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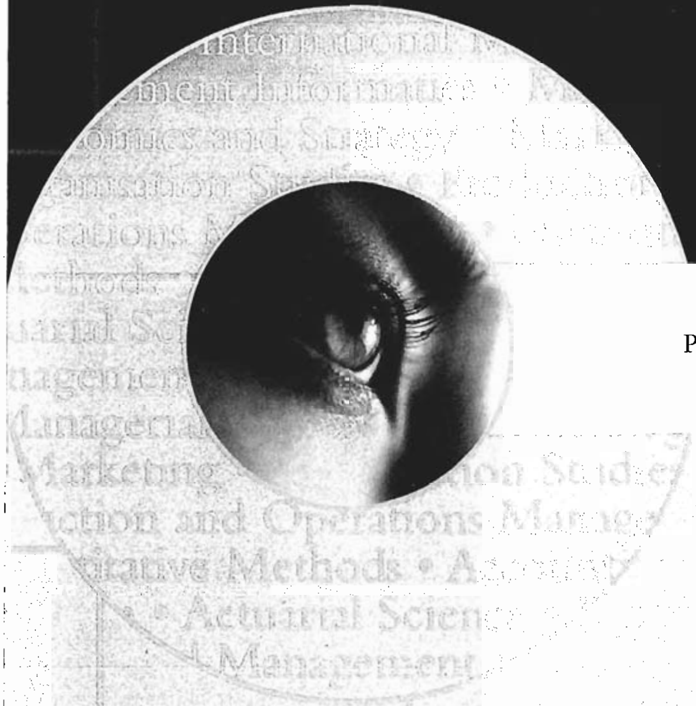

RESEARCH REPORT

ANTIDUMPING PROTECTION AND PRODUCTIVITY GROWTH OF DOMESTIC FIRMS

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Antidumping Protection and Productivity Growth of Domestic Firms

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Abstract

In this paper we provide empirical evidence that Antidumping (AD) Protection can induce technological catching-up by domestic firms affected by the import protection. We identify a panel of 1,793 import-competing domestic firms between 1993 and 2000, directly affected by AD cases that were initiated in 1996. Using a difference-in-difference approach, we find evidence of increased Total Factor Productivity (TFP) growth for firms protected by AD measures compared to firms that did not receive protection. However, our analysis indicates that the effect of protection depends on the "distance to the frontier firm" in the industry. While protection raises TFP growth of "laggard" firms, the reverse holds for domestic firms that are close to the efficiency frontier. These results confirm recent theoretical work supporting the view that protection can induce technological catching-up.

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Antidumping Protection and Productivity Growth of Domestic Firms

I. Introduction

From an economic point of view, there seems to be a growing consensus that in many cases Antidumping policy (AD) is an industrial policy tool in disguise. Rather than being targeted at keeping 'unfair imports' out to safeguard future welfare, it is often aimed at fostering the interests of domestic producers (Lawrence, 1998), irrespective of the intent of importers[1]. However, in view of the industrial policy nature of AD measures, it is surprising that so little empirical work exists on measuring the effects of AD policy on domestic producers[2]. Most empirical work so far has focused on the trade and political economy aspects of AD protection and on the impact on foreign producers[3]. In contrast, the focus of this paper is on the effects of AD protection on the performance of domestic firms in the importing country that compete with the foreign product. In particular, we look at the effects of AD protection on domestic firms' total factor productivity growth.

A priori, the relationship between protection and productivity growth is not an unambiguous one. On the basis of the Schumpeterian idea that a relaxation of competition raises firms' incentives to invest in cost reducing technology, we would expect to find a positive relationship between trade protection and productivity growth. Rodrik (1992) points out that if protection induces a higher effective market size, a technologically backward producer will invest in catching-up. However, when oligopolistic interactions are considered in the home market and firms can commit to cost reducing investments before product market competition takes place, incentives can go either way, depending on the mode of strategic conduct. Miyagiwa and Ohno (1995,1999), use a dynamic model to show that irrespective of the mode of strategic conduct, temporary tariff protection can speed up the adoption of cost reducing new technology by the protected domestic firms, provided there exists an exogenous ending date of protection[4]. However, this result may be reversed when firms interact in more than one market. In particular, Gao and Miyagiwa (2003) show in a reciprocal dumping

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[1] Shin (1998) provides evidence that less than 10% of AD cases are about predatory intent, arguably the only economic rationale for protecting against dumped imports.

[2] A small number of papers have looked at the effects of trade policy on abnormal returns of domestic US producers using stock market data (e.g. Lenway et al., 1990; Hartigan et al., 1989 and Blonigen et al., 2002). These studies all identify potential excess returns from import relief.

[3] Empirically, a large range of trade aspects of AD have already been well documented like the inward FDI effects (Blonigen, 2002), trade restrictiveness (Staiger and Wolak, 1994; Prusa, 1997, Konings et al. 1999), retaliation aspects (Blonigen and Bown, 2003), pass-through effects (Blonigen and Haynes, 2002) and others. Also, the political economy aspects of AD have formed the subject of many studies including Finger et al. (1982), Tharakan and Waelbroeck (1994), Moore (1992) and Hansen and Prusa (1997).

[4] When the ending date of protection is endogenous, i.e. if it depends on when firms adopt the new technology, protection delays adoption. Everaert (2004) extends their model to the case of AD price undertakings in the European AD context.

model that when both the home and the foreign firm compete in each others' markets incentives to invest in cost reducing technology are reduced when a single government imposes AD actions. Finally, Crowley (2002) shows in a multi-country setting that country-specific AD duties induce both import-competing and non-dumping foreign exporting firms to adopt new technology earlier compared to free trade, however, when duties are worldwide, like a safeguard tariff only the import-competing firms accelerate technology adoption.

In Section II, we extend the Miyagiwa and Ohno (1995) framework to bring out two additional results that were not explicitly treated in their paper, but that will prove useful in further motivating and understanding our empirical results. One is that we show that the productivity effects of a duty are stronger for 'laggard' home firms, compared to efficient home firms that operate closer to the technology frontier. Another result is to show that when we allow for differentiated products, it becomes clear that the effect of duty protection on restructuring[5] is stronger in industries with homogeneous goods compared to those with differentiated products. Firms that file for AD-protection are typically selling a good that is relatively homogeneous compared to the imported foreign product, since by law, the foreign product has to be a 'like product' of the domestically produced product for an AD-case to be eligible. It is exactly in this case that the theoretical framework suggests that the impact of a duty on productivity growth can be expected to be strongest.

To empirically test for changes in productivity growth as a result of AD protection, we will use the 1996 European AD cases and the domestic producers affected by them. We identify 1,793 EU firms directly affected by the AD policy and use their corresponding firm level company accounts data to obtain output and input measures between 1993 and 2000 to estimate Total Factor Productivity (TFP) growth before and after AD protection. We estimate TFP growth using the approach proposed by Olley and Pakes (1996) to correct for sample selection and the endogeneity of input factors. Our empirical analysis consists of two steps. In step 1, we estimate TFP for the firms involved in AD-cases. This will be done on a product-by-product basis. In a second step we use a difference-in-difference approach to evaluate the effect of AD-protection on firm level TFP growth. We use several control groups in the difference-in difference approach. One consisting of all AD cases that did not receive protection and another where we randomly draw a control group of 1,002 firms in industries similar to the AD industries but not involved in AD cases. Our results clearly indicate that the average productivity growth of domestic firms after protection (1997-2000) goes up compared to the free trade period (1993-1996) before protection and compared to the two control groups that we use.

[5] We use the word restructuring to refer to firms engaging in cost reducing investment, broadly defined and interpreted.

While we study the effects of trade protection on productivity growth of firms, there exists a literature that has analyzed the effects of trade liberalization on firm level TFP. Levinsohn (1993), Harrison (1994) and Tybout and Westbrook (1995) and more recently Pavcnik (2002) for Chile, all point in the direction that trade liberalization raises productivity of domestic firms in developing countries. These studies consider firms that belong to the manufacturing sector as a whole, including import competing and export oriented firms and are therefore more general equilibrium in nature than our study. Their results can be regarded as the outcome of a macro-economic trade liberalization policy where productivity growth can come from the exit of less productive firms and a reallocation of resources across different sectors. Our analysis in this paper is much more partial equilibrium. We will only consider the productivity effects of trade protection on import-competing firms producing a very close substitute to the imported product. Thus our purpose is to evaluate the effectiveness of AD policy for the domestic firms it is designed to foster, rather than to evaluate its overall welfare effects or desirability. While our results indicate that AD-protection enhances the productivity growth of protected firms, it may well be that the overall effect of AD-protection is to slow down the productivity growth of the economy as a whole. AD-protection may well prevent allocative efficiency to take place in the sense that resources of firms that would be freed up under free trade and reallocated to more productive sectors in the economy, instead stay in place in the import-competing sector which is likely to lower overall welfare[6]. However, our results do suggest that a policy of trade protection can induce technological catching-up and alter the growth path of the firms affected by the policy.

II. Theoretical Framework

In this section we present a simple model which motivates our empirical work. We use the model by Miyagiwa and Ohno (1995) to show that temporary tariff protection with an exogenous ending date results in earlier adoption of new technology compared to free trade[7]. This implies that protected firms have an incentive to restructure and will lower their marginal costs faster under protection than under free trade. The adoption of new technology is modelled as a reduction in marginal cost which corresponds with an increase in TFP. In this paper we bring out two new results that were not explicitly treated by Miyagiwa and Ohno (1995). First, we show that the effect of protection on the implementation of cost reducing new technology depends on the *efficiency level* of the protected home firms. We find protection to have more of an effect on less efficient home firms, in other words, while protection speeds up the adoption of new technology by 'laggard' home firms, this is far less

[6] Gallaway et al. (1999) have estimated the welfare cost of US AD and CVD law at $4 billion a year.
[7] Antidumping Protection in the EU lasts for 5 years ('Sunset Clause').

the case for home firms that already operate closer to the technology frontier. Our empirical results will confirm that there is firm heterogeneity in the effects of duty protection. Second, we also introduce product differentiation into the model and show that a duty sorts more effect when products are homogeneous than when products are differentiated. This implies that AD-cases are a very good area to look for potential increased productivity as a result of protection, since by law, import-competing products have to be close substitutes to the foreign imported products, for an AD-investigation to start.

We first start by deriving the Miyagiwa and Ohno (1995) result. Consider a model with two firms, a home (H) and a foreign firm (F), competing for output in the home market in every period t with $t \in [0,+\infty[$. The foreign firm is the most technologically advanced and has a marginal cost $c_{\underline{\theta}}$. The home firm is a technological laggard and operates at a higher marginal cost of production $c_{\bar{\theta}}$ where $c_{\bar{\theta}} > c_{\underline{\theta}}$. Demand in the domestic market for each of the firms is given by

$$P^i = 1 - q^i - bq^j \qquad \text{with i,j = H,F and } i \neq j \qquad (1)$$

where we normalize market size to 1 and parameter b is the extent of product differentiation between the home and the foreign product and $0 < b \leq 1$. By assumption the marginal costs are lower than the market size $1 > c_{\bar{\theta}} > c_{\underline{\theta}}$.

A cost reducing technology is available and can be adopted at a fixed cost k(t), which falls over time at a decreasing rate k'(t)<0 and k''(t)>0. This makes the adoption cost a negatively sloped convex function over time which is shown in Figure 1. We further assume that by t=0, the firm in the foreign country has adopted this new technology and enjoys a lower marginal cost of production $c_{\underline{\theta}}$. The home firm still uses an old technology and operates at a higher cost of production $c_{\bar{\theta}}$. The home firm compares the cost of adopting this new technology with the gains of technology adoption in each period. However, there is a trade-off, since postponing the technology adoption makes its adoption less costly. So the home firm balances the gains from early adoption against higher costs of early adoption and chooses the timing accordingly. Given that protection affects profits, the profitability of early technology adoption might be altered and hence the timing may change as compared to free trade. This comparison was the central concern in the analysis of Miyagiwa and Ohno (1995). Before the new technology is adopted, the home firm's profits under free trade (FT) are given by

$$\Pi^H{}_{FT,\bar{\theta}} = (P^H - c_{\bar{\theta}})q^H \tag{2}$$

At the time of adoption of new technology t*, a one time fixed cost k(t*) is incurred, which implies that for t >t*, period t home profits equal

$$\Pi^H{}_{\underline{\theta}} = (P^H - c_{\underline{\theta}})q^H \tag{3}$$

While the foreign profits at any time during free trade (FT) are

$$\Pi^F{}_{FT,\underline{\theta}} = (P^F - c_{\underline{\theta}})q^F \tag{4}$$

Without loss of generality we set $c_{\underline{\theta}}$=0 and simplify notation now by writing $c_{\bar{\theta}}$ as c >0. It is easy to show that lower marginal production cost of the foreign firm will result in a lower equilibrium price for that firm compared to the home firm, which allows the home firm to apply for antidumping protection.[8] When the home government installs an AD-duty τ, the foreign firm's profits after protection (D) become

$$\Pi^F{}_{D,\underline{\theta}} = (P^F - \tau)q^F \tag{5}$$

II.1. Free Trade

A any t < t*, i.e. before the adoption date,under free trade the outcome of the Cournot game is characterized by the solution to the following problem

$$\max_{q^H} \quad \Pi^H{}_{FT,\bar{\theta}} = (P^H - c_{\bar{\theta}})q^H \tag{6}$$

$$\max_{q^F} \quad \Pi^F{}_{FT,\underline{\theta}} = P^F q^F \tag{7}$$

Equilibrium profits at t < t* are as follows

[8] Foreign price-undercutting in the domestic market is one of the most important injury criteria in Antidumping cases.

$$\Pi^{H}{}_{FT,\bar{\theta}} = \frac{(2-b-2c)^2}{(4-b^2)^2} \tag{8}$$

$$\Pi^{F}{}_{FT,\underline{\theta}} = \frac{(2-b+bc)^2}{(4-b^2)^2} \tag{9}$$

The characterization of the equilibrium at t> t* is easy since the marginal costs of both firms in that case will be the same as both have adopted the new technology. The equilibrium is symmetric and equilibrium profits are equal to

$$\Pi^{H}{}_{\underline{\theta}} = \Pi^{F}{}_{\underline{\theta}} = \frac{(2-b)^2}{(4-b^2)^2} \tag{10}$$

Note that the home firm has an incentive to adopt the new technology since $\Pi^{H}{}_{\underline{\theta}} > \Pi^{H}{}_{\bar{\theta}}$. The optimal timing of technology adoption under the case of free trade, t*, is chosen by maximising the following inter-temporal profit function (Miyagiwa and Ohno, 1995)

$$\max_{t^*} \quad \Psi = \int_0^{t^*} e^{-rt}\Pi^{H}{}_{FT,\bar{\theta}}dt + \int_{t^*}^{+\infty} e^{-rt}\Pi^{H}{}_{FT,\underline{\theta}}dt - e^{-rt^*}k(t^*) \tag{11}$$

where r denotes a given interest rate. The first and second integral represent the discounted sum of profits before and after the adoption of new technology, respectively whereas the last term is the present discounted value of the adoption cost.

Miyagiwa and Ohno (1995) have shown that the solution to t* is given by the following equilibrium condition

$$rk(t) - k'(t) = \Pi^{H}{}_{FT,\underline{\theta}} - \Pi^{H}{}_{FT,\bar{\theta}} \tag{12}$$

This expression equates the marginal cost to the marginal benefit of technology adoption at time t. The left hand side represents the marginal benefit of waiting one period: the home firm benefits from investing the money k(t) in an alternative use and earns rk(t) and saves on the cost of technology adoption k'(t) by waiting one more period. The right hand side of the equation gives the marginal benefit of adopting the new technology now.

Graphically, in figure 1, the optimal timing of technology adoption t*, is found at the intersection of benefits and costs. Note that the benefit of technology adoption is independent over time. To see whether duties change the timing of technology adoption one has to compare the marginal benefit of technology adoption with and without protection.

II.2. Protection

The temporary character of AD-protection lies in the fact that we assume that after a fixed period of protection T, free trade is back in place. Also we assume that the length of the protection period T, is longer than the date of technology adoption under free trade t*.

The equilibrium condition for optimal timing of investment entails the marginal benefit of technology adoption by the home firm. Therefore our focus lies on the profits of the home firm. In the case of duty protection, the home profits before technology adoption are given by

$$\Pi^{H}{}_{D,\bar{\theta}} = \frac{(2-b-2c+b\tau)^2}{(4-b^2)^2} \tag{13}$$

After technology adoption, home profits during protection are

$$\Pi^{H}{}_{D,\underline{\theta}} = \frac{(2-b+b\tau)^2}{(4-b^2)^2} \tag{14}$$

The optimal timing for cost reducing investment under protection $t_\tau$is then derived from the following maximand, assuming that adoption occurs before the ending date of the protection.

$$\max_{t_\tau} \quad \Psi = \int_0^{t_\tau} e^{-rt}\Pi^{H}{}_{D,\bar{\theta}}dt + \int_{t_\tau}^{T} e^{-rt}\Pi^{H}{}_{D,\underline{\theta}}dt + \int_{T}^{+\infty} e^{-rt}\Pi^{H}{}_{FT,\underline{\theta}} - e^{-rt_\tau}k(t_\tau) \tag{15}$$

And is found at t_τ that satisfies

$$rk(t) - k'(t) = \Pi^{H}{}_{D,\underline{\theta}} - \Pi^{H}{}_{D,\bar{\theta}} \tag{16}$$

Miyagiwa and Ohno (1995) argue that duty protection speeds up the timing of technology adoption compared to free trade (t_τ < t*), by showing that the marginal benefit of adoption with protection has to be larger than the one without protection, or:

$$\Pi^{H}{}_{D,\underline{\theta}} - \Pi^{H}{}_{D,\bar{\theta}} \quad > \quad \Pi^{H}{}_{FT,\underline{\theta}} - \Pi^{H}{}_{FT,\bar{\theta}} \tag{17}$$

In other words, Miyagiwa and Ohno have shown that a tariff raises the marginal benefit of technology adoption. Or, that the derivative of the marginal benefit of technology adoption is an increasing function of the duty

$$\frac{\partial(\Pi^{H}{}_{D,\underline{\theta}} - \Pi^{H}{}_{D,\bar{\theta}})}{\partial \tau} = \frac{4bc}{(4-b^{2})^{2}} \quad > \quad 0 \tag{18}$$

The finding that trade protection by the home country results in higher productivity growth of the home firm, at the expense of productivity growth of the foreign firm abroad, corresponds with the recent findings of Melitz and Ottaviano (2003). Using a monopolistic competition model and allowing for entry and exit of firms, they look amongst others at the effects of increased product market competition on firm level efficiency. They find that a country that liberalizes its trade, results in a deterioration of domestic firm productivity while the foreign firms experiences productivity improvement. While their model holds many more results than the one reported here, we just focus on the notion that corresponds with the theoretical framework used here which points out that trade protection on foreign imports raises the incentives of domestic firms to invest in productivity growth.

A result that is not made explicit by Miyagiwa and Ohno (1995) but present in their model is that a tariff on imports has different effects depending on the efficiency level of the home firm. This can be seen by taking the cross-derivative with respect to the home marginal cost of production. It can be verified that this derivative is positive, implying that the more inefficient the home firm, the more an AD duty speeds up the adoption of new technology. Or in other words, AD protection sorts more of an effect for 'laggard' home firms compared to home firms that operate at an efficiency level closer to the technology frontier.

$$\frac{\partial}{\partial c}\left(\frac{\partial(\Pi^{H}{}_{D,\underline{\theta}} - \Pi^{H}{}_{D,\bar{\theta}})}{\partial \tau}\right) = \frac{4b}{(4-b^{2})^{2}} \quad > \quad 0 \tag{19}$$

This finding is also related to the work of Acemoglu et al. (2003). Using an endogenous growth model they argue that more 'backward' economies may benefit from a limit on product market competition in order to move closer to the world technology frontier. The reason is that anti-competitive policies will increase the productivity gains that the firms in these countries can appropriate from their initial investment costs. However, they also point out that when the 'distance to the frontier' is small, continuing to use import competing protection, may result in a non-convergence trap, where a country/firm will never be able to catch up with the foreign frontier countries/firms. Also, Boone (2000) and Aghion et al.

(2002) argue that a firm's response to competition, depends on its efficiency level. Aghion et al. (2002) show both theoretically and empirically that competition may increase the incremental profit from innovating, but for laggards more competition may reduce innovation incentives.

A second extension that we highlight here is related to the degree of product differentiation in the market. Miyagiwa and Ohno (1995) developed their model under homogeneous Cournot, while here we introduce differentiated products. This allows us to raise another interesting question, namely whether the effect of an AD-duty depends on the degree of product differentiation between the home and the foreign product. This can be seen by taking the cross-derivative with respect to the parameter of product differentiation b, which turns out to be positive. This suggests that as products become more homogeneous and b gets closer to 1, the effect of AD protection speeds up technology adoption more.

$$\frac{\partial}{\partial b}\left(\frac{\partial(\Pi^{H}{}_{D,\underline{\theta}} - \Pi^{H}{}_{D,\bar{\theta}})}{\partial \tau}\right) = \frac{4c(4+3b^2)}{(4-b^2)^3} \quad > \quad 0 \tag{20}$$

In what follows it is not our intention to structurally test the above framework, rather it is a useful guideline for interpreting our empirical evaluation of AD protection on firm behavior. Because we have no information on the timing of adoption of new technology and the type of technology, we interpret technology adoption in the above framework as general efforts of firms to engage in efficiency enhancing restructuring. It is also for this reason that we will focus on firm level productivity growth, which is regarded as a reasonable proxy for technical change (Keller, 2004).

III. The Data

An important innovation of our work is that we will use firm level data to test for the relationship between AD-protection and productivity growth of the protected firms. An AD-case typically involves an investigation against product level imports from exporting countries that are accused of dumping by the import-competing EU industry. The dumping complaint is investigated by the EU Commission and can result in 'Protection' or in 'Termination'. If protection is decided upon, an AD duty on imports is installed on the 'dumped' product and benefits all EU import competing producers of the same product. If the Commission decides to 'terminate' the case, the dumping complaint is rejected and the EU producers do not get import relief. For the purpose of analyzing the relationship between AD-protection and productivity growth of EU producers, we identify EU firms that are competing with the dumped product in the EU market. We obtained their company accounts from a commercial database sold under the name of AMADEUS[9] that runs from 1993-2000. This is a pan-European set of company accounts with harmonized entries for all European enterprises. In view of the time dimension of this data, we focused on the AD-cases initiated and brought to the European Commission for investigation in 1996. This allows us to have a number of annual observations before and after the initiation of an AD-case. This is a useful property for the empirical methodology when we turn to a difference-in-difference approach to study the differential effects of AD-protection on TFP-growth, by making the pre-treatment period to be about equally long as the post-treatment period. Protection, if decided upon, starts one year after the initiation of an AD case, i.e. the years 1997-2000. To identify the EU firms affected by the 1996 AD-cases, we use the information published in the Official Journal of the European Commission. In 1996, 26 new[10] AD Investigations and 3 expiry review[11] cases were initiated, representing 13 different products or product groups. A product is very narrowly defined at the 8 digit HS-product classification. Examples are 'Luggage and Travel Goods', 'Seamless Steel Pipes and Tubes' and 'Cotton Fabrics'. The novelty of our data lies exactly in 'matching' these 8 digit products mentioned in the AD-case, with the EU firms producing these products[12]. However, not all cases offer a sufficient number of observations to carry out a sensible empirical analysis, so we only focus on those cases for which we could find a reasonable number of firm level data [13].

In Table 1 we list the 8 product groups for which we were able to retrieve all the variables from the unconsolidated company accounts, required for our analysis, together with summary statistics of the most important variables required in the first stage of the analysis for estimating TFP per import-competing product group. In 4 cases (by product group), the outcome was protection in the form of an AD-duty, while in 4 other cases, the EU Commission did not grant import relief, after which the case was terminated. In total, these cases represent 1,793 EU import competing firms for which we could retrieve all the required variables to carry out our analysis. Of these, 890 EU firms benefited from AD-protection,

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[9] AMADEUS is a commercial dataset that can usefully be compared to COMPUSTAT data in the US, but in addition to the large and listed firms, our version of AMADEUS also includes small and medium sized enterprises. The AMADEUS data set has increasingly been used in other academic work. Recent examples include Budd, Konings and Slaughter (2004), Smarzynska-Javorcik (2004) and Helpman, Melitz and Yeaple (2004).

[10] The initiation of a case concerning several countries is accounted as separate investigations/proceedings per country involved. We considered only those cases for which products were not subject to AD-protection in the years before.

[11] An 'expiry review' represents a case where protection is in place before 1996 but the EU domestic industry files for new protection because aledged dumping and injury are still carrying on.

[12] In the data appendix we give more details on how this 'matching' was exactly carried out.

[13] For a number of cases we could not identify the firms that were producing the AD product under investigation. For some cases, no initiating firms were mentioned and/or the product description was very specific, which made it impossible or difficult to trace firms producing such products in the firm level data base. For instance, for the case "Dihydrostreptomycin" no initiating firms were mentioned and the product was too specific to be able to trace firms in Amadeus producing this product.

while 903 firms did not. Trade weighted duties range between 0 and 24%, with an average duty of 16%.

In the second column of Table 1 we show the total number of firm-year observations for each case. For clarification, we point out that when the EU Commission decides to impose a duty, it applies to all EU-member states and can be compared to a 'common tariff' protecting the EU market of identical products as a whole against the named dumping countries. Antidumping protection remains in place for five consecutive years, after which AD-measures come off[14].

A number of further remarks are in order here. First, we believe 1996 to be a very average type of year in terms of AD-filings. The number of new initiations in 1996 lies slightly below the average number of annual initiations of 32 in the period 1992-2000, to our knowledge there was neither a sector bias in terms of the type of product under investigation, nor a country bias in terms of the defending countries involved in the year 1996. Therefore we would expect to find the same results when applying our analysis to AD-initiations in different years. Second, the company accounts data provide all the necessary information to estimate production function coefficients and to apply an Olley and Pakes correction. However, one important drawback of using company accounts is the absence of firm level sales prices which would be useful to deflate the firm level value added figure to get a measure for output. Instead many studies on productivity have used industry wide deflators, which is fine as long as the evolution of firm level prices is in line with average industry price levels. However, when there are reasons to believe that firm level prices have risen more than industry prices, the use of industry wide deflators can result in an overestimation of TFP levels as recently shown by Katayama et al (2003). This critique would definitely apply on our empirical analysis, since there are both theoretical and empirical reasons to believe that AD-protection can result in increased sales prices of the domestic firms involved (Konings and Vandenbussche 2003; Prusa, 1994). Therefore, as an alternative to using industry deflators, we looked for a deflator that much more closely would reflect any possible increase in prices resulting from AD-protection. While firm level prices were not at our disposal, the price of goods traded on the EU market were readily available. The idea being that if AD-protection would induce higher prices for their products on the European market after protection, this would show up in the unit values of intra-European trade flows of the products protected by a 'common' AD-duty. These unit values were retrieved over the same time period as our company accounts data. By deflating our output measure with the unit

[14] For one of the 1996 AD-cases in our sample an 'expiry review" investigation was initiated in 2002 (seamless steel pipes and tubes).

values, we avoid that an observed increase in TFP is driven by increased prices[15]. In addition to an aggregate producer price industry deflator and unit values of intra-EU exports, we also experimented with other deflators. In particular, instead of using unit intra-EU *export* values we used unit intra-EU *import* values. In all these cases our results remained robust.

Apart from the firm data that correspond to the AD cases we also retrieved an additional control group of firms, which we use as an exogenous counterfactual to evaluate whether any effect that we pick up after 1997 and attribute to AD protection is not spurious. We constructed a counterfactual group of firms by the random sampling of EU firms, constraining the sampling to 6 sectors, different from the ones already in our data. In the sampling of this counterfactual group we controlled for two aspects. First, in order to have a sufficient number of observations in each product group, we sampled sectors at the 4-digit NACE[16] level and second, we wanted to obtain sectors that were comparable to AD-sectors in terms of their 'openness'. The reason is that sectors with AD-filings are typically very open sectors in terms of their share in extra-EU imports, which is a general property of sectors filing for AD protection.[17] Therefore we ranked the 235 NACE 4-digit sectors according to openness in terms of extra-EU import shares in the year 1996, we constrained the random sampling of firms for our control group in the top 25 % of these sectors, clustered around 6 different product groups, but excluding those sectors that had been subject to AD filings in the past. This resulted in a random control group of 1,002 firms. The sectors these firms are operating in are listed in Table 3 and include products like 'Manufacture of Plastics' and 'Copper Production'.

IV. Empirical Methodology and Results

IV.1. Estimating TFP

The first step in the empirical methodology consists of estimating TFP using our firm level data for each product group. Let us describe firm i's technology at time t by a Cobb-Douglas production function:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \eta_{it} \tag{21}$$

[15] We construct our deflator by dividing the product level intra-EU export values by their corresponding product level intra-EU export volume in each year and then normalized the index to 1 in 1993. The export values exclude costs of freight and insurance and are less subject to measurement error due to misreporting or underreporting for tax purposes as recently suggested by Fisman and Wei (2004).

[16] NACE is the official EUROSTAT industry classification.

[17] For example, for EU AD-cases from 1984-2000, there is a strong positive correlation between 4-digit NACE extra-EU import shares and AD filings.

where y_{it}, denotes the log of real value added[18], l_{it} denotes the log of labor and k_{it}, denotes the log of capital measured by fixed tangible assets. The residual term can be decomposed into a white noise component (η_{it}) and a time varying productivity shock (ω_{it}), the latter known by the firm, but not by the econometrician. An OLS estimation of the above equation would result in inconsistent estimates for the labor and capital coefficients. The reason is that labor is a variable input factor and thus its choice can be affected by the current value of the unobservable productivity shock ω_{it}. In other words, labor is likely to be correlated positively with the error term. This results in an upward bias of the labor coefficient under OLS. Capital is assumed to be a fixed factor of production and is only affected by past values of ω.

To control for this endogeneity bias an IV approach can be applied when estimating (21). The IV General Methods of Moments estimator (GMM) introduced by Arellano and Bond (1991) is one that has often been used in applications using firm level panel data to estimate production functions. However, this estimator requires a large number of cross-section observations to obtain reliable estimators. Pooling all cases together for estimating the production function would be one option, but has the disadvantage that technological differences between sectors are not taken into account. In addition, past values of the endogenous variables may turn out to be inappropriate instruments, for instance in the presence of serial correlation. Instead, we will use a semi-parametric estimation technique as introduced by Olley and Pakes (O-P) (1996), which allows us to estimate the production function (21) consistently for each product group[19]. This approach is based on firm profit maximization behavior in a dynamic framework as developed by Ericson and Pakes (1995). In the appendix we briefly describe the estimation methodology.

An important caveat in estimating TFP is the possibility of measurement error that may plague our analysis. In particular, for the labor input in our production function we use number of employees. Although number of hours worked would have been an input with less measurement error and would more truly reflect the actual use of labor input, this was not available to us. In terms of capital, we used the book value of fixed tangible assets, but we have no information on capacity usage or periods of idle capacity. However a recent paper by

[18] We use a valued added production function as in Olley-Pakes, rather than a gross output function for a number of reasons. First, by using a value added production function we avoid finding a good material inputs price deflator, which is difficult to find as we do not know from our data what type of materials are being used in the production process, we just know the total amount of materials that have been used. Second, by not including material inputs as a regressor we avoid a potential endogeneity problem with material inputs as they are most likely highly correlated with a productivity shock. Third, depending on the specific accounting legislation in the different EU countries where our firms are located, the reporting requirements regarding sales and material costs vary, which results in missing observations on sales and material costs in a number of firms. However, value added is reported in most firms and is hence used as our left hand side variable.

[19] This approach has been used in a number of recent empirical trade papers, examples include Pavcnik (2002), Keller and Yeaple (2003), Smarzynska-Javorcik (2004) amongs others.

Van Biesebroek (2003) compares different methods for estimating production functions on data characterized by known measurement errors and finds that the semi-parametric methods, like the O-P one we use here, is least sensitive to measurement error when estimating productivity growth. In fact, Van Biesebroek (2003) shows that the correlation between estimated and true productivity when using semi-parametric methods remained high, even in the case of measurement error.

Using the estimates of the labor and capital coefficients we compute TFP of firm i at time t, denoted by tfp_{it}, in a standard way or

$$tfp_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it} \tag{22}$$

In Table 2, we report results of the input coefficients based on two different estimation methods, OLS and O-P. As expected, the OLS results in most cases over-estimate the labor coefficients and underestimate the capital coefficients[20]. The O-P estimates in Table 2 stem from our basic specification, where we allowed for exit of firms and included time dummies to control for aggregate shocks in investment. However, we also experimented with various other specifications of the O-P algorithm. The exit we observe in our sample is very limited and may reflect the fact that firms fall below the threshold of the inclusion criteria of the data set. Therefore, a first experiment was, instead of allowing for exits, to set the probability of survival equal to 1. This resulted in a smaller capital coefficient compared to the results in Table 2, but had no effect on our final analysis. We also experimented with excluding time effects in the investment function and with different depreciation rates to compute investment, again our estimated TFP did not change very much and had no effect on our final analysis. The labor coefficient obtained from O-P typically is estimated lower than the one obtained from OLS and the capital coefficient is typically higher, which makes it hard to sign the potential bias in estimating TFP based on OLS. We find a positive and high correlation of 76% between TFP growth based on OLS estimates and on O-P estimates. In the last column of Table 2 we show average TFP growth for the various AD cases that we investigate. We can note that average TFP growth over the entire sample period varies between slightly below zero (cotton fabrics) to 10% (Polyester Fibre and Yarns). We also estimated the OLS and O-P production function coefficients for our randomly selected control group which are reported in Table 3.

In Figure 2, we pool all cases together and plot over time the average TFP for three types of firms: the termination cases, the protection cases and the random counterfactual firms over

[20] In two cases the labor coefficient under OLS is estimated lower than under O-P. This may reflect a negative correlation between the productivity shock and the use of labor, rather than a positive correlation, which is usually the case.

time. It shows that the average TFP improves after protection sets in. This can be seen both in panel A of Figure 2, where we plot the TFP levels as well as in panel B, where we normalize the average TFP to 1 in 1993. Interestingly, from panel A, we note that the average TFP level is higher in termination cases than in protection cases, which indicates that for AD cases which the EU commission terminated, the average efficiency level was higher. We also note that after 1996 when protection sets in, average TFP in the protection cases increases more strongly than in the termination cases. In panel B it becomes clear that after 1996, TFP growth increased more in the protection cases compared to the termination cases and compared to the random counterfactual.

In Table 4 we show how aggregate industry (product level) TFP has evolved and whether its pattern is mainly driven by *within* firm improvements in TFP or mainly by a *reallocation* of market share from less efficient to more efficient firms. We follow the decomposition introduced by Olley and Pakes (1996), where industry productivity is a weighted average of firm level productivity, with shares of industry output as weights or,

$$TFP_t = \sum_{i=1}^{N} s_{it} tfp_{it} \tag{23}$$

where TFP_t is industry productivity at time t that is a weighted average of firm level productivities, tfp_{it} is firm level productivity and s_{it} is firm i's share of output at time t. This index can be decomposed in two terms as follows

$$TFP_t = \sum_{i=1}^{N} (\overline{s_t} + \Delta s_{it})(\overline{tfp_t} + \Delta tfp_{it}) = \overline{tfp_t} + \sum_{i=1}^{N} \Delta s_{it} \Delta tfp_{it} \tag{24}$$

with

$$\Delta s_{it} = s_{it} - \overline{s_t}$$
$$\Delta tfp_{it} = tfp_{it} - \overline{tfp_t}$$

and $\overline{tfp_t}$ and $\overline{s_t}$ represent unweighted average productivity and share, respectively.

This decomposition allows us to disentangle the industry productivity (*TFP_t)* improvement into *within* firm productivity improvements, given by the unweighted average productivity $\overline{tfp_t}$ versus the productivity improvement resulting from *reallocation* of market shares, captured by the covariance term $\sum_{i=1}^{N} \Delta s_{it} \Delta tfp_{it}$. In Table 4 we show for each AD case all three measures. In column 1 we show the aggregate industry productivity measure (TFP_t), the second column shows the unweighted average of firm level productivity $\overline{tfp_t}$ and the third column shows the sample covariance between productivity and output. If industry TFP growth is mainly driven by within firm productivity improvements, we would expect to see high and increasing values in column 2 over time. While in the opposite case, when productivity is mainly driven by reallocation, especially the values in column 3 would appear to be high and increasing.

A first observation arising from Table 4 is that industry productivity (TFP_t) increases more over time in duty cases, than in termination cases. And secondly, Table 4 clearly shows that in all cases, the aggregate increase in TFP is driven by the increase in the unweighted average productivity and therefore by *within* firm productivity improvements, and only to a very small extent by the reallocation component. This suggests that protection mainly affects TFP through *within* firm level restructuring; rather than reallocation, which is consistent with the idea that it is firm level efforts to restructure in response to protection that is driving TFP. In the next section we will test more formally whether this pattern holds up.

IV.2 Evaluating the Effects of AD-Protection: A difference-in-difference approach

Single Difference Equations

As a first step in the analysis we start by reporting the results of single difference equations, where we consider changes in TFP growth of firms pre-and post 1997 by including a time dummy (T97) that gets a value of 1 for observations after 1997 and a value of 0 otherwise. We also include the lagged level of TFP to control for mean reversal and potential serial correlation, although this is less likely to be a problem in our case since we use TFP growth rates as a dependent variable as opposed to productivity levels.

$$\Delta tfp_{it} = \alpha_0 + \alpha_1 tfp_{it-1} + \alpha_2 T97 + \varepsilon_{it} \quad (25)$$

Δtfp_{it} stands for the growth rate in TFP in firm i at time t. The coefficient α_2 captures the average change in productivity after 1997 compared to the average of the period before protection.

In Table 5 we report the magnitude and significance of the coefficient α_2 for the single difference equations for the termination cases, the protection cases and a randomly selected control group. For each single difference equation we report two specifications (below each other), one in which we do not include lagged TFP and one including lagged TFP. The results can be summarized as follows. For the termination cases we find a small positive effect on TFP growth after 1997, but for the protection cases the positive increase in TFP growth after 1997 is larger. The result for the protection cases holds both when we use a protection dummy after 1997 as when we replace the dummy by the trade weighted AD duty. For the randomly selected control group we find no statistically significant increase in TFP growth after 1997.

When we look at the results for the individual cases in Table 6, however, we find some variation across individual AD cases. For the protection cases, listed in the bottom half of Table 6, we find a strong positive effect of AD protection on TFP growth with average increases in productivity growth ranging from 13% points in the "Leather Handbags" case to 3% points in the "Seamless Steel Pipes and Tubes case". One potential explanation for these differences could be the extent to which market share for domestic producers increases after protection. From Figure 3a it becomes clear that in the "seamless steel tubes" case, while the imports from the named countries fell after protection by the EU, the imports from the non-named countries increased strongly. This import diversion could imply that the loss of sales in the EU market of the dumping countries predominantly resulted in an increase in sales in the EU market for the non-dumping importing countries rather than for the domestic producers. Whereas in the case of "Leather Handbags", Figure 3b shows that there was far less import diversion to non-named countries. While the imports of the dumping countries also fell substantially in this case, the benefit in terms of sales did clearly not go to other importing countries but most likely accrued to the domestic EU producers. The increase in market share for the domestic producers could have resulted in a larger incentive for domestic firms to engage in restructuring than it was the case in "Seamless steel tubes".

All protection cases are newly initiated cases, apart from "Polyester Fibres and yarns". This case was initiated in 1996 as an 'expiry review', implying that protection was already in place before 1996 and that in 1997, it was decided by the Commission to extend the protection for another 5 years. After that, the industry no longer applied for an extension of AD protection. What we observe in Table 6 is that during that last period of protection between 1997-2002, the "Polyester Fibres and Yarns" EU producers engaged in restructuring thereby increasing their productivity growth by 13% points.

In two of the four termination cases "Cotton Fabrics" and "Video Tapes", listed in the top half of Table 6, we find no increase in average TFP growth after AD protection. While "Cotton Fabrics" is a new case, "Video Tapes" is initiated in 1996 as an 'expiry review'. But in contrast to the other expiry review case, "Video Tapes" did not get an extension of the protection period, and was terminated in 1997 without protection. For this termination case we do not find an increase in TFP growth after 1997. In the two other newly initiated cases that were terminated, we do find positive but smaller TFP growth after 1997. The strongest effect is found in the termination case, "Luggage and Travel Goods". For this case, we find average TFP growth to increase with 7% points after protection. The likely reason for this 'atypical' termination case is potential contamination in the data. In our data there are a number of EU firms that produce both "Luggage and Travel Goods" and "Leather Handbags". While the EU Commission did not impose duties on the imports of the former products, it did impose AD-duties on "Leather Handbags" during the same period. Even after excluding the EU firms that appeared in both cases, however, we still find a positive effect after 1997 for the "Luggage and Travel Goods", although the point estimate of 7% is estimated smaller than the point estimate of 13% for "Leather Handbags". Overall we can say that the TFP growth in termination cases is usually lower than in protection cases.

The problem with a single difference approach is that we cannot exclude the possibility that the increase in productivity growth after 1997 in the protection cases is driven by other forces than AD protection. To identify the effects of AD-protection better we next turn to a difference-in-difference approach (DD). This type of an approach consists of comparing TFP growth of the 'treated' group i.e. the firms that got AD protection, to a control group of firms. This control group is very similar to the 'treated' group of firms but did not get the treatment i.e. AD protection. This way we can control for all other forces that are common for the treatment group and the control group that may affect TFP growth, apart from AD protection. An increase in TFP growth of the treatment group on top of the TFP growth in the control group properly disentangles the effect of AD protection on TFP growth. That is the essence of the DD approach.

Difference-in-Difference Equations

In order to apply the difference-in-difference approach, the treatment should be a one-time change in government policy. Applied to the issue of the effect of AD protection on TFP growth, this approach suggests that one can compare the TFP growth pattern among firms before and after AD protection with the TFP growth pattern of a control group before and after the protection period. The effect of AD protection is then identified as the estimated difference in differences of TFP growth rates before and after the protection period between the two groups of firms. We first use the Termination cases as a control group. This control group consists of firms that have also applied for protection but did not receive it. Afterwards we turn to a randomly selected control group of European firms that were not involved in any AD-cases during the period of our analysis but that belonged to industries with a similar level of 'openness' compared to the industries involved in the AD cases. Starting with the termination cases as a control group, the DD approach can be summarized as follows:

$$\Delta tfp_{it} = \alpha_0 + \alpha_1 tfp_{it-1} + \alpha_2 PROTECT + \alpha_3 T97 + + \beta_1 T97\_PROTECT + \varepsilon_{it} \qquad (26)$$

PROTECT is a dummy that takes a value of 1 for the entire period, if a firm got protection after 1997. The PROTECT dummy captures any time-invariant differences between the protection firms and the termination firms and hence controls for the fact that firms that receive protection may have some unobserved specific characteristics. T97 is a dummy where both the firms in the control group as well as the firms that got AD-protection after 1997, get a value of 1 after 1997 and a value of zero before. This dummy picks up any time effect on TFP growth that is common to all firms, due to common business cycle effects or other common macro shocks. And finally the term T97_PROTECT is a dummy equal to 1 after 1997 for firms that got protection, which captures the essence of the difference-in-difference approach. This interaction term captures the differential effect that AD-policy has on protected firms versus firms in cases that were terminated after 1997. Thus β_1 captures the additional difference in productivity growth after protection sets in.

One of the potential problems with using a DD approach is the potential serial correlation. Bertrand et al (2004) have shown that not controlling for serial correlation may result in underestimation of standard errors or overestimation of t-statistics. They mainly question the significance of t-statistics around 2, which when not accounting for serial correlation are likely to be false rejections of the null hypothesis of 'no treatment' effect. In our research set up this is less likely to be a problem for three reasons. First, while productivity levels are likely to be correlated over time, this is far less the case with productivity growth rates. Second, the time series we consider here is relatively short. Nevertheless, we control for potential serial correlation in the data by including lagged log of TFP. And third, all the t-statistics we obtain for the 'treatment' effect well exceed 2.

Another assumption that has to be taken into account to justify the use of the DD approach is the randomness of the intervention. If the focus of our work would be to explain imports, clearly there would be a serious concern about the endogeneity of AD protection, however, the focus here is to explain firm level efficiency in which case the endogeneity of AD protection is less obvious. Nevertheless we try to deal with this concern in a number of ways. We experimented with a specification where we include the *level* of TFP in 1996, the year before the AD protection sets in. This variable captures productivity of firms before protection that may affect the AD decision, as an extra control variable. It will become clear below that including TFP in 1996 results in somewhat lower estimates of the treatment effect, but the effect of AD protection on TFP growth is still positive and remains statistically significant. Another way to deal with this is by choosing as a counter-factual the Termination cases, which arguably are most similar in terms of characteristics to the AD cases that received protection. As discussed below, we find that the estimated effects are lower when the

Termination cases are used as a control group compared to a Random control group, but overall the results are still positive and statistically significant.

In the first three columns of Table 7 we report the results of various DD specifications, using the termination cases as a control group. The second column accounts for potential serial correlation by including lagged TFP, while the third column includes the TFP level in 1996 instead. The coefficient of interest is the one on T97_PROTECT , which captures the differential impact on TFP growth after 1997 for the firms receiving AD-protection. In all three specifications the effect of protection after 1997 is positive and statistically significant with estimates varying between 2.8 % to 6.4 % depending on the specification. We note that the coefficient on the T97 which is a dummy equal to 1 from the year 1997 onwards is always positive and significant. This captures common aggregate effects applying to both protection cases and termination cases. The significance of this dummy indicates that not only the protection but also the termination cases have experienced an increase in TFP growth after 1997. Therefore, in the regressions (1) to (3), the interaction term T97_PROTECT captures the *additional* increase in TFP growth that the protection cases have experienced.

An alternative way to check the effects of the intervention is instead of using the termination cases as a control group, to use a random counterfactual control group. In selecting this control group we paid particular attention to selecting industries that are similar in their openness to imports, compared to the AD industries. The results of the DD specifications using the random control group are shown in Table 7 columns (4)-(6). It can be noted from Table 7 that now, the common aggregate effect captured by T97 disappears and the coefficients on the interaction term T97_PROTECT becomes larger, compared to the specifications where we used the terminations as a control group. The effect of AD protection on TFP growth now ranges between 7.2% and 8%. This implies that compared to the random counterfactual firms, the TFP growth of the protected firms in AD cases increased more. This may suggest that in fact termination cases are more similar to the cases that received protection and it could therefore be argued that this is the more proper control group to compare with.

In the last three columns of Table 7, we take both the termination cases and the random counterfactual as a control group. Hence, we now have three 'groups' of cases: Protection cases, Termination cases and Counterfactual cases. This will allow us also to evaluate the effect on TFP growth of 'Filing' in addition to the effect for 'Protection'. We construct a dummy (FILING) equal to 1 either if a firm belongs to the group of firms receiving protection or to firms that got a termination decision. Focusing on column (8) of Table 7 we note that our basic AD-protection effect on TFP growth after 1997 is still estimated positive and statistically significant with a coefficient on T97_PROTECT of 5.4 %. In addition, we also find a positive 'filing' effect on TFP growth of 2.8 %. This suggests that the net effect of AD protection on firm level TFP growth is about 8 % (5.4 %+2.8 %), which is similar to what we found in columns (4) to (6).

Our results seem to be robust with respect to using different counterfactual samples and with respect to whether or not we include lagged TFP or productivity levels prior to protection. Given that we have estimated TFP after taking into account variation in input factors, the increase in TFP we pick up is unlikely to be explained by a scale effect, but seems rather to be consistent with the idea that firms have more incentives to engage in cost reducing restructuring efforts once they receive temporary protection. From our theoretical framework we expect, however, that depending on whether firms are laggards or not the effects of protection are different. In particular, we characterize each firm in terms of its "distance to the frontier firm", where we define 'frontier firm' as the firm with the highest TFP level in a particular industry. In the theoretical section we have shown that the effect of protection will be relatively stronger, the larger the difference in efficiency between the domestic firm and the foreign firm. Since we have no information on the efficiency levels of foreign firms we will take the most productive EU firm as our benchmark frontier firm in a particular sector[21]. Hence for each firm in our data we compute the distance to the frontier firm as the ratio of TFP of firm i, in sector j in 1996, relative to the firm with the maximum TFP level in sector j in 1996:

$$DISTANCE_{ij} = \frac{tfp_i}{\max tfp_j} \tag{27}$$

A distance of 1 implies that a particular firm is as efficient as the frontier firm, while a distance of 0 refers to a "laggard" with very low efficiency compared to the frontier firm. In Table 8 we show the average distance for each of our three groups of firms and for each AD case in our sample. We find a pattern that is quite revealing. First we note that typically those firms involved in affirmative AD-cases are on average further away from the EU frontier firm than those that did not receive protection. The average distance of affirmative AD-cases is 47%, while for termination cases this is 63%. In addition, the average distance to the frontier firm in the termination cases is very similar to the average distance in the randomly selected control group. This suggests that the protection cases can typically be classified as "laggard" industries. When we look at the average distance level of the individual cases we can note that within the termination cases "Cotton fabrics" is more comparable to the protection cases. Although we classify the case "Cotton fabrics" as a termination case it is worth pointing out

[21] Griffith, Redding and Simpson (2002) develop empirically a similar idea to investigate productivity convergence between foreign and domestic UK establishments.

that during the investigation period of the EU Commission a high preliminary duty was imposed on importers. The only reason that the case was terminated was that the 'Commission had exceeded the legal period of investigation and had not reached a final decision after 15 months since the initiation of a case'.

In Table 9 we show the results of our DD specification, but now including the 'DISTANCE96' variable and the interaction of that variable with our previous treatment variable T97_PROTECT. Including the DISTANCE96 measure is a relative measure of past productivity, that just like including the TFP level in 1996, as we did previously, is also an alternative way to control for the potential endogeneity of protection. When we use termination cases as a control group, which is shown in column (1) of Table 9, our basic result still holds. The coefficient of T97_PROTECT is still positive and significant suggesting an average increase in TFP growth resulting from AD protection. In the second column in Table 9, we interact our treatment variable T97_PROTECT with the distance variable 'DISTANCE96'. We find a negative and statistically significant effect of this interaction term. This indicates that the further a firm is away from the EU frontier firm in its corresponding sector, the stronger the impact of protection, which is what we expected on the basis of our theoretical framework. For the frontier firm with a distance equal to '1' the effect of protection becomes in fact negative and is -17 % (0.21-0.38=-0.17), compared to the termination cases. These effects persist when we instead use our randomly selected group of firms, which can be seen from columns (3) and (4). The positive effect of AD protection reduces as firms are closer to the frontier. Based on the estimates of our last column in Table 9, firms with an average distance to the frontier of 71 % or lower will benefit from protection, which holds for most firms in our data.

V. Conclusion

This paper provides empirical evidence that temporary AD protection on average raises the productivity growth of domestic import-competing firms. For this purpose we identified around 2,000 European producers affected by AD cases. While some firms were granted protection, others were not. Our results indicate that protected firms experienced higher TFP growth during the protection period, compared to firms that did not receive AD protection. The TFP growth we measure is one driven by improved technical efficiency within firms, rather than by a reallocation of market shares towards more efficient firms. We also find that the effect of protection is subject to firm heterogeneity. Depending on the relative 'distance to the frontier' firm in the industry, AD protection can either increase or decrease the productivity growth of the domestic firms. While, AD protection especially raises the productivity growth of 'laggard firms' in the industry, this is far less the case for domestic firms closer to the technology frontier. For these firms protection can even result in negative TFP growth. These empirical results confirm recent theoretical findings that have pointed at the relationship between temporary tariff protection and domestic firms' incentives to become more efficient.

It is worth pointing out that the analysis in this paper is not a general equilibrium one and it is therefore not possible to make welfare statements. In fact the overall welfare effects are likely to be negative since AD protection prevents a process of allocative efficiency in the importing country to take place. The results in this paper are therefore best interpreted as an evaluation of the effectiveness of AD policy on domestic firm performance and on the incentives it provides for technological catching-up.

An interesting line of future research would be to do a similar analysis for the US. One distinct feature between the EU and the US implementation of the AD-code is the length of AD-protection. While protection in the EU has always been limited to 5 years, it was not until the end of the Uruguay Round that the US adopted the 'Sunset Review' clause and limited the length of AD protection. Before that time, AD protection in the US had a permanent nature. The question than becomes whether permanent AD protection has provided similar incentives for domestic US firms to engage in restructuring.

Another interesting area for future research would be to consider to what extent the effects under AD duty protection are the same as under price-undertakings, which are a very popular alternative AD measures in the EU. In particular, it is well known that price-undertakings, in contrast to duties, may facilitate price collusion which could reduce the incentive to restructure.

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Table 1: Summary Statistics of key variables per Antidumping Case

AD-Case	Decision	N° of observations	Emp (units)	Cap (000€)	Value Added (000€)
Cotton Fabrics	Termination	3470	57 (115)	1804 (3835)	2323 (4114)
Synthetic Fibre Ropes	Termination	354	61 (90)	1551 (2986)	2375 (4020)
Luggage and Travel Goods	Termination	632	39 (56)	608 (1363)	1446 (2245)
Video Tapes*	Termination	115	371 (724)	12480 (24333)	28266 (53517)
Leather Handbags	Duty	1495	33 (60)	585 (2632)	2064 (21456)
Seamless Steel Pipes and Tubes	Duty	1892	130 (257)	5387 (12413)	6887 (14684)
Polyester Fibre and Yarns*	Duty	360	287 (360)	17402 (31961)	17242 (24275)
Stainless Steel Fasteners	Duty	644	31 (37)	915 (1920)	1477 (2200)

Notes: standard deviations in brackets
Emp: Average firm level employment in number of workers;
Cap: Average firm level Fixed Tangible Assets in thousands of Euros
Value Added: Reported value added in thousands of Euros
TFP growth: Average TFP growth in the product group
* These cases are Expiry Review cases initiated in 1996.

Table 2: OLS and Olley-Pakes estimates of production function coefficients in AD-cases

Coefficient on	Labor OLS β_l	Capital OLS β_k	Labor O-P β_l	Capital O-P β_k	Estimated TFP growth
Termination Cases					
Cotton Fabrics	0.68 (0.01)	0.20 (0.01)	0.66 (0.01)	0.23 (0.02)	-0.006 (0.25)
Synthetic Fibre Ropes	0.76 (0.02)	0.17 (0.01)	0.71 (0.02)	0.18 (0.07)	0.001 (0.22)
Luggage and Travel Goods	0.82 (0.01)	0.19 (0.01)	0.81 (0.01)	0.19 (0.02)	0.018 (0.28)
Video Tapes	0.37 (0.08)	0.38 (0.06)	0.43 (0.12)	0.25 (0.33)	0.05 (0.42)
Affirmative AD cases					
Leather Handbags	0.66 (0.03)	0.24 (0.02)	0.66 (0.03)	0.29 (0.02)	0.07 (0.34)
Seamless Pipes and Tubes	0.68 (0.02)	0.27 (0.01)	0.64 (0.02)	0.28 (0.03)	0.039 (0.31)
Polyester Fibres and Yarns	0.57 (0.04)	0.30 (0.03)	0.64 (0.04)	0.41 (0.07)	0.09 (0.38)
Stainless Steel Fasteners	0.87 (0.02)	0.17 (0.01)	0.79 (0.03)	0.23 (0.11)	0.06 (0.26)

Note: Standard Errors in Brackets, the last column reports simple averages, with standard deviations in brackets.

Table 3: OLS and Olley-Pakes estimates of production coefficients for the random control group

	Labor OLS β_l	Capital OLS β_k	Labor O-P β_l	Capital O-P β_k	Estimated TFP growth
Manufacture of metal structures	0.67 (0.02)	0.21 (0.01)	0.66 (0.02)	0.26 (0.04)	0.035 (0.28)
Inorganic basic chemicals	0.69 (0.03)	0.26 (0.02)	0.60 (0.03)	0.35 (0.19)	-0.04 (0.20)
Processing and Preserving of fruit and vegetables	0.45 (0.02)	0.39 (0.02)	0.37 (0.03)	0.31 (0.14)	0.07 (0.22)
Wine manufacturing	0.61 (0.02)	0.20 (0.02)	0.54 (0.02)	0.21 (0.09)	0.01 (0.16)
Plastics in primary form	0.56 (0.02)	0.30 (0.01)	0.49 (0.02)	0.23 (0.09)	0.04 (0.18)
Copper Production	0.71 (0.02)	0.25 (0.02)	0.67 (0.02)	0.25 (0.05)	0.017 (0.19)

Note: Standard Errors in Brackets, the last column reports simple averages, with standard deviations in brackets.

Table 4: Olley-Pakes Productivity Decomposition

Cotton Fabrics (Termination)				Handbags (Duty)			
Year	TFP_t	$\overline{tfp_t}$	$\sum_{i=1}^{N} \Delta s_{it} \Delta tfp_{it}$	Year	TFP_t	$\overline{tfp_t}$	$\sum_{i=1}^{N} \Delta s_{it} \Delta tfp_{it}$
1993	1	0.99	0.01	1993	1	0.99	0.01
1994	0.98	0.97	0.01	1994	0.98	0.97	0.01
1995	0.97	0.96	0.01	1995	1.00	0.98	0.02
1996	0.95	0.94	0.01	1996	1.00	0.98	0.02
1997	0.93	0.92	0.01	1997	0.98	0.97	0.01
1998	0.95	0.94	0.01	1998	1.10	1.08	0.02
1999	0.96	0.95	0.01	1999	1.17	1.16	0.01
2000	0.98	0.97	0.01	2000	1.11	1.10	0.01
Synthetic Fibre Ropes (Termination)				**Seamless Pipes and Tubes (Duty)**			
Year	TFP_t	$\overline{tfp_t}$	$\sum_{i=1}^{N} \Delta s_{it} \Delta tfp_{it}$	Year	TFP_t	$\overline{tfp_t}$	$\sum_{i=1}^{N} \Delta s_{it} \Delta tfp_{it}$
1993	1	0.99	0.01	1993	1	0.98	0.02
1994	0.99	0.98	0.01	1994	1.03	1.01	0.01
1995	0.91	0.90	0.01	1995	1.05	1.03	0.02
1996	0.93	0.92	0.01	1996	1.04	1.01	0.03
1997	0.95	0.94	0.01	1997	1.06	1.04	0.02
1998	0.98	0.97	0.01	1998	1.07	1.06	0.01
1999	0.98	0.97	0.01	1999	1.09	1.08	0.01
2000	0.97	0.96	0.01	2000	1.10	1.09	0.01
Luggage and Travel Goods (Termination)				**Polyester Fibres and Yarns (Duty)**			
Year	TFP_t	$\overline{tfp_t}$	$\sum_{i=1}^{N} \Delta s_{it} \Delta tfp_{it}$	Year	TFP_t	$\overline{tfp_t}$	$\sum_{i=1}^{N} \Delta s_{it} \Delta tfp_{it}$
1993	1	0.99	0.01	1993	1	0.99	0.01
1994	1.05	1.04	0.01	1994	0.97	0.97	0.00
1995	1.03	1.02	0.01	1995	0.98	0.97	0.01
1996	1.00	0.99	0.01	1996	1.02	1.02	0.00
1997	1.02	1.01	0.01	1997	1.03	1.02	0.01
1998	1.03	1.02	0.01	1998	1.30	1.29	0.01
1999	1.05	1.04	0.01	1999	1.20	1.18	0.02
2000	1.11	1.10	0.01	2000	1.26	1.25	0.01
Video Tapes (Termination)				**Stainless Steel Fasteners (Duty)**			
Year	TFP_t	$\overline{tfp_t}$	$\sum_{i=1}^{N} \Delta s_{it} \Delta tfp_{it}$	Year	TFP_t	$\overline{tfp_t}$	$\sum_{i=1}^{N} \Delta s_{it} \Delta tfp_{it}$
1993	1	0.98	0.02	1993	1	0.99	0.01
1994	1.06	1.04	0.02	1994	0.97	0.96	0.01
1995	1.04	1.02	0.02	1995	0.90	0.89	0.01
1996	1.06	1.04	0.02	1996	0.94	0.93	0.01
1997	1.15	1.14	0.01	1997	0.99	0.98	0.01
1998	1.07	1.05	0.02	1998	1.02	1.00	0.02
1999	1.06	1.05	0.01	1999	1.07	1.07	0.00
2000	1.02	0.99	0.03	2000	1.06	1.05	0.01

Table 5: Single Difference Equations for Pooled cases

$$\Delta tfp_{it} = \alpha_0 + \alpha_1 tfp_{it-1} + \alpha_2 T97 + \varepsilon_{it}$$

	α_1	α_2	# obs.	R^2
Termination Cases	-	0.03** (0.007)	4571	0.01
Termination Cases	-0.21** (0.01)	0.01** (0.006)	4571	0.12
Protection Cases	-	0.057** (0.008)	4391	0.01
Protection Cases	-0.19** (0.02)	0.08** (0.009)	4391	0.10
Protection cases, using trade weighted duties instead of time dummy T97	_	0.29** (0.04)	4391	0.01
Protection cases, using trade weighted duties instead of time dummy T97	-0.19** (0.02)	0.41** (0.04)	4391	0.10
Random control group	-	-0.013 (0.007)	5461	0.01
Random control group	-0.18** (0.010)	-0.001 (0.011)	5461	0.10

Notes: (i) Heteroskedastic Robust standard errors in brackets, (ii) ** refers to statistically significant different from zero at the 5% critical level or lower, (iii) all equations include country firm location fixed effects and case fixed effects.

Table 6: Single Difference Equations for Individual AD cases

	α_1	α_2	R^2
Termination cases			
Cotton Fabrics	-0.20** (0.015)	0.007 (0.007)	0.12
Synthetic Fibre Ropes	-0.22** (0.052)	0.031** (0.015)	0.12
Luggage and Travel Goods	-0.28** (0.044)	0.071** (0.019)	0.17
Video Tapes	-0.22** (0.055)	-0.034 (0.079)	0.15
Protection cases			
Handbags	-0.17** (0.038)	0.13** (0.016)	0.10
Seamless Pipes and Tubes	-0.19** (0.024)	0.03** (0.01)	0.10
Polyester Fibres and Yarns	-0.27** (0.05)	0.13** (0.036)	0.14
Stainless Steel Fasteners	-0.24** (0.03)	0.12** (0.016)	0.16

Notes: (i) Heteroskedastic Robust standard errors in brackets, (ii) ** refers to statistically significant different from zero at the 5% critical level or lower, (iii) all equations include country firm location fixed effects.

Table 7: Difference in Difference Estimates

Control group =	(1) Termination cases	(2) Termination cases	(3) Termination Cases	(4) Random Counter Factual	(5) Random Counter Factual	(6) Random Counter Factual	(7) Random counter factual and termination cases	(8) Random counter factual and termination cases	(9) Random counter factual and termination cases
tfp_{it-1}	-	-0.16** (0.010)	-	-	-0.11** (0.006)	-	-	-0.12** (0.005)	-
tfp_{i1996}		-	-0.013** (0.005)			-0.005 (0.005)		-	-0.007* (0.004)
T97	0.029** (0.006)	0.017** (0.006)	0.03** (0.007)	-0.014** (0.007)	-0.008 (0.006)	-0.014 (0.007)	-0.014** (0.007)	-0.007 (0.006)	-0.014** (0.007)
PROTECT	0.036** (0.007)	-0.02** (0.008)	0.03** (0.007)	-0.002 (0.007)	-0.10** (0.009)	-0.007 (0.008)	0.037** (0.007)	-0.003 (0.007)	0.03** (0.007)
FILING	-	-	-	-	-	-	-0.041** (0.007)	-0.104** (0.007)	-0.045** (0.007)
T97_PROTECT	0.028** (0.011)	0.064** (0.011)	0.028** (0.01)	0.072** (0.011)	0.081** (0.011)	0.072** (0.011)	0.028** (0.011)	0.054** (0.010)	0.028** (0.011)
T97_FILING	-	-	-	-	-	-	0.044** (0.010)	0.028** (0.009)	0.043** (0.010)
R^2	0.02	0.10	0.02	0.01	0.07	0.01	0.01	0.07	0.01
# observations	8962	8962	8962	9852	9852	9852	14423	14423	14423

Note: (i) **/* refer to respectively significance at the 5%/10% level, (ii) Heteroskedastic robust standard errors between brackets, (iii) All equations include firm location fixed effects.

Table 8: Distance to the Frontier

	Distance 1996	Standard Deviation
Termination cases	**0.63**	**0.10**
Cotton Fabrics	0.61	0.09
Synthetic Fibre Ropes	0.71	0.10
Luggage and Travel Goods	0.66	0.10
Video Tapes	0.79	0.11
Protection cases	**0.47**	**0.13**
Leather Handbags	0.34	0.07
Seamless Pipes and Tubes	0.51	0.09
Polyester Fibres and Yarns	0.54	0.13
Stainless Steel Fasteners	0.64	0.08
Random control group	**0.63**	**0.13**

Table 9: Effectiveness of AD protection and Distance to the frontier

	Termination Cases as control group	Termination Cases as control group	Random control group	Random control group
DISTANCE96	-0.064** (0.02)	0.08** (0.02)	-0.06** (0.019)	0.021 (0.023)
T97	0.028** (0.011)	0.029** (0.006)	-0.014** (0.007)	-0.014** (0.007)
PROTECT	0.026** (0.008)	0.049** (0.008)	-0.012* (0.008)	0.000 (0.008)
T97_PROTECT	0.028** (0.01)	0.21** (0.029)	0.072** (0.011)	0.23** (0.027)
T97_PROTECT x DISTANCE96	-	-0.38** (0.05)	-	-0.32** (0.049)
R^2	0.02	0.03	0.01	0.02

Notes:

'Distance to the frontier firm' is defined as follows, $DISTANCE_{ij} = \frac{tfp_i}{\max tfp_j}$ in 1996, implying that for a DISTANCE equal to 1, an individual firm i is equally productive as the frontier firm in sector j, and with a Distance of 0 implying that a firm is very far below the frontier firm in terms of efficiency.

Column (1) and (2) use terminations as a control group in DD, columns (3) and (4) use the random counterfactual as control group.

Figure 1: Optimal Timing for Restructuring (Miyagiwa and Ohno, 1995)

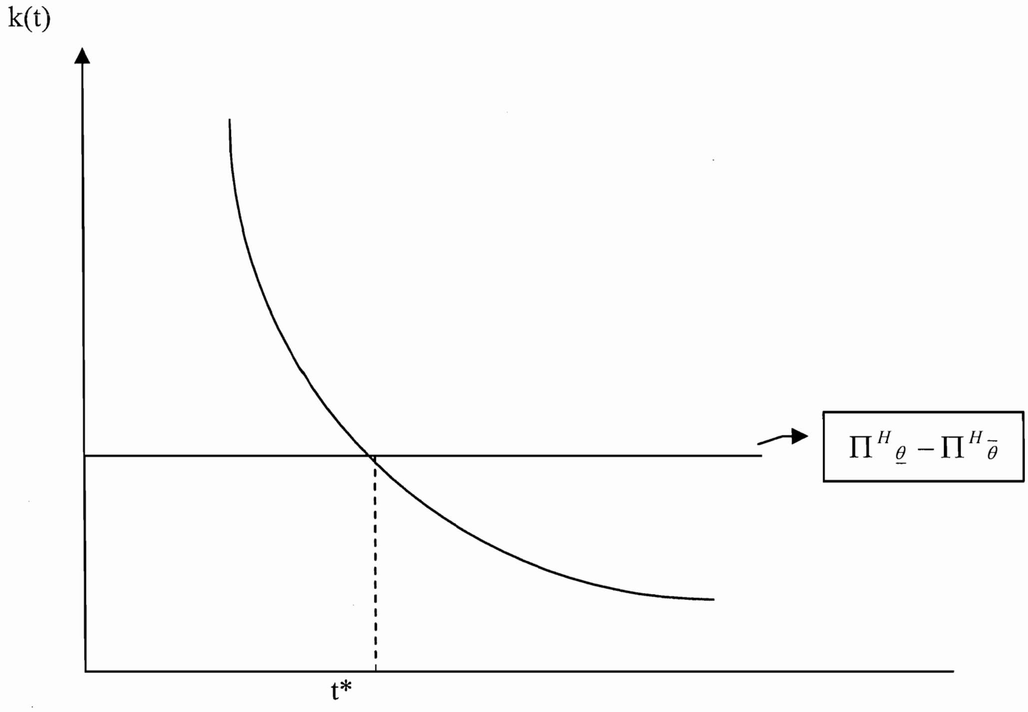
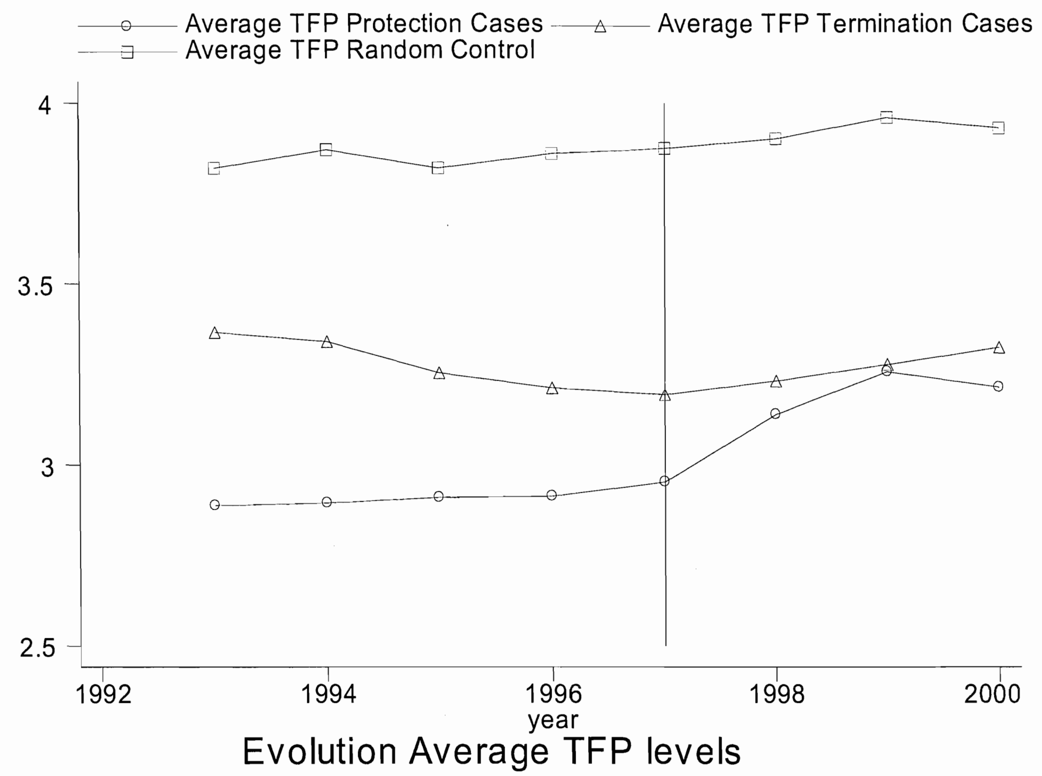


Figure 2
Panel A



Panel B

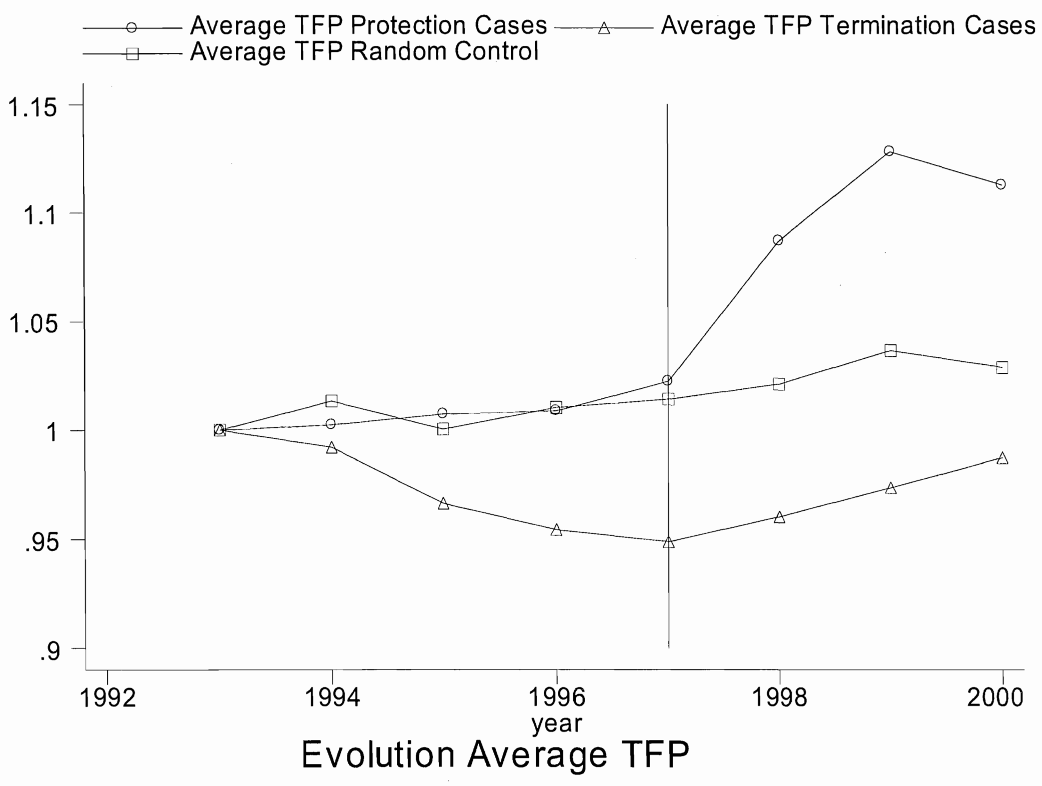


Figure 3a: Evolution of Imports in metric tons of 'Seamless Steel Tubes Case'

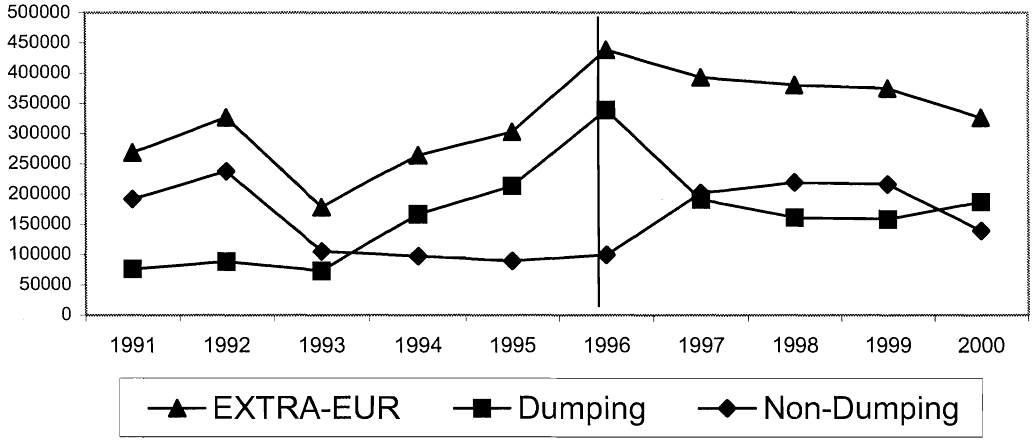
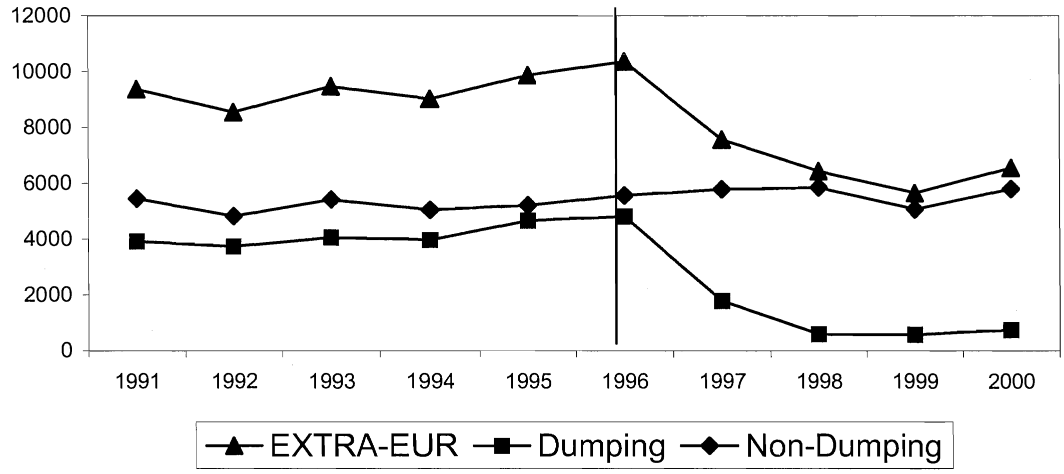


Figure 3b: Evolution of Imports in metric tons of 'Leather Handbags'



APPENDIX

A/ Construction of the data set

We took great care in identifying as closely as possible the import-competing EU firms producing a similar product to the one subject to AD investigation. The 'matching' between the 8 HS-digit product subject to AD-investigation that we obtained from the Official Journal, and the import-competing EU firms could not be done by using a general 'algorithm' for all cases involved, but required a specific approach in almost every case as documented in the A1. Some of the reasons for this are outlined here. While each firm in our commercial database AMADEUS has a 'trade description', that description is often much wider than the product description mentioned in the AD-case. And while the AMADEUS-software allows a search of firms on the basis of this trade description, we were often unable to identify any EU firms producing the very specific product we were after.

Therefore in most cases, a different approach was required. The Official Journal usually, though not always, mentions the names of the EU firms that initiated the AD-complaint. In the 8 AD cases that we consider, at least one initiating firm was mentioned. On the basis of these company names we traced the initiating firms in AMADEUS and identified their 7 digit CSO activity code, the classification used in the AMADEUS company accounts dataset[22]. Most initiators were large firms with more than one 7 digit activity code. In that case we identified the 7-digit CSO code(s) that corresponded most closely to the AD-product in order to consequently retrieve all EU firms in that same 7-digit activity line. One problem with this approach was that 7-digit CSO activity codes are only available for the medium and large sized enterprises in our data, but are not reported for the small firms. For the small firms, AMADEUS only reports their activity at a higher level of aggregation, like the 4-digit NACE code or the 6 digit NAICS code. So, we only based our search strategy on the 7-digit CSO code when despite missing out on all the small firms, a sufficient number of firms producing the AD-product could be obtained. In each case we also made sure that all the initiating firms were included. In cases where the search on the basis of 7-digit CSO yielded too few EU firms for meaningful analysis, we turned to the 6 digit NAICS activity codes of the initiating firms in order to identify the 6 digit NAICS code description best corresponding with the AD-product and then retrieved all EU firms in that NAICS category. By moving up one level of aggregation, we introduced somewhat more noise compared to the 7-digit CSO codes, but we gained many more observations because a search of EU firms on the basis of the 6 digit NAICS codes also included all the small firms.

[22] The CSO code is an activity code that is used by the British Statistical Office and defines the activities of firms at a 7-digit level of detail.

And finally, when all other approaches were unsuccessful we turned to the NACE 4 digit codes reported by the initiators and retrieved all firms in that NACE classification. Eventually a case-by-case decision based on common sense was necessary. In Table A1 below we provide an overview of the search strategy applied in each case.

Table A1: Search Strategies for putting the Data together

Name of the product	Search Strategy
Cotton Fabrics	5 initiating firms for which the following CSO codes were found: 4322007: Bunting, Cotton, Weaving 4322019: Cotton Weaving 4322028: Felt, Cotton, Weaving 4322030: Flag, Cotton, Weaving 4322034: Gaberdine, Cotton, Weaving 4322073: Weaving Cotton and Man-Mad Fibres
Synthetic Fibre Ropes	1 initiating firm identified, and the following CSO code found: 4396000: Rope, Twine and Net. We also experimented with a second strategy, by taking the 6-digit NAICS code: Rope, Cordage and Twine Mills, the number of firms remained the same, irrespective of the search strategy. We report the results based on the CSO codes.
Luggage and Travel Goods	No initiating firms mentioned in the Official EU Journal We took the following 6-digit NAICS code: 316991: Luggage Manufacturing
Leather Handbags	2 initiating firms CSO code: 4410202: Fellmongery The CSO search strategy yielded too few EU firms for a sensible analysis, we therefore considered the 6-digit NAICS code: 316992: Women's leather handbag and Purse Manufacturing
Seamless Steel Pipes and Tubes	8 initiating firms which yielded the following CSO codes: 2220016: Tube Steel Manufacturing 2220011: Seamless Tube Steel Manufacturing 2220008: Pipe Steel Manufacturing
Polyester Fibres Yarns	7 initiating firms yielding the following CSO activity codes: 2600012: Synthetic Fibre Manufacturing 2600011: Synthetic Man-Made Fibre Manufacturing 2600008: Polyamide Man-Made Fibre Manufacturing 2600009: Polyester Man-Made Fibre Manufacturing
Video Tapes	No initiating firms, but took the following 7-digit CSO code: 3452004: Video Tape Recording Manufacturing
Stainless Steel Fasteners	5 initiating firms, but based on the 7-digit CSO activity codes we ended up with a small number of firms. We therefore took the 4-digit NACE code, which in fact corresponds closely to the product under investigation: 2874: manufacturing of fasteners, screw machine products.

B/ Olley-Pakes (O-P) Methodology

The idea behind the O-P estimation procedure is that the unobservable productivity shock ω can be identified using an observable investment function, $i_t = I_t(k_t, \omega_t)$ that is monotonically increasing in ω and the state variable k. By inverting the investment function an expression for productivity can be written as an unknown function h of investment and capital ($\omega_{it}=h_t(i_{it}, k_{it})$).[23] As a result the productivity term in (21) can be substituted out or

$$y_{it} = \beta_l l_{it} + \phi_t(i_{it}, k_{it}) + \eta_{it}$$

and
$$\phi_t = \beta_0 + \beta_k k_{it} + h_t(i_{it}, k_{it})$$

The above expression can be estimated semi-parametrically to obtain a consistent estimate of the coefficient on labor[24].

In the second step of the procedure, information is used on firm dynamics to obtain a consistent estimate of the capital coefficient. In particular, it is assumed that productivity ω, follows a first order Markov process g, i.e. $\omega_{t+1} = E(\omega_{t+1}|\omega_t) + \xi_{t+1}$ where ξ_{t+1} represents the news in the process and is assumed to be uncorrelated with the productivity shock and with the capital input at t+1 (k_{t+1}). Capital used in any given period t+1, is assumed to be known and fixed at the beginning of that period. News arriving at t+1 is therefore is uncorrelated with capital $E(\xi k) = 0$. However, the news is not uncorrelated with the variable input (labor). For this reason the labor input is subtracted from the production and we consider the expectation of E($y_{t+1} - \beta_l l_{t+1}$) conditional on the survival of the firm. A firm's probability of survival P_t (with $P_t = \Pr\{\chi_{t+1} = 1\}$) into the next period depends on whether its efficiency level exceeds a critical productivity level ($\chi_{t+1}=1$ if $\omega_{t+1} > \underline{\omega}_{t+1}$ and 0 if otherwise). All this results in the following expression

$$E\left[y_{t+1} - \beta_l l_{t+1} \middle| k_{t+1}, \chi_{t+1} = 1\right] = \beta_0 + \beta_k k_{it+1} + E\left[\omega_{t+1} \middle| \omega_t, \chi_{t+1} = 1\right]$$
$$= \beta_k k_{it+1} + g(\underline{\omega_{t+1}}, \omega_t)$$

Using the above and using the law of motion for the productivity shocks, we get

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[23] Levinsohn and Petrin (2003) suggest a modification of the Olley-Pakes (1996) approach by using intermediate inputs, such as electricity or fuel usage instead of investment to identify the unobservable productivity shock. In our data, however, we have no information on electricity or fuel usage so we could not pursue this correction method.

[24] We proxy $\phi_t(i_{it}, k_{it})$ with a 5th order polynomial in investment and capital and included time dummies to control for aggregate shocks in investment.

$$
\begin{aligned}
y_{it+1} - \beta_l l_{it+1} &= \beta_0 + \beta_k k_{it+1} + E(\omega_{it+1} | \omega_{it}, \chi_{t+1} = 1) + \xi_{it+1} + \eta_{it+1} \\
&= \beta_k k_{it+1} + g(\underline{\omega}_{it+1}, \omega_{it}) + \xi_{it+1} + \eta_{it+1} \\
&= \beta_k k_{it+1} + g(P_t, \phi_t - \beta_k k_{it}) + \xi_{it+1} + \eta_{it+1}
\end{aligned}
$$

The final step in the Olley and Pakes correction method, is to arrive at a consistent estimate of the capital coefficient. We get the coefficient on capital by minimizing the sum of squares of the residuals in the equation below, thereby taking the first stage estimates of β_l and ϕ_t and the estimated probability of survival P_t and substituting them for the true values.

$$
y_{t+1} - \hat{\beta}_l l_{t+1} = c + \beta_k k_{t+1} + \sum_{j=0}^{s-m} \sum_{m=0}^{s} \beta_{mj} (\widehat{\phi}_t - \beta_k k_t)^m \widehat{P}_t^{\,j} + e_{t+1}
$$

where s denotes the order of the polynomial used to estimate the coefficient on capital. We experimented with this order of the polynomials used and we find that there is almost no change when moving from the 4th to the 5th order polynomial. We use bootstrapping methods to come up with the correct standard errors for the series estimator of the capital coefficient.