The Signaling Power of Trade Protection

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Abstract

This paper investigates a theoretical channel as well as an empirical test to provide a new insight into the trade diversion effects of Antidumping (AD) policy. Trade diversion is the shift in trade from the named countries in an AD investigation to non-named subjects. Previous studies, all empirical, have concluded that AD action causes a considerable drop in exports from named countries, however the extent to which trade is diverted to non-named countries is still an open debate and depends very much on the country imposing the law and the sector receiving the benefit. The aim of this paper is to put forth the following intuition. Exporting countries usually don’t have insight into the decision-making process of the importing country’s AD policy. Therefore when an AD duty is imposed against a major exporter, this can be used as signaling device to reveal information to a newcomer about the level of protection the government wishes for its domestic producers. For example, in the case of an international triopoly, when an AD action against a major exporter ends up with the imposition of a very high duty, this might signal (depending on certain conditions formulated in the paper) to the newcomer that it will also face a high duty, should an AD case be filed. As a result, the newcomer can decide to restrain exports to avoid being scrutinized.

Keywords and Phrases: Signal Extraction Problem, Antidumping, Trade Diversion, Market Entry.

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1 Introduction

Antidumping (AD) protection has become a very important policy that is seen as a form of flexibility required in trade agreements when countries commit to deeper liberalization. It comes therefore as no surprise to notice its widespread use across countries. Many papers have been dedicated to understanding the economic effects of AD action, and a good example is the recent paper by Vandenbussche and Zanardi (2008). This paper contributes to the literature on trade diversion: the trade that is shifted from the named countries in the AD investigation to the non-named subjects.

By now there is a large body of empirical work (Prusa 1997; Lasagni 2000; Brenton 2001; Konings et al 2001; Niels 2003; Ganguli 2008, Malhorta et al 2008, 2009) that examines the trade effects of antidumping policy. All of these works conclude that antidumping measures on named countries cause a considerable drop in their exports. But the extent to which trade is diverted from named to non-named countries is still an empirical issue and depends very much on the country imposing the law and on the sector receiving the benefit. For the US, Prusa (1997) shows that antidumping measures cause substantial trade diversion from named to non-named countries making antidumping policy ineffective in protecting its domestic producers. A more recent study by Malhorta, Rus and Kassam (2008) uses data on US agricultural commodities to show that for this particular sector trade diversion is low, thus making the point that antidumping policy is rather an effective protectionist tool. For Europe, Lasagni (2000) and Konings, Springael and Vandenbussche (2001) provide evidence that trade diversion in general is low and that antidumping is good at protecting the EU market. Nevertheless, Konings, Springael and Vandenbussche (2001) provide evidence of significant trade diversion in highly concentrated sectors, but show that the effect is not strong enough to offset protection. Other studies on Mexico (Niels 2003), Canada (Malhorta and Rus 2009) and India (Ganguli 2008) reveal that trade diversion is low, making antidumping policy effective as a protectionist measure.

This paper presents a theoretical model that endeavors to provide an insight as to why trade diversion can be either high or low. To study trade diversion, this paper introduces a model of international triopoly in which two foreign competitors, a major and minor exporter, compete with a home producer. The analysis begins with the observation that the major exporter is scrutinized in an AD investigation. It is assumed that whenever the AD decision making process has an element of uncertainty, the outcome of the AD decision against the major exporter can reveal valuable insight into the
nature of the importing country governments AD policy. In other words, an AD action against a major exporter can reveal information to the minor exporter which can under certain circumstances motivate the minor exporter to restrain its exports in order to avoid being scrutinized.

The theoretical tool used to study information revelation of AD policy is with a signal extraction framework, which has by now been extensively used in the industrial organization literature (Gal-or 1985, 1986; Li 1985; Vives 1985, 2001; Leslie 2005) and with applications to strategic trade policy by Caglayan (2000) and Caglayan and Usman (2004). Looking at AD policy with a signal extraction problem allows to analyze how the predictability of the minor exporter, should it be named in an investigation, is affected when it observes the AD duty taken against the major exporter. The AD duty imposed against the major exporter is considered to be a signal because it carries information about the decision making process of the government. It is a noisy signal, because it reveals some information about the future AD action, should a case be initiated. The information content of the AD duty or alternatively the variance of the noise affects the minor exporters predictions as to the outcome of future AD protection.

The goal of the theoretical model is to provide a thorough analysis by considering cases where AD action reveals information (or alternatively when the variance of the noise is low) and cases where the minor firm does not gain any insight when observing the AD outcome against the major exporter (i.e. when the variance of the noise is high). Moreover, an empirical test is carried out to see whether AD policy acts as a signaling device.

The present analysis has important policy implications. Notably, it suggests that the trade effects of antidumping protection go beyond the direct reduction in exports from major exporters targeted by the protection. Indirect trade effects on non-targeted trade partners also occur. The findings show that as a result of signaling, antidumping protection can spill over to minor exporters, modeled here by a newcomer. Moreover, this paper assumes the spillover to occur in the same product, but spillovers are also possible on other products than the targeted ones. Recent empirical evidence by Vandenbussche and Zanardi (2009) points out that antidumping measures depress aggregate imports of the protected country and not just trade in the protected products which is suggestive of indirect spillover effects between trade partners and between products.
2 The Setup

The model in this paper is inspired by Miyagiwa and Ohno (1998) which assumes an international triopoly, in which a home firm, denoted by $H$, competes with two foreign firms, labeled $A$ and $B$ in two periods. The foreign firms export from different countries and more specifically, $A$ exports to $H$ in periods 1 and 2 while the firm $B$ enters the home market in period 2. Thus, firm $A$ represents the major exporter whereas firm $B$ is a newcomer in the industry. To avoid any confusion, it is assumed that firm $B$ always enters the market in period 2. However, before entering, it has to make capacity investments, building a new plant, establishing a dealer network, etc., a required step before entering the export market in period 2. On top of that, it is assumed that having invested in capacity, firm $B$ exports its full capacity in period 2. Let $k_B$ be the amount of capacity chosen, and $C(k_B)$ its associated cost. Capacity investments are assumed to be monotonically increasing and convex: $C'(k_B) > 0$, $C''(k_B) > 0$ and $C(0) = 0$.

Firms produce homogenous goods at constant marginal cost $c_i$, $i = \{A, B, H\}$ and choose quantities as the strategic variable. The analysis concentrates on the home market and abstracts from modeling foreign demands. The demand function for domestic sales and foreign exports on the home market in periods one and two are given by

\[
\begin{align*}
    p_1 &= \alpha - q_{H1} - q_{A1} \\
    p_2 &= \alpha - q_{H2} - q_{A2} - q_{B2}
\end{align*}
\]

where $\alpha > 0$ is a strictly positive parameter, and $p$ together with $q_i$, $i = \{A, B, H\}$, are the price and output levels. The aim of the model is to focus on how an antidumping penalty on $A$ can have an effect on the exporting decision of the newcomer $B$.

Antidumping action is invoked by firm $H$ in order to reduce competition from the foreign firms. The game begins in period 1, with $H$ having already filed a complaint against $A$. To simplify the analysis, it is assumed that there are no filing costs associated with AD investigations.\footnote{Relaxing this assumption does not change the qualitative analysis of the present model. To give an indication as to how the model changes is that the introduction of filing costs leads the home firm to initiate less AD action. Indeed, if the expected benefit from AD action is lower than the filing costs, then firm $H$ does not find it worthwhile to petition.} However, it is assumed the home firm is entitled to file a complaint if both dumping and injury occurs. Dumping occurs whenever the foreign firm exports its product at a lower price than it charges on its own market. Injury, on
the other hand, can be established through negative trends in financial and economic indicators such as a sharp decline in output, sales, profits and market share just to name a few. Following Veuglers and Vandenbussche (1999), Wauhty and Vandenbussche (2001), Prusa (1994), it is assumed that dumping always holds. This simplification can be justified on several grounds. First, since the analysis abstracts from modeling foreign demands, it is impossible to define prices in the foreign countries. Second, under the WTO antidumping agreement, the foreign price is not directly relevant to the investigation because the AD authority can compute, by itself, the local foreign price using the information they have about foreign firm. Regarding injury, it is assumed that a sudden and sharp increase in imports above a certain threshold, denoted by $\kappa$ (cf. Figure 1.) results in the home firm filing an investigation. Given that there are no history in imports from $A$ prior to period 1, one way to comprehend and justify the investigation in period 1 is to assume that the marginal cost of the major exporter, $c_A$ is sufficiently low to result in a substantial import flow, i.e. $q_{A1} > \kappa$.

The AD decision process is assumed to contain some discretion, making AD action uncertain for the firms. The AD ruling by the home government is in a form of a specific duty, and is imposed in period 1 until the end of period 2. As will be explained (cf. Lemma 1), the imposition of an AD action leads the firms to form an expectation before the actual duty is revealed. The idea of ambiguity and discretion in AD policy either in the determination of dumping or injury (see Prusa 1994) or through the channel of political economy (see Bloningen 2006 and Tharakan, Greenaway and Kerstens 2006) is extensively used in the AD literature (Fischer and Mirman 1994; Prusa 1994; Bloningen 2006; Tharakan, Greenaway and Kerstens 2006 and Martin and Vergote 2009). The goal of the paper is not to explain from which part of the AD investigation the ambiguity comes from but rather to examine how the governments’ decision on firm $A$ in period 1 affects exports from firm $B$. The idea is the following, before entering the home market, firm $B$ will endeavor to gather information about the governments AD decision making process. It happens to be that the best information at the disposal of firm $B$ is to observe the action the government takes against $A$. Thus, observing the AD outcome on $A$, firm $B$ updates its belief about the expected level of duty it can also face, should firm $H$ invoke an AD action against it in period 2. As a result, based on its posterior beliefs, firm $B$ makes its capacity investments.

Figure 1 illustrates the timing of the game. As shown, period 1 begins with the home country having filed an antidumping investigation against its rival $A$. Since the behavior of $A$ is not modeled prior to period 1, it
is assumed that exports from A are high enough so that H is entitled to petition against A. The AD decision, t, is then taken by the government and revealed to the firms. The non-named firm B updates posterior beliefs after observing t and forms the conditional expectation \( E(\tau \mid t) \). The fundamental assumption here is that an AD decision made by the government today, denoted by t, signals information about future AD policy \( \tau \). In the jargon of industrial organization, this problem is referred to as a *signal extraction* problem, namely that t in period 1 acts as a signal to infer the expected level of protection \( E(\tau \mid t) \) the newcoming firm B will face in period 2, should H file a case. In exact terms, \( t \) is a *noisy signal* of \( \tau \), because observing \( t \) reveals some information about the the expected value of \( \tau \). Admittedly, in the real world, one does expect \( t \) to be a noisy signal. For example, if the AD decision on A is very high, then this can signal that the government can equally decide to impose high duties against B, should a case be filed. Nevertheless it is important to note that observing \( t \) in period 1 allows firms to form an *expectation* about \( \tau \), it is perfectly possible for the government to impose a lower duty against B when a case is invoked in period 2.

Referring back to figure 1, observing \( t \), B updates posterior beliefs about the governments decision on \( \tau \). At this point, B has two choices: it can either make relatively small capacity investments, i.e. below a certain threshold \( \kappa \), making export insignificant for H to be eligible to file a complaint, or it can invest above this threshold, and risk paying an AD duty. In period 2, observing the buildup in capacity, H files a complaint whenever \( k_B \geq \kappa \) in which case the government will then reveal its decision \( \tau \).

The rest of the paper is organized as follows. The next section examines the free trade equilibrium in which AD action is never invoked, this section

Figure 1: Timing of the game
serves as a benchmark and introduces the theoretical framework. Section 4 then proceeds with the analysis of the antidumping equilibrium from which the major conclusions are interpreted. Section 5 provides an empirical analysis that aims to see if antidumping policy acts as a signaling device. Finally, the conclusion is presented in section 6.

3 The Free Trade Equilibrium

This section will characterize the equilibrium under free trade (ft). The notion of free trade in this model refers to the situation where no antidumping action is ever used by the home government. As usual with multi-period games, the notion used to solve the game is that of backwards induction. The equilibrium obtained is hence a subgame perfect Nash equilibrium. Starting at the second period, firms $H$ and $A$ maximize their period-2 profit function given by:

$$\max_{q_{i2}} \pi_{i2} = (\alpha - q_{i2} - q_{j2} - q_{B2} - c_i) q_{i2}$$

where $i \neq j = \{H, A\}$. Following Miyagiwa and Ohno (1998), at equilibrium, firm $B$ knows that under free trade it can export its entire capacity $q_{B2} = k_B$, and hence sets $k_B$ to maximize its profit:

$$\max_{k_B} \pi_{B2} = (\alpha - q_{H2} - q_{A2} - k_B - c_B) k_B - \frac{1}{2} [k_B]^2$$

where $C(k_B) = \frac{1}{2} [k_B]^2$ is the cost of capacity investment, expressed in quadratic form. Solving for the Nash-Cournot equilibrium ($*$), the optimal outputs under free trade (ft) can be computed to be

$$q_{H2}^{ft} = \frac{2(\alpha + c_A) + c_B - 5c_H}{7}$$ (1)
$$q_{A2}^{ft} = \frac{2(\alpha + c_A) + c_B - 5c_A}{7}$$ (2)
$$q_{B2}^{ft} = k_B^{ft} = \frac{\alpha + c_A + c_H - 3c_B}{7}$$ (3)

Consequently, the market equilibrium price in period-2 can readily be shown to be

$$p_2^{ft} = \frac{2(\alpha + c_A + c_H) + c_B}{7}$$ (4)
Pursuing the game in period-1, the maximization problem for $H$ and $A$ is that of a two-player cournot duopoly. Under free trade, $A$ is never targeted with an AD action and therefore the maximization problem of both firms is given by

$$\max_{q_i} \pi_i = (\alpha - q_i - q_j - c_i) q_i$$

The maximization problem leads to the Nash-Cournot quantity levels

$$q_{ft}^H = \frac{\alpha + c_A - 2c_H}{3}$$  \hspace{1cm} (5)$$

$$q_{ft}^A = \frac{\alpha + c_H - 2c_A}{3}$$  \hspace{1cm} (6)$$

and the market price

$$p_{ft}^1 = \frac{\alpha + c_H + c_N}{3}$$  \hspace{1cm} (7)$$

The main conclusion, drawn from the free trade equilibrium, is simple and intuitive. The newcomer $B$ enters the market in period 2 and creates more competition. As a result, total output provided to the home market increases and the market price decreases with respect to period 1: $p_{ft}^2 < p_{ft}^1$.

4 Market Entry in Face of Antidumping Policy

In this section we enrich the model in the previous section by introducing antidumping policy. As mentioned before, the main intuition here is to analyze how the strategic behavior of firm $B$ changes in presence of AD policy. More specifically, before building capacity, firm $B$ will try to incorporate as much information as possible on the home government's decision making process. In fact, the best information available to $B$ is its observation about the action the government takes against $A$. The most interesting results emerge from period-1, where the newcomer has to anticipate AD policy in period-2 while choosing its capacity. As will be seen, firm $B$ can either choose a capacity level $k_B \leq \kappa$ and avoid being scrutinized by the AD authority or choose $k_B > \kappa$, in which case $H$ files an AD investigation.

4.1 Antidumping as a Signaling Device

The endeavor in this section is to show the effects on competition when AD actions reveal some information about the future protection levels. Formally,
the signal in this paper has a linear information structure which yields a linear conditional expectation. To put the noisy signaling framework into context, a typical linear structure, written in standard form, is given by:

\[ t = \tau + \varepsilon \]  
(8)

where \( t \), the signal, is the observed AD outcome in period-1, \( \tau \sim N(\mu, \sigma^2_\tau) \) is the decision of the government when a case is filed in period-2 and \( \varepsilon \sim N(0, \sigma^2_\varepsilon) \) is the noise term. The key point is that firms observing \( t \) in period-1 can extract information about \( \tau \) in period-2. In other words, \( t \) and \( \tau \) are positively correlated. Moreover, the smaller \( \sigma^2_\varepsilon \) then the more accurate are firms perception about \( \tau \) when they observe \( t \). On the other hand, the larger \( \sigma^2_\varepsilon \) then the less accurate are firms anticipations.

As mentioned above, equation (8) is expressed in standard form. However, another useful way to understand how \( t \) acts as a signaling device, is to express (8) as follows:

\[ \tau = t - \varepsilon \]  
(9)

and to think of \( \tau \) as being composed of two components. The first is \( t \), the AD outcome against \( A \) which is observable to firms in period-1 and \( \varepsilon \) the unobservable term in period-1. Therefore, it is precisely \( \varepsilon \) that makes the duty \( \tau \) imposed against \( B \) in period-2 different than \( t \). However, \( \varepsilon \) will becomes observable in period-2. Consequently, what firm \( B \) does in period-1, is to infer \( \tau \) from \( t \), the only signal it has at its disposal!

A further clarification is necessary. Typically, as could be seen from (14), a positive \( \varepsilon \) means that if an AD investigation is initiated against \( B \), it will face a lower AD duty than \( A \). One’s guess might be that this should on average be true, since \( A \) is a bigger exporter than \( B \). It is assumed however that \( E(\varepsilon) = 0 \), implying that on average \( E(t) = E(\tau) = \mu \). For those who find this assumption uncomfortable, one could very easily extend the model to have a positive \( E(\varepsilon) \). In such a case, the signal \( t \) systematically overestimates \( \tau \). However, bare in mind that using either \( E(\varepsilon) = 0 \) or \( E(\varepsilon) > 0 \) does not change the results of the model. Consequently, for simplicity the latter case is chosen.

Before moving to the next section, the following Lemma is stated which reveals the conditional expectation of \( \tau \) given the observed value of \( t \) in period-1.

**Lemma 1** Suppose random variables \( t \) and \( \tau \), where \( t = \tau + \varepsilon \) have the
following distributional properties:

\[
\begin{bmatrix}
\tau \\
t
\end{bmatrix}
= 
\begin{bmatrix}
\mu \\
\mu 
\end{bmatrix}
\begin{bmatrix}
\sigma^2_t & \sigma^2_t \\
\sigma^2_t & \sigma^2_t + \sigma^2_\varepsilon
\end{bmatrix}
\]

It can be shown that:

\[E(\tau \mid t) = \xi t + (1 - \xi) \mu\]  

(10)

where

\[\xi = \frac{\text{cov}(t, \tau)}{\text{var}(t)} = \frac{\sigma^2_\varepsilon}{\sigma^2_\tau + \sigma^2_\varepsilon} \in [0, 1]\]

Proof in Appendix □

Lemma 1 is essential in this paper and all the results derive from (10). What it basically says is that the conditional expectation \(E(\tau \mid t)\) depends on \(t, \xi\) and \(\mu\). The focus is on \(\xi\), which will henceforth be referred to as the signaling power of antidumping policy. Indeed, as the variance of \(\varepsilon\) goes to zero \(\sigma^2_\varepsilon \to 0\) then \(\xi = \frac{\sigma^2_\varepsilon}{\sigma^2_\tau + \sigma^2_\varepsilon} \to 1\), and the AD duty \(t\) in period 1 becomes a perfect predictor of \(\tau\) in period 2, therefore \(E(\tau \mid t) = t\). What this means is that when the level of protection is taken against \(A\), firm \(B\) also expects to receive \(\tau = t\). On the other hand, when \(\xi = 0\), this means that \(\sigma^2_\varepsilon\) is infinitely large so that AD action against \(A\) does not reveal anything about how the government will act against \(B\) in period 2. In such a case the signaling power of AD is nil and therefore the best prediction of the future is simply the average mean of \(\tau\)'s distribution \(\mu\). In such a case \(E(\tau \mid t) = \mu\). Now, the aim here is not to say that the signaling power \(\xi\) is large or small, the intention is rather to study \(B\)'s reaction to \(t\) for different values of \(\xi\). The econometric analysis will provide a hint as to whether AD policy has a signaling power or not.

4.2 The Antidumping Equilibrium

This section considers the equilibrium in presence of AD action. Starting from the second period, given the AD decision on firm \(A\) in period-1 as well as firm \(B\) exporting its entire capacity, \(H\) and \(A\) maximize their period-2 profits given by

\[
\begin{align*}
\max_{q_{H2}} \pi_H &= (\alpha - q_{H2} - q_{A2} - k_B - c_H) q_{H2} \\
\max_{q_{A2}} \pi_A &= (\alpha - q_{H2} - q_{A2} - k_B - c_A - t) q_{A2}
\end{align*}
\]
Firm $B$ chooses its capacity after having observed the AD action $t$ taken against $A$ in period-1. Observing $t$ reveals information which allows $B$ to form its expectation about $\tau$. To simplify the notation, let $\hat{\tau} = E(\tau | t)$. Assuming that at equilibrium, firm $B$ exports its entire capacity in period-2, firm $B$ chooses a capacity to maximize expected profits. Consequently the optimization problem for firm $B$ is:

$$\max_{k_B} \left((\alpha - q_{A2} - q_{H2} - c_B) k_B - \frac{1}{2} [k_B]^2 \right) \text{ if } k_B \leq \kappa$$

$$E \left[(\alpha - q_{A2} - q_{H2} - k_B - c_B + \tau) k_B | t \right] - \frac{1}{2} [k_B]^2 \text{ if } k_B > \kappa$$

Note that firm $B$ has always the option of building a capacity $k_B \leq \kappa$ and avoid the uncertainty created by the AD investigation. Therefore, the aim here is to examine under which conditions firm $B$ would choose a capacity below $\kappa$ and conditions in which it will risk producing more and consequently facing a penalty. It can be shown (proof in Appendix) that given the magnitude of the AD action $t$ taken against $A$ and considering its signaling power $\xi$, the equilibrium quantity $q_{B2}^{AD}$ is given by

$$q_{B2}^{AD} = \begin{cases} 
\frac{\alpha + c_H + c_A + t - 3c_B}{\bar{t}} & \text{if } \bar{t} < t \leq \underline{t}, \ 0 \leq \xi \leq 1 \\
\kappa & \text{if } \bar{t} < t \leq \bar{t}, \ \xi < 1/3 \quad \text{or} \quad t > \bar{t}, \ \xi \geq 1/3 \\
\frac{\alpha + c_H + c_A + t - 3c_B - 3\hat{\tau}}{\bar{t}} & \text{if } t > \bar{t}, \ \xi < 1/3.
\end{cases} \quad (11)$$

where $\underline{t} = 7\kappa - \alpha - c_H - c_A + 3c_B$ and $\bar{t} = \frac{t + 3(1 - \xi)\hat{\tau}}{1 - 3\xi}$ with $\bar{t} > \underline{t}$.

When an antidumping duty is imposed upon the major exporter $A$, this creates an opportunity for firm $B$ to increase its exports with respect to free trade. This is referred to by the literature (Prusa, Vandenbussche, ... ) as the trade diverting effects of antidumping policy, since imposing an AD protection will divert trade from the firm named in the investigation to the firm not-named in the investigation. Therefore, depending on the size of $t$, trade diversion can either be low ($q_{B2} \leq \kappa$) or large ($q_{B2} > \kappa$), in which case $H$ is entitled to file a complaint in period 2. For relatively low values of $t$, i.e. $t \leq \underline{t}$, the optimal export $q_{B2}^{AD} \leq \kappa$ and therefore $B$ will not be preoccupied about limiting its exports, and this no matter the signaling power of $t$. In this case, $t$ is simply not high enough to have a large trade diversion effect. Note that $\underline{t} = 7\kappa - \alpha - c_H - c_A + 3c_B$, depends on the threshold $\kappa$, the capacity above which $H$ is entitled to file a complaint, and a higher $\kappa$ leads to a higher $\underline{t}$. 

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Now, the most interesting effects take place when AD duty is high enough, that is when \( t > \underline{t} \). For these cases the signaling effects of AD policy become important and affect the strategic behavior of \( B \). As can be seen from equation (11), two cases are distinguished: when the signaling power is high (\( \xi \geq 1/3 \)) or low (\( \xi < 1/3 \)). For case 1, the correlation between \( t \) and \( \tau \) is high enough, so that whenever \( B \) observes \( t \) in period 1, it will strategically limit its exports to \( \kappa \) in order to avoid being scrutinized in period 2. In other words, for all \( t > \underline{t} \), if \( B \) decides to export more than \( \kappa \), it will expect to pay an AD duty

\[
\hat{\tau} = E[\tau \mid t] = \xi t + (1 - \xi) \mu
\]

which leads lower expected profits:

\[
\pi_{B_2}(\hat{\tau}) < \pi_{B_2}(\kappa)
\]

With regard to case 2, when \( \xi < 1/3 \), firm \( B \) knows that \( t \) do not reveal much information about the future. From equation (11), when \( t \in [\underline{t}, \overline{t}] \), \( B \) prefers to restrict its imports to \( \kappa \), because \( t \) is not high enough to generate an expected payoff bigger than the profits resulting from exporting \( \kappa \). In a way, one can interpret this situation as such: for intermediate values of \( t \), firm \( B \) prefers to limit its export to \( \kappa \) and not face the uncertainty of being scrutinized. On the other hand, when values of \( t > \overline{t} \):

\[
q_{B_2}^{AD}(\hat{\tau}) > \kappa \Rightarrow \pi_{B_2}(\hat{\tau}) > \pi_{B_2}(\kappa)
\]

the expected payoff will be higher by exporting more than \( \kappa \).

Note that for case 2 (\( \xi < 1/3 \))

\[
\overline{t} = \frac{\xi + 3(1 - \xi)\overline{t}}{1 - 3\xi}
\]

is an increasing function of \( \xi \). At the limit, when \( \xi \to 1/3, \overline{t} \to \infty \). This is important to the extent that, as the signaling power of \( t \) increases, \( t \) has to be ever more larger for \( B \) to export more than \( \kappa \).

The second period quantities for \( H \) and \( A \) can also be obtained in a similar fashion and are given by

\[
q_{H_2}^{AD} = \begin{cases} 
\frac{2(\alpha + c_A + t) + c_B - 5c_H}{7} & \text{if } t \leq \underline{t}, 0 \leq \xi \leq 1 \\
\frac{\alpha + c_A + t - 2c_B - \kappa}{3} & \text{if } \underline{t} < t \leq \overline{t}, \xi < 1/3 \quad \text{or} \quad t > \underline{t}, \xi \geq 1/3 \\
\frac{2(\alpha + c_A + t) + c_B + \overline{t} - 5c_H}{7} & \text{if } t > \overline{t}, \xi < 1/3.
\end{cases}
\]
\[
q_{A_2}^{AD} = \begin{cases} 
\frac{2(\alpha + c_H + c_B - 5(c_A + t))}{7} & \text{if } t \leq \xi \\
\frac{\alpha + c_H - 2(c_A + t) - \kappa}{3} & \text{if } \xi < t \leq \overline{T}, \ \xi < 1/3 \ \text{or } \ t > \xi, \ \xi \geq 1/3 \\
\frac{2(\alpha + c_H + c_B + \bar{\tau} - 5(c_A + 0)}{7} & \text{if } t > \overline{T}, \ \xi < 1/3.
\end{cases}
\]

Having obtained the second period quantities, the second period market price can be expressed:

\[
p_{2}^{AD} = \begin{cases} 
\frac{2(\alpha + c_H + c_A + t) + c_B}{7} & \text{if } t \leq \xi \\
\frac{\alpha + c_H + c_A + t - \kappa}{3} & \text{if } \xi < t \leq \overline{T}, \ \xi < 1/3 \ \text{or } \ t > \xi, \ \xi \geq 1/3 \\
\frac{2(\alpha + c_H + c_A + t) + c_B + \bar{\tau}}{7} \ \text{if } t > \overline{T}, \ \xi < 1/3.
\end{cases}
\]

To appreciate how the optimal quantities adjust with different values of \(t\) and \(\xi\), it is helpful to use the following figure. Figure 2, plots the Nash equilibrium outputs with respect to the amount of \(t\) imposed by the home government for the case where \(\xi = 0\), and the case where \(\xi = 1\). The aim of the figures is to see how an antidumping duty changes the optimal strategies and the market price for the two different cases. From figure 2 it can be seen that the effect of \(t\) on the outputs and market price are the same for both cases \(\forall t \leq \overline{T}\), where \(\overline{T}\) for the case where \(\xi = 0\) is given by \(\overline{T} = \frac{t + \overline{\tau}(1-\xi)}{1-\xi} = \overline{t} + 3\overline{\tau}\). The effect becomes different when \(t > \overline{T}\). Starting from the lower left figure, when \(\xi = 1\), firm B will always limit its exports to the dashed line, whereas it would increase its exports when \(\xi = 0\). This difference makes AD policy more of a protectionist instrument when it has signaling effects. Clearly, as can be seen from the upper right figure, firm’s \(H\) output is higher when \(\xi = 1\). Interestingly enough, looking at the figure for firm \(A\) when \(\xi = 1\), the slope of its optimal output for a given \(t\) is no longer as steep as it is with a \(\xi = 0\). This result is not surprising, because when firm \(B\) limits its exports to \(\kappa\) then firm \(A\) gains back part of its market share. Finally, it interesting to see that the increase in price is always greater when \(\xi = 1\).

Next, proceeding with the game in period-1, when the AD decision \(t\) is revealed the maximization problem of \(H\) and \(A\) is respectively

\[
\max_{q_{H_1}} \pi_{H_1} = (\alpha - q_{H_1} - q_{A_1} - c_H) q_{H_1} \\
\max_{q_{A_1}} \pi_{A_1} = (\alpha - q_{H_1} - q_{A_1} - c_A - t) q_{A_1}
\]
Figure 2: The Effect of an AD duty $t$ on Optimal Quantities and Market Price

which leads to the Nash-Cournot outputs:

$$q_{AD}^{H} = \frac{\alpha + c_A + t - 2c_H}{3}$$

(15)

$$q_{AD}^{A_1} = \frac{\alpha + c_H - 2(c_A + t)}{3}$$

(16)

and the market price

$$p_{AD}^{A_1} = \frac{\alpha + c_H + c_N + t}{3}$$

(17)

The interpretation of the first period is standard, an antidumping duty has the effect of increasing the marginal cost of firm $A$, which leads to decrease its market share. Although firm $H$ increases its output, overall the
increase in output is not large enough to compensate firm A exports. As a result, the market price increases in period 1.

The inspection of equation (11) as well as figure 2 shows the first main result that no matter the amount of duty placed on firm A, for \( t > 0 \), trade diversion, i.e. the increase in exports from B with respect to free trade scenario is always positive. This leads to the following proposition:

**Proposition 1** Exports form a minor exporter (firm B) in face of antidumping action against a major exporter (firm A) are always higher than under free trade. In other words, AD policy has trade diverting effects:

\[
q_{B2}^{AD} > (=) q_{B2}^{ft} \iff t > 0 (= 0)
\]

Proposition 1 is important to the extent that AD policy has a trade diverting effect. Indeed, by targeting a major exporter such as firm A, the latter responds to a duty by decreasing its output, this creates an opportunity for firm B to increase its outputs. Its increase in output is therefore greater than under free trade when A is never scrutinized. This is usually referred to as the trade diverting effects of AD policy.

The question that arises next is to see whether the amount of trade diversion can be influenced when AD policy acts as a signaling device? The second results identifies that as the signaling power of AD increases, firm B will incorporates this information into its decision making processes and reduce its amount of exports to the home country. More specifically, it is shown that when the signaling power of AD (\( \xi \)) converges to its critical value \( \xi \to 1/3 \), then as a result, firm B will restricts its levels of export, \( q_{B2}^{AD} \to \kappa \), to avoid being targeted in the future. These results are summarized in 2.

**Proposition 2** For an AD duty \( t \leq t^*_1 \), where \( t^*_1 \) is the value below which the build up in capacity \( k_B \) is always below or equal to \( \kappa \), exports from B are an increasing function of \( t \). For \( t > t^*_1 \), two cases are distinguished:

**Case 1:** When the signaling power of AD action, \( \xi \), is high enough, i.e. \( \xi \geq 1/3 \), exports from B are limited to \( \kappa \).

**Case 2:** For values of \( \xi < 1/3 \), there exists a duty level, \( \overline{t} > t^*_1 \), below which B limits capacity to \( \kappa \). When \( t > \overline{t} \), exports from B are above \( \kappa \) and are an an increasing function of \( t \).

Proposition 2 has the following intuition. As an antidumping duty is imposed upon the major exporter A, this creates an opportunity for B to
increase its exports with respect to free trade. This is referred to by the litterature (Prusa, Vandenbussche, ... ) as the trade diversion effects of antidumping policy. Depending on the size of \( t \) however, trade diversion can be benignant \(( k_B \leq \kappa )\) or harmful \(( k_B > \kappa )\), in which case \( H \) is entitled to file a new complaint. For relatively low values, \( t \leq t_L \) the optimal export \( q_{2B}^{AD} \leq \kappa \) and therefore \( B \) will not be preoccupied about limiting its exports, and this no matter how \( t \) is used as a signaling device.

5 Econometric Analysis of the Effects of EU AD activity on Trade Diversion

The rest of the paper turns to the econometric analysis to see whether there is empirical evidence of AD policy acting as a signaling device. In the jargon of the empirical literature on trade effects of antidumping, firm \( A \) is refereed to as the named country and firm \( B \) as the non-named country. This terminology is hence adopted in the rest of the paper. The aim of the test is to determine whether there is evidence that the imposition of a duty can restrain exports from non-named countries.

At this point, it is important to justify the theoretical model with respect to the empirical analysis. Typically, in the real world, non-named firms compete in both periods 1 and 2. The theoretical model developed above, however, is in one where firm \( B \), i.e. the non-named firm enters the market in period 2. One way to extend the model, in which firm \( B \) competes in periods 1 and 2, as shown by Miyagiwa and Ohno (1998), is to think of firm \( B \) as having relatively high marginal and therefore exporting a small quantity in period 1. Being a minor exporter, firm \( B \) is not included in the AD petition initiated against \( A \). After observing the antidumping decision on firm \( A \), firm \( B \) contemplates R&D investment which is to reduce its marginal cost, and enables it to capture larger market share in period 2. This extension is not carried out for this paper since the main objective is not whether the non-named firm exported to the \( H \) market in the first period but rather to see if the size of the antidumping duty on named firms influence exports from non-named firms.

The empirical analysis consists of a very simple experiment. The aim here is to test whether the size of the duty matters in explaining trade diversion. For this purpose imports from non-named countries into the EU are collected and for all cases that ended up in an imposition of a duty. The sample is then split in two low versus high duties. A priori, without the theoretical evidence, one expects trade diversion to be rather low for the first
group and high for the second. However, as it will be shown, this paper finds evidence that for low AD duties, trade diversion is positive and significant, whereas for high duties, trade diversion is low and not significant.

5.1 The Empirical Analysis

To examine the trade effects on non-named countries that result from European antidumping investigations, a time-series trade data is constructed for all cases initiated between 1997 and 2002. The antidumping cases identified are collected from Chad Bowns Global Antidumping Database version 3.0. For each antidumping initiation, the annual trade data for non-named countries is collected from EUROSTAT by using the 8-digit Harmonized System (HS) Code for each product mentioned in the investigations. For each product, import values by country of origin were collected for eight consecutive years, including one year prior to the initiation, the year of initiation, the period of investigation following the initiation (which is on average twelve months), and the period of protection (which is five years if the investigation is concluded affirmative).

In order to compare imports over time, the time series were deflated using GDP-price deflators. Note that for the antidumping investigation period mentioned above, the actual data collected runs from 1996 to 2007. During this period, the European Union has increased from 15 members to 27 member countries in 2007. This potentially causes some problems, because the market size is not constant throughout the analysis. In order to avoid dealing with increases in market size, the EU domestic market considered is the EU-15 member countries. The trade values for the EU-15 are provided by EUROSTAT and therefore facilitate the analysis significantly.

The main objective of econometric analysis is to determine the effect of antidumping duties on how imports are shifted from named countries to non-named countries. The dataset for the econometric analysis is a pool of all the products reviewed in antidumping investigations during the period 1997-2002 in which data on the magnitude of the duty is given. Since more than one county can be named in an investigation, the duty computed is a trade weighted data of the product under review. In addition to the dataset constructed above, this paper also carries out the same tests by using the dataset produced by Konings, Vandenbussche and Springael (2001). The two datasets are exactly the same, save for one used by Konings and al results from European antidumping cases initiated in the period 1985-1990.

The basic specification used for the estimation is the one proposed by Konings, Vandenbussche and Springael (2001) and takes the following gen-
The variable $\ln x_{i,t_k}$ denotes the value of the natural log of imports for product $i$ at time $t_k$ ($k = 0, \ldots, 6$). Time zero, denoted by $k = 0$, corresponds to the year of antidumping initiation. The period of investigation lasts on average one year, and is denoted by period $k = 1$ during which the outcome of the investigation is still not determined. If the investigation is concluded affirmatively, the antidumping measure lasts for five years and therefore corresponds to the period 2 to 6. However, during the period of investigation, provisional duties are imposed; hence the protection period runs from 1 to 6.

The first explanatory variable, $\ln x_{i,t_{k-1}}$, denotes the imports in the year prior to initiation. This variable is included as a control for the initial import size effects and for the evolution of imports prior to the antidumping investigation. The other explanatory variables include a dummy $D$ equal to 1 if a duty is imposed for the product under review and a year dummy as a control for unobserved fixed effects, such as macroeconomic trends for instance.

Separate equations are estimated for cases in which low and high duties are imposed. The problem that arises is to choose the cutoff rate at which to split the data into the respective low and high duties. The most natural candidate that comes to mind is the average duty of the sample, however, the experiment here is carried out using several different cutoff rates.

The main estimation method of model is an OLS with heteroskedastic consistent standard errors. The reason for this lies in the nature of the data. Observations within a case are not independent over time, while observations across different antidumping cases are; hence, when estimating model (1), each product is considered as one cluster.

### 5.2 Econometric Results

Tables 1 and 2 show the result of the econometric analysis performed both by using the dataset constructed for the present analysis (denoted by AK) and the dataset used by Konings Vandenbussche and Springael (KVS). The tests are carried out by using several different values of the trade weighted duties to split the data into low versus high duties. The first duty level used as a cutoff rate (as denoted by $t^*$ in the tables) is simply the average mean, equal to 33 % for the AK and 26 % for KVS dataset. The rest are shown in the table.
Table 1: Effects of Low versus High Duties on Non-Named Countries

<table>
<thead>
<tr>
<th></th>
<th>$t^c = 0.33$</th>
<th>$t^c = 0.45$</th>
<th>$t^c = 0.70$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(mean)</td>
<td>(mean)</td>
<td>(mean)</td>
</tr>
<tr>
<td>AK: 1997-2002</td>
<td>Low $t$</td>
<td>High $t$</td>
<td>Low $t$</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>$\ln x_{i,t_{k-1}}$</td>
<td>0.59***</td>
<td>0.68***</td>
<td>0.59***</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.07)</td>
<td>(0.07)</td>
</tr>
<tr>
<td>Duty $D$</td>
<td>0.30</td>
<td>0.29</td>
<td>0.37*</td>
</tr>
<tr>
<td></td>
<td>(0.27)</td>
<td>(0.21)</td>
<td>(0.22)</td>
</tr>
</tbody>
</table>

Year Dummies Yes Yes Yes
Sector Dummies No No No
$R^2$ 0.46 0.73 0.48 0.80 0.49 0.83
Observation 317 219 401 135 450 86

Notes: Standard errors in parentheses.

** and * indicate significance at 1% and 10% respectively.

Column 1 and 2 in table 1 shows the result of the regression of AD action on imports from non-named countries. Unfortunately, the results are not decisive, because there is no significant effect of antidumping action on imports from non-named countries in both the low and high group. Fortunately, the results from columns 1 and 2 from the KVS data show interesting results. In particular, the regression results show that in the low duty group, antidumping action on named countries has a positive and significant effect on imports from non-named countries, while in the high duty group this effect is absent. This result is new and goes in the direction of stating that AD policy can act as a signaling device.

Since the first two columns of the AK data where not a great success, the experiment is carried once again by choosing this time a higher duty as threshold value. By using a duty rate equal to 45% to split the data into, the results become interesting. As can be seen in column 3 (table 1), for antidumping cases ending up with a duty less than 45%, the effect on the imports from non-named imports is positive and significant. On the other
Table 2: Effects of Low versus High Duties on Non-Named Countries

<table>
<thead>
<tr>
<th></th>
<th>$t^c = 0.26$ (mean)</th>
<th>$t^c = 0.6$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low $t$</td>
<td>High $t$</td>
</tr>
<tr>
<td>$ln x_{i,t_k-1}$</td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td>0.80***</td>
<td>0.69***</td>
</tr>
<tr>
<td></td>
<td>(0.13)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>Duty $D$</td>
<td>0.17*</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.26)</td>
</tr>
<tr>
<td>Year Dummies</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sector Dummies</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.93</td>
<td>0.89</td>
</tr>
<tr>
<td>Observation</td>
<td>308</td>
<td>140</td>
</tr>
</tbody>
</table>

Notes: Standard errors in parentheses. * *** and * indicate significance at 1% and 10% respectively.

hand, Column (4) shows differently for the high duty group. Imports from non-named countries is no longer significant. In fact, the sign of the coefficient is shown to be negative, pointing more toward a decrease in imports rather than an increase. Having found this negative sign in front of the $D$ coefficient, makes it worthwhile to pick a very high duty as a threshold, to see how imports in the high duty group are affected.

Repeating the test once again with threshold duty of 70% for the AK data, the result seems to confirm that AD policy has a signaling effect across countries not named in the investigation. Indeed, results form column (5) show that in the low duty group, trade diversion is still positive and significant. However, column (6) provides two new insights with respect to column (4). First, the duty ($D$) coefficient has become more negative previously, and second the standard error makes the coefficient in (6) more significant than in (4).

A final consideration, is to also pick a high threshold value for the KVS dataset. By choosing a threshold equal to 60%, the result show the same
as in table 1. In particular, column (4) shows that the coefficient of the duty \((D)\) is negative but not significant. For the low group however, the coefficient \(D\) is no longer significant. One explanation is that since the duty chosen is relatively high, AD cases in the low group, especially the one for which the duty imposed is between 26 and 60 \% make the the coefficient not significant.

6 Conclusion

This paper attempted to provide a new insight into the AD effects on trade diversion. The model is a first attempt to focus on the signaling effects of antidumping action. The main result of the model is that as an antidumping duty is imposed upon the major exporter, this creates an opportunity for a minor exporter to increase its exports, this is referred to by the literature as the trade diversion effects of antidumping policy. Without AD policy acting as signaling device, trade diversion is an increasing function of the duty imposed. However, once AD acts as a signaling device, then a high duty signals to the minor exporter that it could also expect a high duty should it increase its exports above an accepted level. The minor exporter will limit its exports to avoid being scrutinized in AD investigation.

This paper also tested empirically to see if AD could be used as a signaling device. The econometric analysis provided evidence that when duties against named countries are low, then trade diversion to non-named countries is positive and significant. However, when the test is carried out for the group where duties are high, then trade diversion is very low and not significant.

References


7 Appendix

Proof of Lemma 1

The original and complete proof is given by Ericson (1969), however the proof provided here is much simpler and is taken from Leslie (2004, 2005).

Consider the following regression line:
\[ \tilde{\tau} = a + bt \]
where \( a \) and \( b \) are the regression coefficients. The distribution of errors is then
\[ v = \tau - \tilde{\tau} \]
\[ \Rightarrow \tau = a + bt + v \]

First, it follows from \( E(v) = 0 \) that
\[ E(v) = \tau - \tilde{\tau} = \mu - a + b\mu = 0 \]
\[ \Rightarrow a = (1 - b)\mu \]

Second, since \( \tilde{\tau} \) is an unbiased estimator of \( \tau \) at all points along the regression line, it follows that \( E(v \mid \tilde{\tau}) = 0 \), i.e. \( cov(\tilde{\tau}, v) = 0 \). Consequently:

\[
cov(\tilde{\tau}, v) = E(\tilde{\tau}v) - E(\tilde{\tau})E(v)
= E(\tilde{\tau}v)
= E[(a + bt)(\tau - a - bt)]
\]

By simplifying and noting that \( E(t^2) = (\sigma^2_{\tau} + \sigma^2_{\epsilon}) - \mu^2 \) and \( a = (1 - b)\mu \), the following expression is obtained:
\[
cov(\tilde{\tau}, v) = (1 - b)b\sigma^2_{\tau} - b^2\sigma^2_{\epsilon}
\]

It can easily be seen that the value of \( b \) that ensures a zero covariance is calculated as:
\[ b = \frac{\sigma^2_{\tau}}{\sigma^2_{\tau} + \sigma^2_{\epsilon}} = \xi \]

It follows that:
\[ \tilde{\tau} = (1 - \xi)\mu + \xi t \]