Cournot and Bertrand competition with the products being either perfect or imperfect substitutes. He finds that the threat of antidumping duties could change the strategic behavior of firms which might improve domestic welfare under Cournot competition but definitely worsen it under Bertrand competition. More surprisingly, the welfare of the foreign country always improves. Pauwels et al. (2001) investigate the effects of EU AD measures on firm behavior and domestic welfare with those of the US in a two-period model. They show that the EU and the US antidumping rules generate opposite strategic effects of firms. Vandenbussche et al. (2001) examine the protection provided by AD duties and

---

[1] According to Global Trade Protection Report (2009), the countries which initiate antidumping investigations most frequently in 2008 are: India(28), Brazil (23), Turkey(22), Argentina (19), EU (19), US (19), China (14), Indonesia (7), Ukraine (7), Australia(6), Colombia (6), Korea (5), Canada (3), Pakistan (3), Chile (1), Israel (1), Mexico (1) and South Africa (1).

price undertakings with a labor union. They show that AD duties provide higher protection effect than price undertakings if the bargaining power of the labor union is high. Wu et al. (2014) examine the differences in welfare implications between AD duties and price undertakings. Besides, Gao and Miyagiwa (2005) and Kao and Peng (2016) investigate how price undertaking polices affect firms' R&D incentives.

Empirical observations have shown that antidumping protections are often targeted on intermediate goods such as primary metals, chemical, electronics, and mechanical engineering parts.[2] Table 1 shows the AD investigations initiated by the traditional users of antidumping (i.e. the EU, Canada, Australia, New Zealand, the US and also South Africa), and some frequent users in developing and transition countries during 2000 and 2008.[3] In Table 1, it is found that there are 968 (55%) AD investigations on intermediate goods while only 803 (45%) AD investigations are on final goods. Developing countries, on average, have 64% of AD investigations on intermediate goods. In particular, countries such as China and India have more than 70% AD filings on intermediate goods. As for developed countries, the proportion of AD investigations on intermediate goods also reaches 42%. Given the above empirical evidence, it is hardly to neglect the protection

---

[2] For example, the U.S. Department of Commerce has announced its affirmative final determinations in the AD duty investigations of imports of **sodium nitrite** from Germany and China, and imports of **electrolytic manganese dioxide** from Australia and China in 2008. EU has imposed AD duties on certain **seamless pipes** and **tubes of iron or steel**, **PSC wires** and **strands** originating in China in 2009. China has imposed AD duties on **methyl ethyl ketone** from Japan, Taiwan and Singapore, on **bisphenol A** from Japan, Korea, Singapore and Taiwan in 2007, on the imports of certain **polyamide** originating in the U.S., Italy, UK, France and Taiwan and **adipic acid** originating in the U.S., the EU and Korea in 2009. Argentina also imposed a provisional ad valorem antidumping duty to Indonesia in its investigation on imports of **acrylic fiber yarns** in 2009.

[3] Data Source: Bown, Chad P. (2009). Data period is from 2000 to 2008, except: JPN (2000, Jan.~2007, Jul.), TWN (2000, Jan.~2006, Oct.), and THL (2001, Apr.~2007, Oct.).

effects induced by AD policies on intermediate good market. However, to the best of our knowledge, little attention is paid to the intermediate good market. However, to the best of our knowledge, little attention is paid to the intermediate good market. Bernhofen (1995) is an exception. He shows that when the upstream firms cross-haul each other, a difference in country-specific final good production costs is the main cause of dumping in the intermediate good markets, and the protected country and upstream firm shall gain from AD duties, whether the AD duties are in favor of the world is ambiguous.

Country		Intermediate Goods	%	Final Goods	%	Country		Intermediate Goods	%	Final Goods	%
Developing countries	BRA	69	67%	34	33%	Transition countries	TWN	9	41%	13	59%
	CHN	143	93%	10	7%		KOR	35	50%	35	50%
	IND	311	71%	126	29%	Sub-Total		44	48%	48	52%
	IDN	18	44%	23	56%	Developed countries	USA	113	39%	180	61%
	TUR	12	50%	12	50%		AUS	34	39%	53	61%
	MYS	11	41%	16	59%		CAN	43	48%	47	52%
	THL	10	29%	25	71%		EUN	90	45%	110	55%
	MEX	18	32%	39	68%		JPN	6	100%	0	0%
	ARG	46	37%	80	63%	Sub-Total		286	42%	390	58%
Sub-Total		638	64%	365	36%	Total		968	55%	803	45%

Table 1. AD filings on final goods and intermediate goods

The aim of this paper is to explore the impacts of the intermediate good AD policies on market protection and social welfare. While AD polices in a final good market which affect the market demand directly, intermediate good AD policies affect the final demand indirectly via derived demands. The double marginalization effect occurs in the latter case. Therefore, the welfare implications in final good AD policies may not robust in intermediate good market. Different from Bernhofen (1995) which merely considers the AD duty case, we also look at the effects of

price-undertakings and compare the welfare and protection effects of AD duty and price undertaking policies.[4]

In this paper, we utilize a parsimonious two-country vertically-related model. In the beginning, dumping occurs in the domestic country and the domestic firm can impose an AD duty or a price undertaking policy to fully eliminate the dumping margin in the intermediate good markets. The major findings of this paper are as follows. We show that comparing with free trade, AD duty on intermediate good market benefits domestic upstream firm at the expenses of domestic consumers, downstream firm and welfare. By contrast, although a price undertaking policy benefits the domestic upstream and hurts the domestic downstream firm, it is in favor of domestic consumers and welfare if the degree of product differentiation of the final products is large. Besides, an AD duty is superior (inferior) to a price undertaking policy in terms of domestic welfare and industrial profitability if the degree of product differentiation is small (large). Finally, the foreign upstream firm always prefers price undertaking to AD duty.

The remainder of this paper is organized as follows. Section 2 introduces the basic model. Section 3 examines the AD duty regime and then compares the results with those under free trade. Section 4 investigates the price undertaking regime. Section 5 compares the equilibrium outcomes under the two AD policies. Section 6 concludes the paper.

2. THE BASIC MODEL

[4] Price-undertakings are important because most of EU antidumping filings finalize with the acceptance by the EU of a price undertaking. This holds especially for antidumping filings against Central and Eastern European Countries with whom the EU has signed Europe Agreements. Zanardi (2004) also shows that, for the period of 1881-2001, Japan accepted more undertakings, i.e. in about 60% of the cases, as well as Finland and Sweden before their EU membership (82% and 100% respectively)

Assume there are two countries, Country H and Country F, each hosts an upstream Firm and a downstream firm. The domestic upstream firm, Firm m, produces m_x and sells its entire output to the domestic intermediate good market while the foreign upstream firm, Firm M, produces and sells M_x and M_y to the domestic and the foreign intermediate good markets respectively. Firm m and Firm M compete in Cournot fashion in the domestic intermediate good. We also assume that the marginal costs for both upstream firms are c, the transportation costs are nil and the input price in the domestic and the foreign markets are w_x and w_y respectively. The domestic downstream firm, firm x, and the foreign downstream firm, firm y, produce x and y respectively and compete in Cournot fashion in a domestic final good market. We assume that one unit final good is produced by one unit intermediate good. Therefore, we have the following condition:

$$x = m_x + M_x \quad \text{and} \quad y = M_y. \tag{1}$$

Following Dixit (1979), Singh and Vives (1984) and many other authors, we assume that domestic consumers have an aggregate utility function:

$$u(x, y) = ax + ay - bxy - \frac{x^2}{2} - \frac{y^2}{2}, \tag{2}$$

where a is the highest willingness to pay of the consumers and $b \in [0,1]$ represents the degree of product differentiation. The two products become more differentiated as b decreases. Thus, the inverse demand functions of the two final products can be derived respectively as follows: $p_x = a - x - by,$ and $p_y = a - y - bx.$ Given the above settings, the profit functions for the upstream and the downstream firms are respectively as follows:

$$\pi_m = (w_x - c)m_x, \tag{3}$$

5

$$\pi_M = \left(w_x - c \right) M_x + \left(w_y - c \right) M_y, \tag{4}$$

$$\pi_x = (p_x - w_x)x = \left(a - w_x - x - by \right) x, \tag{5}$$

$$\pi_y = (p_y - w_y)y = \left(a - w_y - y - bx \right) y. \tag{6}$$

The game in question encompasses two stages. In the first stage, the two upstream firms choose their optimal outputs in the intermediate good markets. In the second stage, taking the outputs of the two upstream firms and the input price as given, the two downstream firms determine their outputs in the final good market. The sub-game perfect Nash equilibrium is solved through backward induction by first considering the second stage (the decisions taken by the downstream firms), followed by the first stage (the decision taken by the upstream firms).

In the second stage, the two downstream firms determine their outputs in the final good market in the domestic country. By utilizing (5) and (6), it is quite stylized to derive the equilibrium outputs as follows:

$$x = \frac{a(2-b) - 2w_x + bw_y}{4 - b^2}, \text{ and } y = \frac{a(2-b) + bw_x - 2w_y}{4 - b^2}. \tag{7}$$

Substituting (7) into (1) yields the inverse derived demand functions facing the two upstream firms as follows:

$$w_x = a - 2m_x - 2M_x - bM_y, \text{ and } w_y = a - bm_x - bM_x - 2M_y. \tag{8}$$

By substituting (8) into (3) and (4), the profit functions for the upstream firms are now as follows:

$$\max_{m_x} \pi_m(m_x, M_x, M_y) = \left(w_x(m_x, M_x, M_y) - c \right) m_x,$$

$$\max_{M_x, M_y} \pi_M(m_x, M_x, M_y) = \left(w_x(m_x, M_x, M_y) - c \right) M_x + \left(w_y(m_x, M_x, M_y) - c \right) M_y.$$

By routine calculations, we derive the equilibrium outputs of the intermediate products as follows:

$$m_x^f = \frac{1}{6}A, \; M_x^f = \frac{4-b}{12(2+b)}A, \text{ and } M_y^f = \frac{1}{2(2+b)}A. \tag{9}$$

where $A = a - c$ and the variables with a superscript "f" denote that they are associated with the free trade regime. By substituting (9) into (2) to (8), the equilibrium outputs and prices of the final products and the price of the intermediate products and the profits of the firms are as follows:

$$x^f = \frac{(b+8)A}{12(b+2)}, \; y^f = \frac{1}{2(b+2)}A,$$

$$p_x^f = \frac{(16+5b)}{12(2+b)}A + c, \; p_y^f = \frac{(18+4b-b^2)}{12(2+b)}A + c,$$

$$w_x^f = \frac{1}{3}A + c, \; w_y^f = \frac{(6-b)}{12}A + c. \tag{10}$$

$$\pi_x^f = \frac{(b+8)^2}{144(b+2)^2}A^2, \; \pi_y^f = \frac{1}{4(b+2)^2}A^2, \; \pi_m^f = \frac{1}{18}A^2, \; \pi_M^f = \frac{(26-5b)}{72(b+2)}A^2.$$

In addition, we can also derive the resulting consumer surplus (CS), domestic social welfare (SW) and world welfare (WW) as follows:

$$CS^f = u(x, y) - p_x x - p_y y = \frac{100 + 112b + 13b^2}{288(b+2)^2}A^2,$$

$$SW^f = CS + \pi_m + \pi_x + tM_x = \frac{146 + 31b}{288(b+2)}A^2,$$

$$WW^f = SW + \pi_M + \pi_y = \frac{572 + 272b + 11b^2}{288(b+2)^2}A^2.$$

In practice, dumping margin is usually measured by the ex-factory price gap between the foreign market and the domestic market, i.e., $w_y^f - w_x^f$.[5] Dumping occurs and the domestic country can implement AD policies if dumping margin is positive, i.e., $w_y^f - w_x^f > 0$. From (10), it is derived that $w_y^f - w_x^f = (2-b)A/12 > 0$. As a result,

---

dumping occurs in the intermediate good markets under free trade. In addition, the dumping margin increases as the final products become more differentiated. When dumping is observed and causing material injury to the domestic firm, GATT/WTO allows the domestic government to impose an AD duty no larger than the dumping margin or request the foreign firm to enter a price undertaking.[6]

To focus our analysis on the efficacy of AD policies, we assume that the material injury occurs as long as dumping exists and the domestic upstream firm shall petition for AD protections. Then, the domestic government imposes an AD duty or a price undertaking policy to protect its domestic firms.

3. THE ANTIDUMPING DUTY REGIME

In this section, we assume that the domestic government adopts an AD duty policy to eliminate the dumping margin. We shall investigate the corresponding equilibrium and then compare the results with those under the free trade regime. The game in question remains of two-stage, except that the foreign upstream firm now subject to an AD duty. Since the second-stage game is similar to that under free trade, we proceed to solve the first-stage game; that is, the optimal outputs for the upstream firms with AD duties. In the first stage, the profit functions of the two upstream firms become:

$$\max_{m_x} \pi_m = \left(w_x - c\right)m_x, \tag{11}$$

$$\max_{M_x, M_y} \pi_M = \left(w_x - c - t\right)M_x + \left(w_y - c\right)M_y, \tag{12}$$

where t is the AD duty charged by the domestic government. Routine calculations yield the equilibrium outputs and prices in the intermediate good markets as follows:

---

[6] To facilitate our analysis between AD duty and price undertaking policies, we assume that the domestic government charges the AD duty up to the level at which dumping margin is completely eliminated.

$$M_x^D = \frac{(4-b)(2-b)A-(16-b^2)t}{12(4-b^2)}, \quad M_y^D = \frac{(2-b)A+bt}{2(4-b^2)} \quad m_x^D = \frac{A+t}{6}$$

where the variables with a superscript "D" denote that they are associate the AD duty regime. It is found that a higher the AD duty on M_x^D, albeit decrease M_x^D, increases not only m_x^D but also. This is because AD duty increases firm M's export cost on M_x^D, making firm m more competitive in the domestic intermediate good market on the one hand. It also raises p_x, encouraging the consumption of y. By using (8), we derive the prices of the intermediate products as follows:

$$w_x^D = \frac{A+t}{3}, \quad w_y^D = \frac{(6-b)A+bt}{12}+c.$$

This result follows that both input prices are raised by the AD duty. By setting the duty rate equals to $w_y^D(t)-w_x^D(t)$, we have $t=(2-b)(8-b)A/144>0$.

Therefore, the equilibrium outputs, prices, the resulting profits, consumer surplus, domestic social welfare and world welfare are as follows:

$$x^D = \frac{88+12b-b^2}{144(2+b)}A, \quad y^D = \frac{b+12}{24(b+2)}A,$$

$$m_x^D = \frac{14-2b}{72}A, \quad M_x^D = \frac{(b-4)(b-8)}{144(b+2)}A, \quad M_y^D = \frac{b+12}{24(b+2)}A,$$

$$p_x^D = \frac{5(40+12b-b^2)}{144(2+b)}A+c, \quad p_y^D = \frac{b^3-12b^2+50b+216}{144(b+2)}A+c,$$

$$w_x^D = \frac{14-b}{36}A+c, \quad w_y^D = \frac{72-14b+b^2}{144}A+c,$$

$$\pi_x^D = \frac{(b^2-12b-88)^2}{20736(b+2)^2}A^2, \quad \pi_y^D = \frac{1}{576}\frac{(b+12)^2}{576(b+2)^2}A^2,$$

$$\pi_m^D = \frac{(14-b)^2}{2592}A^2, \quad \pi_M^D = \frac{7b^3-352b-38b^2+3104}{10368(b+2)}A^2$$

$$CS^D = \frac{12928 + 15648b + 2788b^2 - 24b^3 - 11b^4}{41472(b+2)^2} A^2,$$

$$SW^D = \frac{22016 + 3728b - 134b^2 - 17b^3}{41472(2+b)} A^2,$$

$$WW^D = \frac{79232 + 40800b + 1820b^2 - 264b^3 + 11b^4}{41472(b+2)^2} A^2.$$

By comparing the above results to those under free trade, we can find that[7]

$$\pi_m^D - \pi_m^f > 0 \quad , \quad \pi_x^D - \pi_x^f < 0 \quad , \quad (\pi_m^D + \pi_x^D) - (\pi_m^f + \pi_x^f) > 0 \quad CS^D - CS^f < 0 \quad ,$$

$$SW^D - SW^f > 0, \quad WW^D - WW^f < 0.$$

The above results suggest that an AD duty policy on intermediate good markets increases the profit of domestic downstream firm and welfare at the expenses of the domestic downstream firm, consumers and world welfare. Thus, we can construct the following proposition.

Proposition 1. An AD duty policy imposed in the domestic intermediate good market

(i)   increases the profit of the domestic upstream firm but decreases the profit of the domestic downstream firm;

(ii)   enhances the domestic industry profit but deteriorates consumers surplus;

(iii)   raises the domestic welfare at the expense of world welfare.

The intuition of the above results is very straightforward. Imposing an AD duty generates two effects. It decreases the export of the foreign upstream firm and increases the input price of the domestic intermediate good market. The first effect leads to a higher profit for the domestic upstream and the second effect reduces the domestic downstream firm's profit. The first effect dominates the second effect, causing a higher

---

[7] Please see the appendix for the detailed proof.

domestic industry profit. In addition, the prices of the final products are also raised by the AD duty, deteriorating consumer surplus. In sum, the gain of domestic industrial profit outweighs the loss of consumers, resulting in a higher welfare level than free trade. However, the world welfare is deteriorated by the AD duty as it increases the prices of intermediate and final products.

4. THE PRICE UNDERTAKING REGIME

We proceed to examine the equilibrium if the domestic government adopted price undertaking as it AD policy.[8] Under the price undertaking regime, Firm M can no longer freely choose its outputs in the domestic intermediate good market. Instead, the outputs have to be adjusted so as to satisfy the equality of the input prices in the intermediate good markets, $w_y = w_x$. Given the price undertaking is imposed, by (8), we can derive that when the foreign upstream determines its outputs, it is subject to $M_y - M_x = m_x$. The game in question is the same as that in our basic model except that now the foreign upstream firm is constrained by the price undertaking policy in the first stage. Again, the second-stage is similar to that under free trade. We proceed to solve the first-stage game. Given the above settings, in the first stage, the profit maximization problem for the domestic and foreign upstream firms are respectively as follows:

$$\max_{m_x} \pi_m = (w_x - c) m_x, \tag{13}$$

$$\max_{M_x, M_y} \pi_M = (w_x - c) M_x + (w_y - c) M_y, \tag{14}$$

s.t. $M_y - M_x = m_x$.

By routine calculation, we derive the equilibrium outputs of the intermediate

---

[8] Differently from antidumping duty, the constraint under price undertaking gives an explanation of different purpose against antidumping duty. The legislation of price undertaking prohibits the price in domestic market equal to the foreign price when the foreign firm imports.

products as follows:

$$M_x^U = \frac{1}{5(b+2)} A, M_y^U = \frac{3}{5(b+2)} A, \quad m_x^U = \frac{2}{5(b+2)} A.$$ (15)

where the variables with a superscript "U" denote that they are associated with the undertaking regime. By substituting (15) into (8) the input prices in the two intermediate good markets are derived as follows:

$$w_x^U = w_Y^U = \frac{2}{5} A + c \equiv w^U.$$

Given the above results, the equilibrium outputs, prices, profits of the firms, consumer surplus, domestic welfare and world welfare under the price undertaking regime are derivable as follows.

$$x^U = \frac{3}{5(b+2)} A, y^U = \frac{3}{5(b+2)} A, \quad p_x^U = \frac{(2b+7)}{5(b+2)} A + c, \quad p_y^U = \frac{(2b+7)}{5(b+2)} A + c,$$

$$\pi_x^U = \frac{9}{25(b+2)^2} A^2, \quad \pi_y^U = \frac{9}{25(b+2)^2} A^2, \quad \pi_m^U = \frac{4}{25(b+2)} A^2, \quad \pi_M^U = \frac{8}{25(b+2)} A^2,$$

$$CS^U = \frac{9(b+1)}{25(b+2)^2} A^2, \quad SW^U = \frac{13}{25(b+2)} A^2, \quad WW^U = \frac{3(7b+17)}{25(b+2)^2} A^2.$$

By comparing the resulting profits under the price undertaking regime to those under the free trade regime, we derived that[9]

$$\pi_m^U - \pi_m^f \geq 0 \quad \text{if} \quad b \leq 0.88,$$

$$\pi_x^U - \pi_x^f < 0,$$

$$(\pi_m^U + \pi_x^U) - (\pi_m^f + \pi_x^f) \geq 0 \quad \text{if} \quad b \leq 0.075$$

This result shows that a price undertaking policy in the domestic intermediate good market always hurts domestic downstream firm. It is beneficial to the domestic downstream firm and industry if the product differentiation of the final products is large.

---

[9] Please the appendix for the proofs.

Namely, product differentiation of the final products plays an important role in the protection effect of price undertaking policies. If the final products are nearly identical, imposing a price undertaking policy is undesirable for both the upstream and downstream domestic firms. Thus, we can build the proposition as follows:

Proposition 2. A price undertaking policy imposed in the domestic intermediate good market always decreases the profitability of the domestic downstream firm. It decreases (increases) the profits of the domestic upstream firm and domestic industry if the product differentiation between the final products is small (large).

The intuition behind the above proposition is as follows. A price undertaking policy will increase the domestic input price and decrease the foreign input price. The first effect hurts the domestic downstream firm. The second effect although decreases the competitiveness of the foreign upstream firm in the domestic intermediate market, makes the foreign downstream firm more aggressive in the downstream market. If the final products are very similar, the decline in the derive demand of product x will be very large, making the domestic upstream less profitable.

We then investigate the effects of the price undertaking policy on the domestic consumer surplus, welfare and world welfare. By comparing the corresponding results under the price undertaking and the free regimes, we derive that:

$CS^U - CS^f \geq 0$ if $b \leq 0.301$,

$SW^U - SW^f \geq 0$ if $b \leq 0.121$,

$WW^U - WW^f \geq 0$ if $b \leq 0.444$.

These results differ from those under the AD duty regime in which product differentiation of the final products is irreverent. When the price undertaking policy is implemented, we find whether the consumer surplus, welfare and world welfare will rise

or fall depends on the product differentiation. Surprisingly, the price undertaking policy is in favor of the domestic consumers, welfare and world welfare if the product differentiation is large. In sum, we can establish the proposition as follows:

Proposition 3. A price undertaking policy imposed in the domestic intermediate good market is not only beneficial to the domestic consumers but also socially and globally more desirable if the product differentiation of the final products is large.

The intuition of this proposition is very clear. Note that the foreign upstream firm is a monoposonist in the foreign intermediate good market. It has monoposony power when selling the input to the foreign downstream firm. This monopoly power and the foreign input price increase with the degree of product differentiation under free trade. When the price undertaking policy is imposed, this monoposony power is weakened owing to the equality input prices constraint. The distortion of double marginalization becomes smaller, increasing the consumption of product y which in turn enhances the consumer surplus, domestic and world welfare. This result is very interesting as it is generally believed that trade protections usually against consumers. We find a counter case in which trade protection on one final product increases consumer surplus via lowering the price of the other final product.

5. COMPARISONS BETWEEM THE TWO POLICIES

In this section, we compare the protection and welfare effects of the two AD policies. We will also discuss the case if the foreign upstream can choose its AD penalties. By utilizing the findings in the previous two sections, we can derive the following results:

$\pi_m^U - \pi_m^D \geq 0$ if $b \leq 0.167$,

$\pi_x^U - \pi_x^D < 0$,

$(\pi_m^U + \pi_x^U) - (\pi_m^D + \pi_x^D) \geq 0$ if $b \leq 0.02$

$CS^U - CS^D \geq 0$ if $b \leq 0.731$,

$SW^U - SW^D < 0$,

$WW^U - WW^D \geq 0$ if $b \leq 0.748$.

The above result shows that that an AD duty is superior (inferior) to a price undertaking policy in terms of world welfare and industrial profitability if the degree of product differentiation is small (large). An AD duty is more desirable than a price undertaking from the perspective of the domestic government. In addition, if the foreign upstream firm can choose between the two policies, it always prefers price undertaking to AD duty. Thus, we can construct the proposition as follows:

Proposition 4. An AD duty is superior (inferior) to a price undertaking policy in terms of world welfare and industrial profitability if the degree of product differentiation is small (large). That is to say, the protection effect of the two policies hinges on the product differentiation of the final goods. However, the domestic welfare under the AD duty regime is higher than the price undertaking regime.

We than investigate the case if the foreign upstream can choose between the two AD policies. It is trivial to derive that $\pi_M^U - \pi_M^D > 0$ by using the results in the previous sections. That is to say, the foreign upstream firm always prefers price undertakings to AD duties.

6. CONCLUSION

Whereas the use of tariffs, quotas and voluntary export restraints (VERs) has declined due to the regulations of World Trade Organization (WTO) over the past two decades, instead, antidumping (AD) has emerged recently as a new and highly widespread form of trade protection (for surveys, see Blonigen and Prusa, 2003). The existing studies mainly focus on the market relating to final goods and find that AD policy is welfare-improving for the host country when firms compete in Cournot fashion (Reitzes, 1993).

However, empirical evidence has shown that antidumping protection is often targeted on intermediate goods such as primary metals, chemical, electronics, and mechanical engineering parts (see, e.g., Niels 2000). As is well known, trade policies on the intermediate good market may have opposite effects to the final good trade policies (the effective rate of protection proposed by Corden (1966) is a good example). Therefore, to bridge this important gap, the main purpose of this paper is the employ a vertically-related duopolistic model to investigate the protection effect and the welfare implications of the two most commonly used AD policies, i.e., antidumping duty and price undertaking.

This paper employs a vertically-related model to examine the protection and welfare effects of antidumping (AD) duty and price undertaking policies on intermediate good markets. We assume that the intermediate products are identical but the final products are horizontally differentiated. Findings show that, comparing to free trade, imposing AD duty on intermediate good market increases the profits of the domestic upstream firm and industry and welfare at the expense of profit of the domestic downstream firm, consumer surplus and world welfare. By contrast, a price undertaking policy always hurts domestic downstream firm, it benefits domestic upstream firm, consumers, welfare and world welfare if the degree of product differentiation of the final products is large.

The domestic welfare is always higher under an AD duty policy than a price undertaking policy. However, the AD duty superior (inferior) to the price undertaking policy in terms of consumer surplus, world welfare, the domestic upstream firm's profitability and industrial profitability if the degree of product differentiation is small (large). Finally, if the foreign upstream firm can choose between the two policies, it always prefers price undertakings to AD duties.

This study can be extended in several ways. In this paper, we only consider the dumping as the dumping measure, another commonly used dumping measure, injury margin, can also be investigated. Product differentiation or number of firms in the final good markets is also worth devoting. It is hoped that this study will go some way toward stimulating these lines of research.

REFERENCES

Bernhofen, D. M. (1995), "Price dumping in intermediate good markets", *Journal of International Economics*, **39**, 159–73.

Blonigen, B. (2003), "Evolving discretionary practices of US antidumping activity", NBER Working Paper No. 9625.

Blonigen, B. and T. Prusa (2003), Antidumping. In: Choi, E.K., Harrigan, J. (Eds.), *Handbook of International Trade*. Blackwell Publishers, Oxford U.K., 251–284.

Bown, C. P. (2009), "Global antidumping database", [Version 5.1, October], available at www.brandeis.edu/~cbown/global_ad/ .

Bown, C. P. and R. McCulloch (2012), "Antidumping and market competition: Implications for emerging economies", The World Bank, Development Research Group, Trade and Integration Team. Policy research working paper, No. 6197.

Brander, J. and P. Krugman (1983), "A reciprocal dumping model of international

trade", *Journal of International Economics*, **15**, 313–22.

Corden, W. M. (1966), "The Structure of a Tariff System and the Effective Protection Rate," *Journal of Political Economy*, **74**, 221–237.

Das, S. P. (1992), "Market uncertainties and cyclical dumping", *European Economic Review*, **36**, 71–82.

Davies, S. and A. McGuinness (1982), "Dumping at less than marginal cost", *Journal of International Economics*, **12**, 169–82.

Dixit, A. (1979), "A model of duopoly suggesting a theory of entry barriers," Bell Journal of Economics, 10, 20-32.

Dixit, A. (1988), "Anti-dumping and countervailing duties under oligopoly", *European Economic Review*, **32**, 55–68.

Eaton, J. and L. Mirman (1991), Predatory dumping as signal jamming, In: A. Takayama, M. Ohyama, and H. Ohta, (Eds.), *Trade Policy and Adjustment*. Academic Press, San Diego.

Ethier, W. (1982), "Dumping", *Journal of Political Economy*, **90**, 487–506.

Gao, X. and K. Miyagiwa (2005), "Antidumping production and R&D competition", *Canadian Journal of Economics*, **38**, 211-227.

Hillman, A. and E. Katz (1986), "Domestic uncertainty and foreign dumping", *Canadian Journal of Economics*, **19**, 403–16.

Kao, K. F. and C. H. Peng (2016), "Anti-dumping Protection, Price Undertaking and Product Innovation", *International Review of Economics and Finance*, **41**, 53-64.

Miranda, J., R. Torres and M. Ruiz (1998), "The international use of antidumping: 1987–1997", *Journal of World Trade*, **32**, 5–71.

Niels, G. (2000), "What is antidumping policy really about?" *Journal of Economic Surveys*, **14**, 467–492.

Pauwels, W., Vandenbussche H. and Weverbergh, M., 2001, "Strategic behaviour under European antidumping duties," *International Journal of the Economics of Business*, 8, 75-99.

Prusa, T. J. (2000), "On the spread and impact of antidumping", *Canadian Journal of Economics*, **34**, 591–611.

Prusa, T. J. (2006), "Antidumping: A growing problem in international trade", *The World Economy*, **28**, 683-700.

Reitzes, J. (1993), "Antidumping policy", *International Economic Review*, **34**, 745-763.

Shin, H. J. (1998), Possible instances of predatory pricing in recent US antidumping cases. In: R. Z. Lawrence (ed.). *Brookings Trade Forum 1998.* Brookings Institution Publisher, Washington, DC, 81–97.

Singh, N. and X. Vives (1984), "Price and quantity competition in a differentiated oligopoly," *RAND Journal of Economics,* **15**, 546-554.

Staiger, R. and F.A. Wolak (1992), "The effect of domestic antidumping law in the presence of Foreign Monopoly," *Journal of International Economics*, **32**, 265–87.

Vandenbussche, H., R. Veugelers, and J. Konings, (2001), "Unionization and European Antidumping Protection," *Oxford Economic Papers*, **53**, 297-317.

Zanardi, M. (2004), "Antidumping: What are the numbers to discuss at Doha", *The World Economy*, **27**, 403–433.

Zanardi, M. (2006), "Antidumping: A problem in international trade", *European Journal of Political Economy*, **22**, 591-617.