Antidumping Protection and Productivity Growth of Domestic Firms

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Abstract

We analyze the effects of European Antidumping (AD) protection on Total Factor Productivity (TFP) growth of import-competing domestic firms. We identified a panel of 1,793 European firms between 1993 and 2000 affected by AD cases that were initiated in 1996. Using a difference-in-difference approach, we find evidence of increased TFP growth for those firms that filed for protection compared to firms that did not. Our analysis also indicates that the effects of protection depend on the "distance to the frontier firm" in the industry. While protection raises TFP growth of "laggard" firms, this is less the case for firms close to the efficiency frontier. These results are in line with recent theoretical work relating firms' incentives to restructure in response to competition in the market.

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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 consequences for foreign producers[3]. In contrast, the focus of this paper is on the effects of AD protection on the firms in the domestic import competing industry. In particular, we look at the effects of AD protection on domestic firms' total factor productivity growth, rather than levels, the former is considered as a better way to measure changes in technology especially over relatively short periods as discussed by Keller (2003).

A priori, the relationship between protection and productivity growth is not an unambiguous one. On the basis of the Shumpeterian 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. Recent theoretical work that explores more closely the relationship between trade protection and productivity growth has come to conclusions that seem to support this Shumpeterian idea. Rodrik (1992) in a model of homogeneous Cournot competition points out that trade protection can increase productivity growth as long as protection increases a domestic firm's market share. Miagawa & Ohno (1995, 1999) and Crowley (2002) show that import protection can speed up the adoption of new technology by the protected domestic firms.

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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 & Wolak, 1994; Prusa, 1997, Konings et al. 1999), retaliation aspects (Blonigen & Bown, 2003), pass-through effects (Blonigen & Haynes, 2002) and others. Also, the political economy aspects of AD have formed the subject of many studies including Finger, Hall & Nelson (1982), Tharakan & Waelbroeck (1994), Moore (1992) and Hansen & Prusa (1997).

However, recent empirical evidence suggests that more competition is better for productivity growth of firms (Nickell, 1996, Blundell et al. 1999). Therefore, a priori the empirical relationship between AD protection and productivity growth is not straightforward to sign.

We develop a simple theoretical framework in Section II where we show that these ambiguous findings could result from the non-monotonic nature of the relationship between product market competition and productivity growth. Our theoretical framework explains why a duty on foreign imports can result in an increase in domestic productivity growth of import competing firms. It also documents that the productivity effects of a duty are stronger in industries where goods are relatively homogeneous and rents are low, which typically corresponds with industries in which AD cases are initiated. In Konings and Vandenbussche (2004), we provided evidence that domestic firms obtaining AD-protection are typically industries where markups on average are lower than in industries without protection. Also, industries that file for AD-protection tend to produce a good that is homogeneous to the imported foreign product, since by law, the foreign product has to be a 'like product' of the domestically produced product. It is exactly in industries with low markups and homogeneous products that our theoretical framework in this paper suggests 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 more than 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 & Pakes (1996) to correct for sample selection and the endogeneity of input factors. Our empirical analysis consists of two steps. In step 1, we consistently 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 used.

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 productivity effects of firms. Levinsohn (1994), Harrison (1994) 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. In a sense their results should be seen as the outcome of a macro-economic trade liberalization policy where productivity growth can come from 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. However, our results do suggest that a policy of trade protection can alter the growth path of the firms affected by the policy.

II. Theoretical Framework

In this section we present a simple model whose predictions are consistent with our empirical findings. Empirically we find a robust increase in productivity growth in domestic firms that get protected by AD duties. The framework we describe below gives a theoretical rationalization for these findings. The model consists of one home (H) firm selling locally and one foreign firm (F) selling from abroad into the home market. The firms engage in product market competition in the home market in the second stage of the model and both invest in cost reducing technology in the first stage. The firms compete in differentiated output. Product market competition in this model is measured by a decreasing level of product differentiation, which according to Boone (2004) is a product market competition measure similar to one moving from Cournot to Bertrand competition.

In stage 1, each firm decides on the amount of investment k in cost reducing technology. Investing in cost reducing technology is costly and is increasing in the level of investment $f(k)=(g.k^2)/2$ where $f'(k)>0$ and $f''(k)>0$ and where g is a shape parameter indicating the costliness of the investment k[4]. More investment in the first period, implies a lower marginal

[4] In order to ensure that in the second stage of the model $k_i < c_i$, we need to assume $g > 0$ and sufficiently large.

cost of production c_i in period 2, or $c_i'(k)<0$. This can be considered as a process innovation or a restructuring effort, where the existing production is made more cost efficient. The second period marginal cost then becomes equal to c_i-k_i.

The second period profits of both firms in the market are as follows

$$\pi_i = p_i q_i - (c_i - k_i)q_i - (g.k_i^2)/2 \quad \text{with i=H,F} \qquad (1)$$

For simplicity we assume a linear inverse demand function where p_i is the price for each product and q is the quantity sold

$$p_i = a - q_i - bq_j \quad \text{with } i \neq j \text{ and b<1} \qquad (2)$$

Where 'a' reflects the size of the home market and 'b' is a parameter of product differentiation and lies between zero and 1, with a value closer to 1 indicating more homogeneous products. Parameter b captures the degree of product market competition in the market with more differentiated products corresponding to lower competition and more homogenous products corresponding to tougher competition.

With a duty, t, on foreign imports in the home market[5], the foreign firm's profit function in stage 2 becomes as follows

$$\pi_F = p_F q_F - (c_F - k_F)q_F - g(k_F^2)/2 - tq_F \qquad (3)$$

It is clear that while the home firm's profit function will not be affected by the duty, the equilibrium values of second period output and first period investment levels will all be a function of the duty t.[6]

Second stage profit maximization under free trade with respect to output results in the following equilibrium values for output

[5] For this model to be a 'true' AD model, there has to be a positive dumping and injury margin. For simplicity we are assuming (rather than modeling) that this is the case, since that is not critical for the central point that we are making here namely that trade protection results in an increase in cost reducing investment.

[6] The theoretical literature on AD often argues that the duty is endogenous and depends on the cost asymmetry between home and foreign firms. While this is fully acknowledged, the endogeneity of the duty would not change our results here. In a European context it would imply that the larger the cost disadvantage of the home firm vis-à-vis the foreign firm, the higher the foreign price-undercutting and hence the injury margin which would result in a higher duty level (i.e. Vandenbussche & Veugelers, 1999 for more details on the relationship between cost asymmetries and AD-duties).

$$q_i = \frac{a(2-b)+b(c_j-k_j)-2(c_i-k_i)}{4-b^2} \text{ with } i \neq j = H,F \tag{4}$$

while second period profit maximization under trade protection results in the following equilibrium output levels

$$\begin{aligned} q_H &= \frac{a(2-b)+b(c_F-k_F+t)-2(c_H-k_H)}{4-b^2} \\ q_F &= \frac{a(2-b)+b(c_H-k_H)-2(c_F-k_F+t)}{4-b^2} \end{aligned} \tag{5}$$

where it can be seen that a duty has a positive effect on home output, but a negative effect on foreign imports.

First period profit maximization under free trade wrt k results in the following equilibrium expressions for k

$$k_i = \frac{16(a-c_i)+4(4-b^2)(-2a+ab-bc_i+2c_j)}{16-(4-b^2)g\left[-16+(-4+b^2)^2 g\right]} \text{ with } i \neq j = H,F \tag{6}$$

and under trade protection the equilibrium values are

$$\begin{aligned} k_H &= \frac{16c_H-16a+4a(2-b)^2(2+b)g-(2-b)(2+b)g(2c_H-bc_F-bt)}{16+(4-b^2)g\left[16-(4-b^2)^2 g\right]} \\ k_F &= \frac{16a-4a(2-b)^2(2+b)g-4(c_F+t)+(4-b^2)g(bc_H-2c_F-2t)}{16+(4-b^2)g\left[16-(4-b^2)^2 g\right]} \end{aligned} \tag{7}$$

Figure 1 illustrates the first stage home investment k_H as a function of product market competition measured by b. While the thin line gives the evolution of first period home investment under free trade, the bold line represents investment under protection with a duty of size t. The non-monotonicity of the investment curve can be interpreted as follows. The downward sloping part for low levels of competition corresponds with the Shumpeterian notion that more competition is bad lowers ex-post payoffs and lowers cost reducing effort. However, as products become more homogeneous, the incentive to outperform the foreign firm gets stronger and investment slopes upward. This is known as "escape competition". [7]

[7] The non-monotonic nature of the relationship between competition and growth has also been pointed out by Scherer & Ross (1990), Schmidt, (1997), Boone, (2000) and Aghion et al. (1997, 2002).

The empirical result by Nickell (1994) and others that more competition enhances investment in productivity growth, is consistent with the upward sloping part *along* the investment curve.

The model shows that trade protection in contrast to product differentiation, results in an *upward shift* of the investment curve. In the empirical part of this paper we find that in most AD cases, the productivity growth of domestic firms indeed goes up after AD protection. This corresponds to the vertical shift of the investment curve in Figure 1 as a result of trade protection. The model also suggests that the effect of a duty is largest when the home and the foreign products are quite homogeneous, i.e. for high values of the parameter b (values close to 1), the distance between the free trade investment curve and the one under protection is largest.

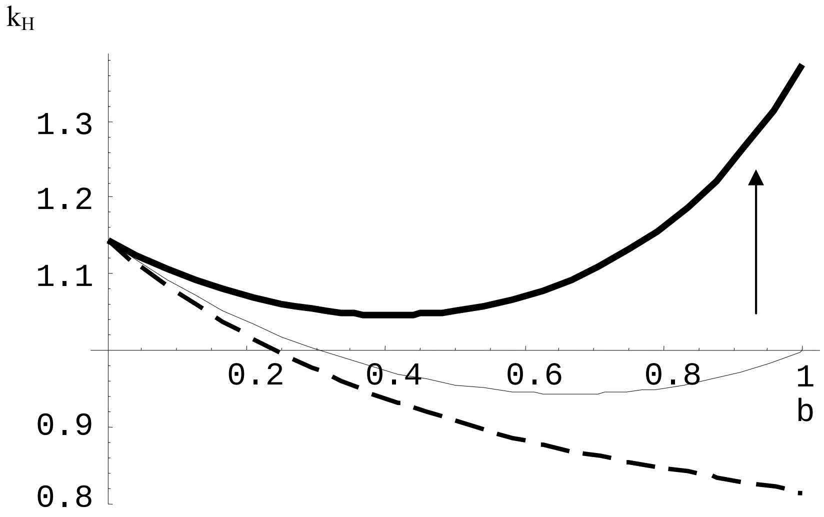
For the foreign firm the movement of the investment curve is the opposite (not shown here); an increase in duty protection t, results in less investment in cost reducing technology compared to free trade. Hence, trade protection raises investment in the domestic firm, but lowers investment in the foreign firm.

The investment curve under free trade in Figure 1 (the thin line) is drawn for a situation where firms are symmetric in their efficiency levels. In the case where the home firm has a cost disadvantage vis-à-vis the foreign firm, the investment curve under free trade shifts downward. This is illustrated by the dashed line in Figure 1, where the efficiency level of the home firm is reduced. Hence when we introduce a 'technology gap' between the home and the foreign firm, home investment is reduced for all levels of product market competition b, while foreign investment (not shown here) increases for all levels of product market competition compared to the situation where both firms are equally efficient.

In fact, the larger the technology gap between the home and the foreign firm, the lower the incentives of the domestic laggard firm to invest in productivity improvement. This finding is in line with Boone (2003) and Aghion et al. (2000). The scenario displayed in Figure 1 clearly shows that under cost asymmetry with a cost disadvantage for the home firm, the downward sloping part of the investment curve (the Shumpeterian effect) continues as b increases. This suggests that when home firms lag behind foreign rivals, more competition slows down investment in cost reducing investment. Hence the effect of duty protection in those industries will have a relatively larger effect. This can be seen from Figure 2, where for the case of asymmetric costs, we both show the free trade investment curve (the same as the dashed line in Figure 1) and the investment curve under trade protection. While the free trade investment curve under asymmetric costs continues to slope downward, trade protection not only results in an upward shift but also restores the U-shape of the investment curve again. Hence the model suggests that especially in lagging EU industries, the role of trade protection can be rewarding in terms of stimulating cost reducing investment. This finding is also related to the work of Acemoglu et al. (2002). 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. While our simple framework is not suited to capture non-convergence of home efficiency compared to foreign efficiency levels, we do find empirically that AD protection sorts less of an effect in industries that are 'closer to the technological frontier'.

Our 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,[8] corresponds with the findings of Mellitz and Ottaviani (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 our theoretical framework which points out that trade protection on foreign imports raises the incentives of domestic firms to invest in productivity growth.

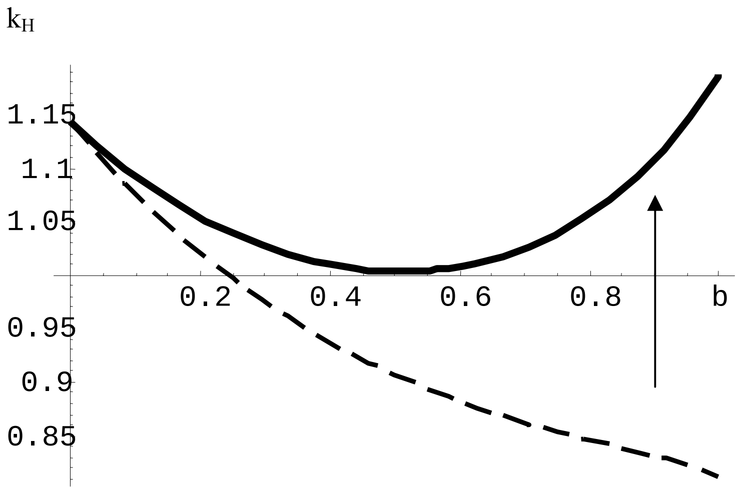
Figure 1: Investment under Free Trade versus Protection with symmetric costs



[8] Antidumping protection in the EU lasts for5 years ('Sunset Clause'). This period corresponds to the second stage product market competition under trade protection in our model.

This thin was generated with the following first period parameter values: a=14, c_H=6, c_F=6, g=4, while the dashed line used a=14; c_H=6; c_F= 5. The bold line used parameter values a=14; c_H=6;c_F= 6, g=4; t=2

Figure 2: Investment under Free Trade versus Protection with asymmetric costs

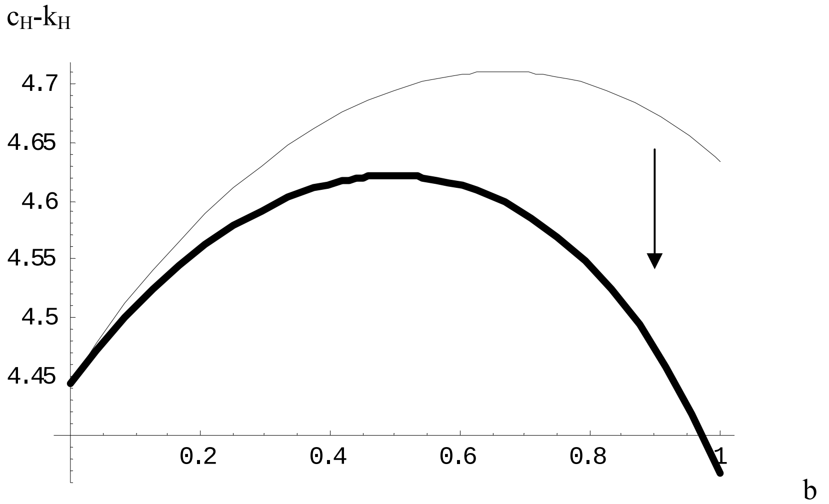


This dashed line was generated with the following first period parameter values: a=14, c_H=6, c_F=5, g=4, while the bold line used parameter values a=14; c_H=6;c_F= 5, g=4; t=2.

In Figure 3, we plot the corresponding evolution of productivity in stage 2, as a function of product differentiation. Here, we find that for all values of the product differentiation parameter b, the second stage marginal cost of production is lower under trade protection than under free trade. This suggests that irrespective of the degree of product differentiation, duty protection spurs productivity growth. Again we can note that while for small values of b (very differentiated industries), the duty has far smaller effects on restructuring efforts of the home firm, while in very homogenous industries, the duty sorts a large improvement in productivity.

Hence the empirical prediction emerging from our simple model is that while duties have a positive effect on productivity growth, the effect is larger in more homogeneous industries. Perhaps than it should not come as a surprise that especially in homogeneous products, there is a lot of protection going on. Or in other words, this can explain the popularity of Antidumping type of protection since in Antidumping cases, the home and the foreign products by law have to be quite similar in order for protection to be imposed. If it is the case that duties sort most of their effect in industries where the home and the foreign products are close substitutes, Antidumping cases are a good area to look for the effects of protection on productivity growth, given that we expect the boost in productivity in homogeneous industries (a high value of b) to be largest based on our theoretical analysis above.

Figure 3: Efficiency (Productivity) under Free Trade versus Protection



This figure was generated with the following parameter values: a=14, c_H=6, c_F=6, g=4, t=2.

Gao and Miyagiwa (2003) in a reciprocal dumping model indicate that when firms interact in more than one market, the result described above may be reversed. In a model where the home and foreign firm both compete in each others' markets, they find that when a single government institutes AD law, the protected firms will decrease innovation efforts, resulting in lower productivity. The main assumption accounting for that different result is that firms interact in more than one market, while in our simple framework above, we limited product market competition to the home market. While Gao and Miagawa (2004) develop their model under the assumption of equal country size, our framework is similar to assuming that the home country has a larger size than its export market and that the most important market for the home firms is their home market. Empirically we can not verify this assumption on our data since we do not have information on the geographical spread of the sales of the European home firms in our sample. Hence, we do not know to what extent the company wide sales are sold in the protected market (the EU) or elsewhere. Based on our theoretical framework we would expect that their sales predominantly occur on the European market. Because under that assumption our model predicts an increase in productivity growth for import-competing domestic firms after AD protection.

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 would benefit 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 all 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 looked up all AD-cases initiated 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 AD Investigations[10] were initiated, representing 12 different products or product groups. A product is very narrowly defined at the 8 digit CN-product classification[11]. 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.

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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 & Slaughter (2004); Konings, Van Cayseele & Warzynski (2004), Smarzynska (2003) and Helpman et al. (2003).

[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] Combined Nomenclature (CN) is a product classification scheme used by the European Union.

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

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 total factor productivity 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, 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[13].

A number of further remarks are in order here. First, we focus on the year 1996 as our firm level data cover in that case a roughly equal period before and a period after protection. We believe 1996 to be a very average type of year in terms of AD-filings. The number of 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 & 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 in our empirical analysis, since there are both theoretical and empirical

[13] In principle protection stops after 5 years. But the EU industry can ask for a 'Review'. If granted by the Commission, a new investigation is opened and protection is prolonged if the Commission agrees that when the duty comes off, dumping would resume. For some of the 1996 AD-cases in our sample a 'Review" investigation was initiated in 2002 (seamless steel pipes and tubes). The outcome of this 'Review' cases was not yet known when we conducted our research.

reasons to believe that AD-protection can result in increased sales prices of the domestic firms involved (Konings & Vandenbussche 2003, Prusa, 1994). Therefore, instead of using industry deflators, we looked for a deflator that would much more closely reflect any possible increase in prices resulting from AD-protection. For this purpose we used as a deflator the unit values of intra-European trade in the same products as the one involved in the AD-case. These unit values were retrieved over the same time period as our company accounts data. The idea being that if AD-protection would allow domestic European firms to charge higher prices for their products on the European market after protection, this would show up in the intra-European trade flows in the form of higher unit values of the products protected by a 'common' AD-duty for the European Union as a whole. By deflating our output measure in this way we try to avoid that an observed increase in TFP may be driven by increased prices. We construct our deflator by dividing the product level intra-EU export values by its corresponding product level intra-EU export volume in each year. 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). In appendix B we show the evolution of the intra-EU export unit values for the AD cases that we investigate, normalized to 1 in 1993. There does not seem to be a particular systematic pattern in the unit values before and after AD protection sets in. This suggests that observed increased TFP after AD protection is unlikely to have resulted from increased unit values in our data. We also experimented with other deflators. In particular, instead of using unit intra-EU *export* values we used unit intra-EU *import* values. We also experimented with an aggregate producer price deflator. 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[14] 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.[15] Therefore we ranked the 235 NACE 4-digit sectors according to openness in terms of extra-EU import shares in the year 1996. We constrain the random

[14] NACE is the official EUROSTAT industry classification.
[15] 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.

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 the data appendix A and include products like 'Manufacture of Plastics' and 'Copper Production'.

IV. Estimating Total Factor Productivity

The first step in the empirical methodology consists of estimating Total Factor Productivity (TFP) for each individual product group separately to allow for the possibility that the coefficients of the production function vary between sectors. Total Factor Productivity (TFP) is the residual when estimating a production function. To obtain TFP measures we need to estimate the technical production function coefficients β_l and β_k. which can be done on the basis of the following expression:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \eta_{it} \tag{8}$$

where y, denotes the log of real value added[16], l denotes the log of labor and k, 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}). 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. In other words, labor is likely to be correlated positively with the error term. This is likely to result 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 to estimating (8). The most commonly used is the General Methods of Moments estimator (GMM) introduced by Arellano and Bond (1991). 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

[16] 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.

endogenous variables may turn out to be inappropriate instruments. Instead, we will use a semi-parametric estimation technique as introduced by Olley and Pakes (OP) (1996), which allows us to estimate the production function (8) consistently for each product group[17].

The idea behind the OP-correction 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 the unobservable productivity shock ω and the state variable k. In the first step of the estimation procedure the investment function is inverted, yielding an expression for productivity as an unknown function h of investment and capital ($\omega_{it}=h_t(i_{it}, k_{it})$).[18] As a result the productivity term in (8) can be substituted out or

$$y_{it} = \beta_l l_{it} + \phi_t(i_{it}, k_{it}) + \eta_{it} \tag{9}$$

and

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

Expression (9) can be estimated semi-parametrically to obtain a consistent estimate of the coefficient on labor[19].

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

[17] This approach has recently been used i.e. to analyze the impact of trade liberalization on plant productivity in Chile by Pavcnik (2002) and to analyze the effect of FDI on productivity of domestic establishments (Keller and Yeaple, 2003).

[18] 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.

[19] We proxied $\phi_t(i_{it}, k_{it})$ with a 5[th] order polynomial in investment and capital and included time dummies to control for aggregate shocks in investment (Robinson, 1989).

$$E[y_{t+1} - \beta_l l_{t+1} | k_{t+1}, \chi_{t+1} = 1] = \beta_0 + \beta_k k_{it+1} + E[\omega_{t+1} | \omega_t, \chi_{t+1} = 1]$$
$$= \beta_k k_{it+1} + g(\underline{\omega_{t+1}}, \omega_t) \tag{10}$$

Using (9) and using the law of motion for the productivity shocks, we get

$$\begin{aligned} y_{it+1} - \beta_l l_{it+1} &= \beta_0 + \beta_k k_{it+1} + E(\omega_{it+1} | \omega_{it}, \chi_{t+1} = 1) + \xi_{it+1} + \eta_{it+1} \\ &= \beta_k k_{it+1} + g(\underline{\omega}_{it+1}, \omega_{it}) + \xi_{it+1} + \eta_{it+1} \\ &= \beta_k k_{it+1} + g(P_t, \phi_t - \beta_k k_{it}) + \xi_{it+1} + \eta_{it+1} \end{aligned} \tag{11}$$

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.

$$y_{t+1} - \hat{\beta}_l l_{t+1} = c + \beta_k k_{t+1} + \sum_{j=0}^{s-m} \sum_{m=0}^{s} \beta_{mj} (\widehat{\phi}_t - \beta_k k_t)^m \widehat{P}_t^{\,j} + e_{t+1} \tag{12}$$

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.

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 Van Biesebroek (2002) compares different methods for estimating production functions on data characterized by known measurement errors and finds that the semi-parametric methods, like the OP one we use here, is least sensitive to measurement error when estimating productivity growth. In fact, Van Biesebroek (2002) 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 in a standard way or

$$TFP = y_{it} - \hat{\beta}_l \, l_{it} - \hat{\beta}_k \, k_{it} \tag{13}$$

In Table 2, we report results of the production coefficients based on two different estimation methods, OLS and OP. As expected, the OLS results in most cases over-estimate the labor coefficients and underestimate the capital coefficients[20]. We experimented with various modifications of the OP algorithm. A first experiment was to set the probability of survival equal to 1 as 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. This resulted in a smaller capital coefficient, 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 fact that the labor coefficient obtained from OP typically is estimated lower than the one obtained from OLS and the capital coefficient is typically higher, it is hard to sign the potential bias in estimating TFP based on OLS. We find a positive and high correlation between TFP growth based on OLS estimates and on OP estimates. In the last column of Table 1 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 under zero (cotton fabrics) to 10% (Polyester Fibre and Yarns). Table A2 in Appendix A reports the results of estimating production function for our randomly selected control group.

In Figure 4, panels A and B we plot the average TFP level for the termination cases, the protection cases and the random counterfactual firms over time. In panel A we note that the average TFP 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, which could be a potential reason why the cases were terminated in the first place. 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 we normalize average TFP to 1 in 1993. It is clear that after 1996, TFP growth increased more in the protection cases compared to the termination cases and compared to the random counterfactual. In the next section we will test more formally whether this pattern holds up.

[20] In two cases the labor coefficient under OLS is estimated lower than under OP. 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.

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

V. 1 Single Difference Equations

We start by reporting single difference equations like the one shown below, where we first 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. In addition, we include the lagged level of log TFP to control for mean reversal in TFP growth.

$$\Delta TFP_{it} = \alpha_0 + \alpha_1 \ln TFP_{it-1} + \alpha_2 T97 + \varepsilon_{it} \tag{14}$$

ΔTFP_{it} stands for the difference in log TFP in firm i at time t, or this is the growth rate in TFP. The coefficient α_2 captures the average change in productivity after 1997 compared to the average of the period before protection.

In Table 3 we report the magnitude and significance of the coefficient α_2 for the single difference equations for the various product groups, the termination cases, the protection cases and a randomly selected control group. We report two specifications (below each other), one in which we do not include lagged TFP and one including lagged TFP. The results in Table 3 show that for the termination cases we find a small positive effect on TFP growth after 1997, while 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 duty. For our 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 4, however, we find some variation across individual AD cases. All the individual protection cases show a strong positive effect on TFP growth. The effects are smallest in the "Seamless Pipes & Tubes case". One potential explanation for this could be the extent to which market share for domestic producers increases after protection. From Figure 5a 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 "Handbags", Figure 5b 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 no doubt provided a larger incentive for domestic firms to engage in restructuring than it was the case in “Seamless steel tubes”. This may explain the larger effect of protection on TFP growth in the “Handbags case” as opposed to the “Seamless steel tubes case”.

In two of the four termination cases we find positive and signficant effects on TFP growth after 1997. The strongest effect is found in the termination case, “Luggage and Travel Goods”. However, here we should point out potential contamination in the data. In our sample there are a number of European firms that produce both “Luggage&Travel Goods” and “Leather Handbags”. While the EU Commission did not impose duties on the imports of the former, it did impose AD-duties on “Leather Handbags” during the same period. We therefore excluded 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” .

To identify the effects of AD-protection better we next follow a difference-in-difference approach, which has the advantage that we can control for any pre-treatment effects that are common across the different control groups.

V.2. Difference-in-Difference with Terminations as a control group

The remainder of our empirical estimation strategy is based on a difference-in difference approach (DD), where the basic intuition is that we compare the performance of a ‘treatment’ group pre-and post-treatment relative to the performance of some control group pre-and post-treatment. In order to apply the difference-in-difference approach, the treatment should be a one-time change in government policy which is exactly the case in the AD-protection cases. In principle the control group shows what would have happened to the treatment group in the absence of any treatment. The essence of the difference-in-difference approach is to try and account for these other forces by also examining the outcomes of a control group that does not receive the treatment but is also affected by these other forces. This approach has become a popular method. Recent examples are Slaughter (2001) and Goldberg & Verboven (2004). Applying a DD approach to our analysis means that one compares the TFP growth of firms in Protection cases pre-and post protection with the TFP growth of a control group of firms pre and post 1997. We first use the Termination cases as a control group. 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 as an additional control group. While the single difference equations only consider changes in average TFP growth over time, the difference-in-difference approach also compares TFP growth with a control group. Our empirical strategy can be summarized as follows:

$$\Delta TFP_{it} = \alpha_0 + \alpha_1 TFP_{it-1} + \alpha_2 PROTECT + \alpha_3 T97 + +\beta_1 T97\_PROTECT + \varepsilon_{it} \quad (15)$$

where ΔTFP denotes the TFP growth of firm i in period t, 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 T97_PROTECT dummy captures whether firms that get protection have a substantially different TFP growth path after 1997. 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 dummy captures the differential effect that AD-policy had 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 of shocks. Bertrand et al (2004) have shown that not controlling for serial correlation may result in underestimation of standard errors or overestimation of t-statistics. Bertrand et al (2004) mainly question the significance of t-statistics around 2, hence 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 TFP. And third, all the t-statistics we obtain for the 'treatment' effect well exceed 2.

Another important assumption that needs to be fulfilled in order to use the DD approach is the randomness of the intervention, conditional on time and group fixed effects. In principle, the AD-protection decision by the EU Commission is legally based on price conditions notably the dumping and injury margin. A positive dumping margin implies that the ex-factory price for local market sales in the exporting country exceeds the price ex-factory for export goods. While the productivity growth of domestic firms is not likely to have a direct effect on the dumping margin of the foreign firm, it may affect the measurement of the injury margin. Injury is assumed to be present when the foreign product in the domestic

EU market price-undercuts the domestic ‘like product’.[21] A lower productivity level of the home firm versus the foreign firm may result in a higher domestic price, which results in a positive injury margin. Lagged TFP can partly account for this potential endogeneity problem, since it controls for past levels of productivity. We will also experimented with including the level of TFP in 1996, the year in which the AD investigation took place, but results stay qualitatively the same.

An alternative way to guarantee the randomness of the intervention is instead of using the termination cases as a control group, to use an appropriate random counterfactual control group. In Table 5 we report the results of the various DD specifications. The first three columns show the results with the termination cases as the control group that did not receive treatment (protection). Then in columns (4)-(6) we report the results using a random counterfactual as control group and in the final three columns we take both the termination cases and the random counterfactual as a control group. Hence, for or the last three columns of Table 5, 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 report various specifications, not including lagged TFP, including lagged TFP and including TFP levels in 1996.

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 specifications and irrespective of the control group we use, we note that the effect of protection after 1997 is positive and statistically significant with estimates varying between 2.8 % and 8 % depending on the specification. This effect is smallest in those specifications where we include the termination cases as a control group, which can be explained by the fact that termination cases are more similar to the cases that received protection and it could therefore be argued that this is the proper control group to compare with. Focusing on the first three columns, we note that the smaller coefficient on the interaction term can be explained by the significant coefficient on the T97 which is a dummy equal to 1 from the year 1997 onwards, and which captures any common aggregate effect applying to both protection cases and non-protection 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. In the regressions (1) to (3), the interaction term T97_PROTECT captures the *additional* increase in TFP growth that the protection cases have experienced. However, when we take the random counterfactual as control group in columns (4) to (6), the common aggregate effect captured by T97 disappears and the coefficients on the interaction term T97_PROTECT become larger.

[21] Belderbos et al (2004), Veugelers & Vandenbussche (1999) have all argued that the most important determinant in the injury decision is the foreign price-undercutting in the domestic market.

This implies that compared to the random counterfactual firms, the TFP growth of the protected firms in AD cases increased more.

In columns (7) and (9) we take both the termination cases as well as the randomly selected control group into account, but in addition we introduce another effect that may have an impact on TFP growth, i.e. filing for AD 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 5 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 %).

Our results seem to be robust with respect to using different counterfactual samples and with respect to whether or not we include lagged TFP. However, from the discussion above what may matter more is the TFP level before protection is received. For this reason we report the same equations, but instead of including TFP levels lagged with one year, we include firm level TFP in 1996 the year in which the AD investigation took place. From Table 5 we see that our estimates of the treatment effect are somewhat reduced, but they are still positive and statistically significant.

To get at the idea that depending on the efficiency level of the industry it may be more likely that particular products will receive AD production, we carry out an additional experiment that has two objectives. First, we want to control for the potential endogeneity of treatment by including a measure of relative efficiency. Second, as recently suggested by Boone (2000) , Aghion, Acemoglu and Zilliboti (2004) and Aghion et al. (2002) the relative efficiency of firms may matter for the way in which protection can have an impact on firm efficiency.

In particular, we characterize each firm in terms of its "distance to the best practice firm" or frontier firm in the EU in 1996, the year of the AD investigation. This is a relative measure of past productivity as opposed to just including the productivity level in 1996. In addition, we also test whether depending on the relative efficiency level of firms, AD-protection has a differential impact. As suggested by our theoretical framework, depending on whether a particular firm is close or far away from the technological leader in the industry and depending on the 'toughness' of competition ruling in the industry, firms may react differently to increased competition. Recent theories by Boone (2000), Acemoglu et al (2004) and Aghion et al. (2002) have also suggested that firms situated close to the frontier are more likely to benefit from increased competition as this provides additional incentives to raise efficiency and to remain close or at the frontier. However, firms far away from the technology frontier may reduce their efforts to engage in efficiency when faced with more competition as they may never consider it possible to ever be able to catch up with the frontier firm, when competition remains high. For these types of firms protection may be good as this provides incentives for step-wise innovation that brings them closer to the frontier firm. This is the Shumpeterian type of argument. This idea is also captured in our theoretical framework in section 2 where 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 best EU firm as our benchmark frontier firm in a particular sector[22].

In order to test for this, we compute the distance to the frontier firm in 1996 as the TFP of firm i, in sector j in 1996 relative to the maximum TFP level in the EU in sector j in 1996.

$$Distance_{ij} = \frac{TFP_i}{\max TFP_j} \qquad (16)$$

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 6 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 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 7 and 8 we show the results of these further experiments. In Table 7 we replicate our DD specification, but now including the 'DISTANCE96' variable and the interaction of that variable with our previous treatment variable T97_PROTECT. The first two columns use

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

the termination cases as the control group, while the third and fourth columns use the random control group as a counterfactual. We note from the first column that our basic result still holds if instead of including lagged TFP levels we include the 'distance to the frontier firm' in 1996. 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 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. The positive effect of AD protection reduces as firms are closer to the frontier. Based on the estimates of our last column in table 7 firms with an average distance to the frontier of 71 % or lower will benefit from protection.

VI. Conclusion

This paper provides empirical evidence that temporary AD protection can raise 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 during that same period. We also find that the relative 'distance to the frontier' firm in the industry matters. Our results suggest that AD protection especially raises the productivity growth of 'laggard firms' in the industry, while for European firms close to the frontier, protection results in negative TFP growth.

It is worth pointing out that the analysis in this paper is not a general equilibrium one and it is therefore not possible to infer any welfare effects. It may well be that AD protection prevents a process of allocative efficiency in the importing country to take place. The results are therefore best interpreted as an evaluation of the effectiveness of AD policy on firm performance. Results suggest that a selective policy of trade protection can alter the growth path of firms affected by the policy.

An interesting line of future research would be to do a similar analysis for the US. One distinguishing feature between the EU and the US implementation of the AD-code until the Uruguay Round has been the length of AD-protection. While protection in the EU has always been limited to 5 years, protection in the US was more permanent until the end of the Uruguay Round. The question can than be raised whether this provides similar incentives for restructuring and productivity growth as documented for the European firms in this paper.

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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€)	TFP growth
Cotton Fabrics	Termination	3470	57 (115)	1804 (3835)	2323 (4114)	-0.006 (0.25)
Synthetic Fibre Ropes	Termination	354	61 (90)	1551 (2986)	2375 (4020)	0.001 (0.22)
Luggage & Travel Goods	Termination	632	39 (56)	608 (1363)	1446 (2245)	0.018 (0.28)
Video Tapes	Termination	115	371 (724)	12480 (24333)	28266 (53517)	0.05 (0.42)
Leather Handbags	Duty	1495	33 (60)	585 (2632)	2064 (21456)	0.07 (0.34)
Seamless Steel Pipes and Tubes	Duty	1892	130 (257)	5387 (12413)	6887 (14684)	0.039 (0.31)
Polyester Fibre and Yarns	Duty	360	287 (360)	17402 (31961)	17242 (24275)	0.09 (0.38)
Stainless Steel Fasteners	Duty	644	31 (37)	915 (1920)	1477 (2200)	0.06 (0.26)

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

Table 2: OLS and Olley & Pakes estimates of TFP-coefficients in AD-cases

Coefficient on	Labor OLS	Capital OLS	Labor Olley-Pakes	Capital Olley-Pakes
Termination Cases				
Cotton Fabrics	0.68 (0.01)	0.20 (0.01)	0.66 (0.01)	0.23 (0.02)
Synthetic Fibre Ropes	0.76 (0.02)	0.17 (0.01)	0.71 (0.02)	0.18 (0.07)
Luggage and Travel Goods	0.82 (0.01)	0.19 (0.01)	0.81 (0.01)	0.19 (0.02)
Video Tapes	0.37 (0.08)	0.38 (0.06)	0.43 (0.12)	0.25 (0.33)
Affirmative AD cases				
Handbags	0.66 (0.03)	0.24 (0.02)	0.66 (0.03)	0.29 (0.02)
Seamless Pipes and Tubes	0.68 (0.02)	0.27 (0.01)	0.64 (0.02)	0.28 (0.03)
Polyester Fibres and Yarns	0.57 (0.04)	0.30 (0.03)	0.64 (0.04)	0.41 (0.07)
Stainless Steel Fasteners	0.87 (0.02)	0.17 (0.01)	0.79 (0.03)	0.23 (0.11)

Note: we report the averages for each industry/product group and between brackets we report the standard errors for the coefficients in the industry.

Table 3: Single Difference Equations:

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

	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 4: Single Difference Equations

	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 5: 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
Lagged log TFP	-	-0.16** (0.010)	-	-	-0.11** (0.006)	-	-	-0.12** (0.005)	-
Log TFP 1996		-	-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)
R2	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 6: 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 7: Effectiveness of AD protection and Distance to the frontier

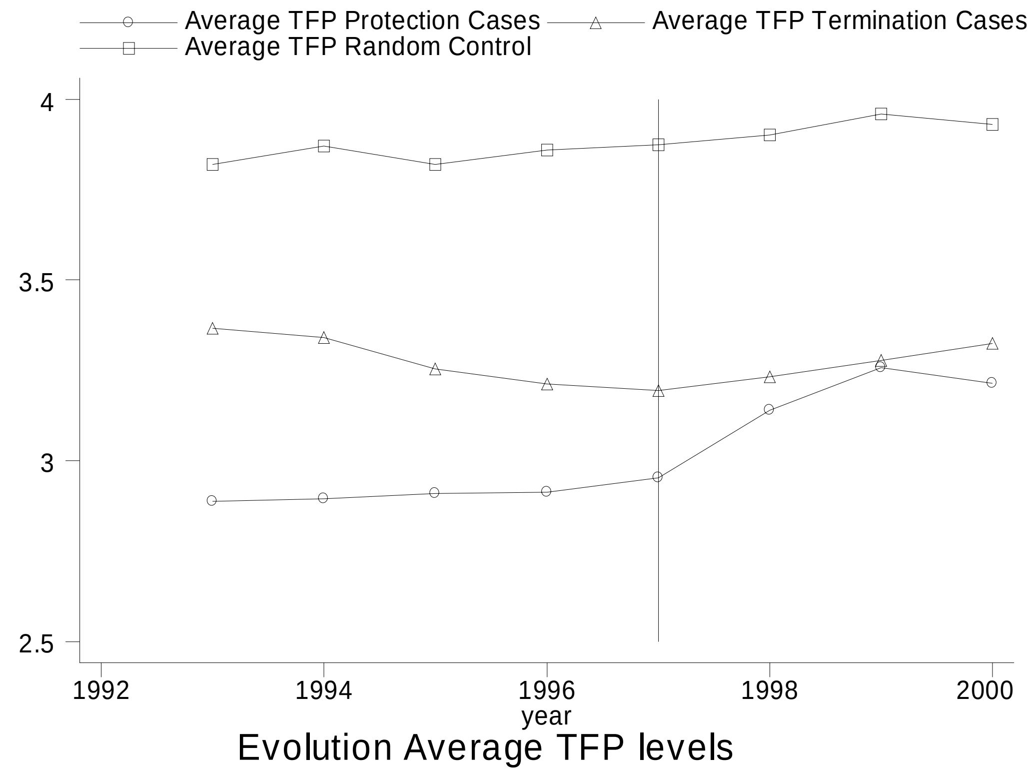
	Termination Cases as control group	Termination Cases as control group	Random control group	Random control group
DISTANCE96	-0.064** (0.02)	0.08** (0.02)	-0.06** (0.019)	0.021 (0.023)
T97	0.028** (0.011)	0.029** (0.006)	-0.014** (0.007)	-0.014** (0.007)
PROTECT	0.026** (0.008)	0.049** (0.008)	-0.012* (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 4
Panel A



Panel B

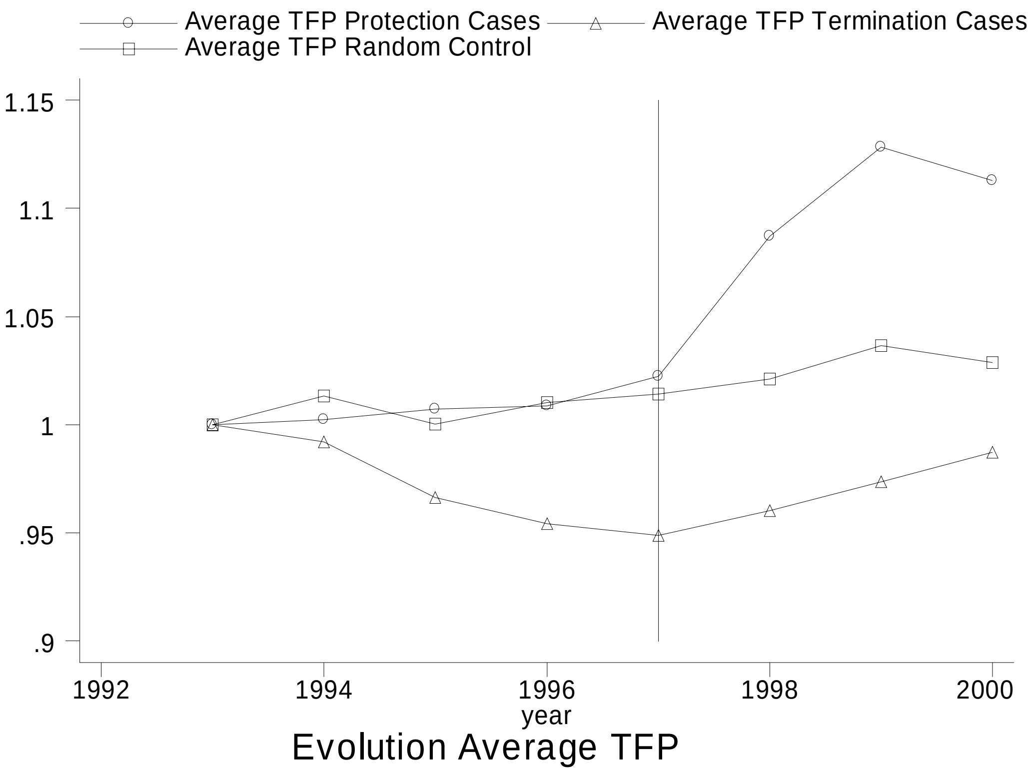


Figure 5a: Evolution of Imports in metric tons of 'Seamless Steel Tubes Case'

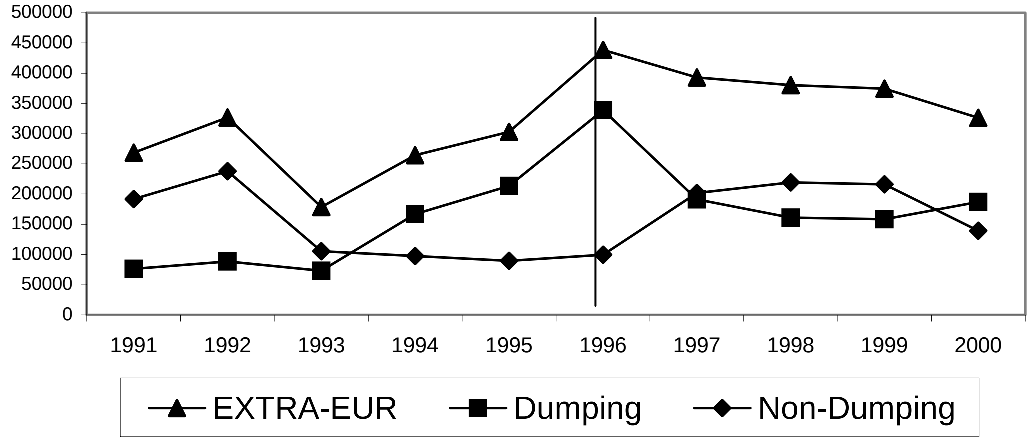
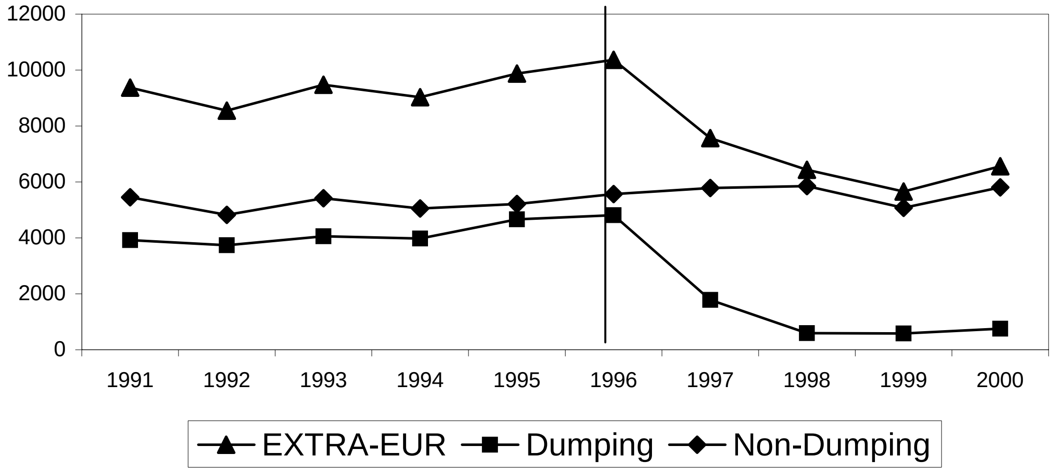


Figure 5b: Evolution of Imports in metric tons of 'Leather Handbags'



APPENDIX

A/ DATA

Construction of the data set

We took great care in trying to identify 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 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 shown in the table below. 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 also the names of the EU firms that initiated the AD-complaint. In 8 of the 10 AD cases that we considered 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[23]. Most initiators were large firms with more than one 7 digit activity code. Our purpose was to look for 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 Activity codes are only available for the medium and large sized enterprises, but are not reported for the small firms. For the small firms, AMADEUS does not provide information on their 7- digit activity/product lines, but only 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

[23] 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.

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.

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 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 results 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 little 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.

Construction of a Counterfactual randomly selected control group

In order to verify whether the positive and significant effect of AD-protection on productivity is driven by a common' Europe effect' we need to make sure that for a control group of firms that were not involved in AD-filings during that same period, we do not find such an increase. For this purpose we randomly sample a control group of EU firms constraining the sampling to 6 sectors, different from the ones already in our data sample. In the sampling 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[24] 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. 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. The randomly selected products are listed below with their corresponding estimates of the production function using OLS and OP.

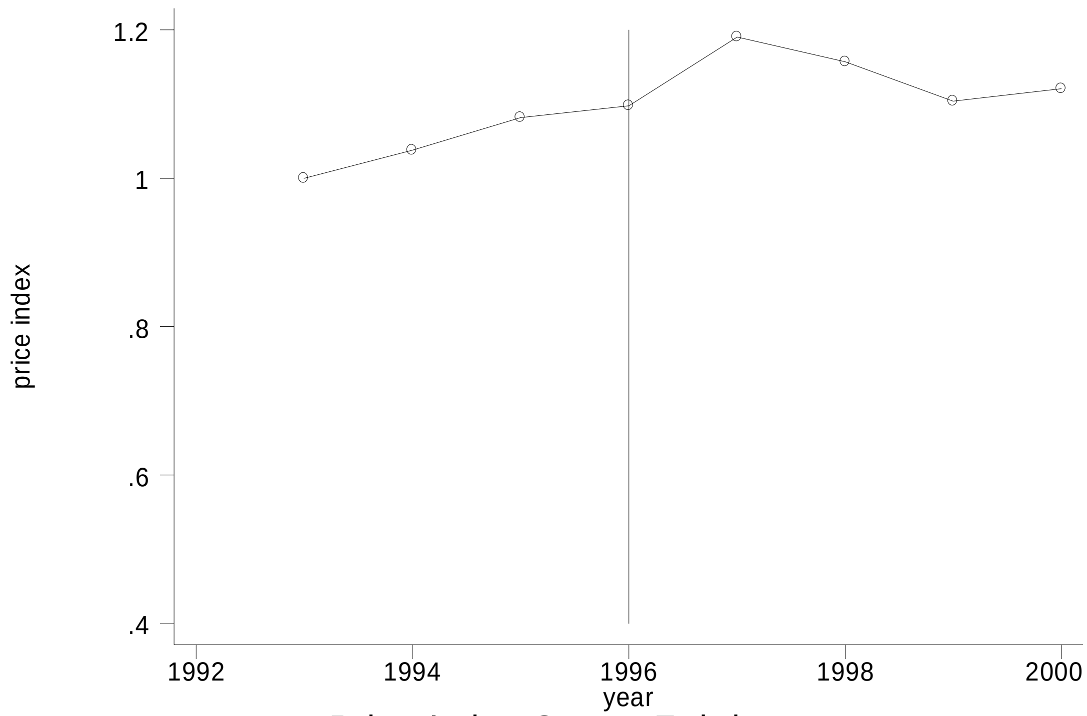
[24] NACE is the official EUROSTAT industry classification.

Table A2: Estimating production coefficients for the random control group

	Labor OLS	Capital OLS	Labor OP	Capital OP	Estimated TFP growth
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)
Inorganic basic chemicals	0.69 (0.03)	0.26 (0.02)	0.60 (0.03)	0.35 (0.19)	-0.04 (0.20)
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)
Manufacture of metal structures	0.67 (0.02)	0.21 (0.01)	0.66 (0.02)	0.26 (0.04)	0.035 (0.28)

Note: Standard errors in brackets

B/ Unit Price



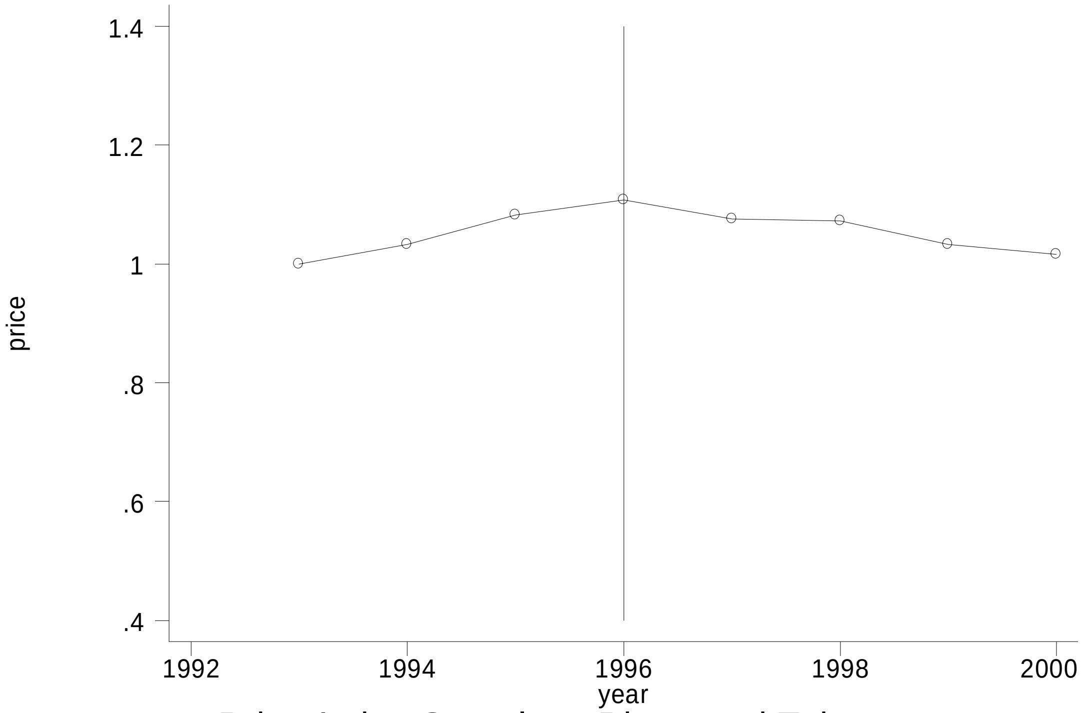
Price Index Cotton Fabrics

Price Index Synthetic Fibre Ropes

Price Index Luggage and Travel Goods

Price Index Leather Handbags

Price Index Farmed Atlantic Salmon



Price Index Seamless Pipes and Tubes

Price Index Polyester Fibres and Yarns

Price Index Stainless Steel Fasteners