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Did US Safeguard Protection on Steel Affect Market Power of European Steel Producers?*

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Abstract

This paper empirically investigates the effects of US safeguard protection on steel imports in 2002 on the mark-ups of EU steel producers. We identify a large panel of European steel producers between 1995 and 2004 affected by the safeguards. Using the Roeger method, our results show that US safeguards significantly reduced EU firms' mark-ups. Single-product EU steel firms suffered relatively more from the protection than multi-product firms. Controlling for firm heterogeneity, these results are robust to alternative specifications. Our evidence further suggests that US protection resulted in some rerouting of European steel especially towards China, aggravating the situation on the Chinese steel market and ultimately resulting in Chinese trade protection of steel imports.

Keywords: Firm data; Markups; Safeguards; Steel industry; Trade deflection
JEL Classifications: F13; L13; L61

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1 Introduction

In March 2002, the US government imposed safeguard protection on imports of certain steel products under initiative of the domestic industry. Such administered protection is permitted under the GATT/WTO rules in order to limit imports of goods that seriously injure or threat to injure domestic industry. Safeguard measures (SG), together with antidumping (AD), have become the prevalent instruments for enforcing new import restrictions. In this paper, we examine the effect of US safeguard protection on mark-ups of European steel producers of subject products.

The theoretical model used in this paper is well known in the international trade literature. We introduce a safeguard tariff into the reciprocal dumping model (Brander, 1981, Brander and Krugman, 1983). Our model predicts that European steel producers should be adversely affected by US safeguard measures through cost and demand side channels. The former is a direct effect of the protection on European exporters of steel as they partially absorb the US safeguard tariff. The latter channel operates through trade rerouting facilitated by US safeguard protection. As the EU experiences an increase in the level of import penetration, mark-ups of EU steel firms are squeezed whilst the US tariff has no direct effect on the EU price for steel. Using the Roeger (1995) methodology, our estimation results confirm the theoretical predictions. We find a negative effect of US safeguards on mark-ups of EU steel producers. Mark-ups are decreasing with import penetration and the level of safeguard tariffs, whereas single-product firms suffer more from US safeguard protection. Controlling for unobservable firm heterogeneity with fixed effects, these results are robust to alternative specifications.

This paper contributes to the literature on trade protection and firm related aspects. We distinguish between two main streams in the literature to motivate our empirical findings. The first type of studies looks at the implications of administered trade protection for domestic industries or firms. The second, refers to the externalities of trade protection. Though following different objectives than antidumping measures, safeguard measures are likely to restrict trade and raise mark-ups of protected firms[1]. While the purpose of antidumping protection lies behind sanctioning free trade violations, safeguard protection aims at providing space for adjustment and technological catch-up within industries. US industries filed in the eighties more antidumping than safeguard petitions and the success rate for antidumping (63 percent) has shown to be higher than for safeguard (26

[1] Both measures may result in ad valorem tariffs, expressed as a percentage of CIF import price. However, antidumping (AD) and countervailing (CVD) measures are distinguishable from safeguard measures in their attempt to remedy injury caused by dumping or actionable subsidies. While "red and yellow" subsidies, such as export subsidies, can be countervailed, the "green-light" subsidies, such as construction subsidies, cannot be countervailed. Safeguard protection is not based upon selectivity principles, it covers larger scope of products or industries, and is rarely extended. Sunset clauses define the upper limit of 5 years of antidumping protection, while safeguard protection is typically administered for only 4 years and results in lower duties. In the US, safeguard protection is much harder to obtain, because it requires the approval of the President, whereas antidumping protection is approved by Department of Commerce.

percent) petitions[2]. More recent literature provides the evidence that some countries are increasing their usage of safeguards as well[3]. It suggests that either strictness of injury criteria (Baldwin, 1988) or retaliation threat (Blonigen and Bown, 2003) condition the decision of which measure to be imposed. Following Hartigan (2002), the filing decision depends largely on procedural differences between AD and safeguard measures. Before filing for protection, firms will take into account the duration, the level of duties, and difficulties to obtain protection. Filing for safeguard protection must meet the serious injury condition, which is much higher standard than material injury condition under AD legislation. Firms will consider filing for safeguard protection only if the expected value of protection is higher relative to AD protection.

Feenstra (1995) and Gawande and Krishna (2003) document well the first branch of economic literature on the impacts of trade remedy measures, like antidumping and countervailing measures, on the performance of domestic firms. The evidence suggests that mark-ups fall with trade liberalization, since foreign competition increases the elasticity of demand that domestic firms face[4]. Konings and Vandenbussche (2005) confirm the positive relationship between import tariffs and prices of imperfectly competitive domestic industries. Using the capital market approach applied in the international trade context, Hartigan, Kamma, and Perry (1989) and Lenway et al. (1990) provide the evidence that mark-ups may change due to altered market structure leading to abnormal returns.

There has been relatively little work done to explore the extent of externalities due to administered trade protection. Unilaterally imposed safeguard measures temporarily disrupt the multilateral framework including trading agreements previously negotiated between the importing and exporting Members of the WTO. Safeguard protection is imposed on all imports regardless of source. As such, it generates more externalities for non-protected markets than AD protection. Bown and Crowley (2005) address the impact of one country's use of an import restricting trade policy on a foreign country's exports to third markets. They show that US import restrictions both depress Japanese export flows to the US and deflect them to third countries. The intent of US safeguards was to provide incentives for the domestic industry to renovate technologies and gain the competitive edge. Miyagiwa and Ohno (1995) find that safeguards provide an incentive for

[2]Hansen and Prusa (1995) find that US safeguard measures from 1980 to 1988 decreased trade volumes by an average of 34 percent. Moreover, over the same period, they find that trade volumes fell by an average of only eleven percent when the government imposed an antidumping duty.

[3]Bown and Crowley (2005) show that the United States imposed only seven safeguard measures in 1980-1994, while in 1994-1999 they imposed five safeguard measures.

[4]The evidence on decreasing mark-ups due to trade liberalization is documented in Levinsohn (1993), Harrison (1994), Feenstra (1995), Krishna and Mitra (1998), and Gawande and Krishna (2003). The impacts of trade liberalization on price mark-ups through the elasticity of demand have been modelled extensively in the literature under several assumptions, e.g. on substitution between foreign and domestic goods (Devarajan and Rodrik, 1991), type of protection (Bhagwati, 1978), variety of goods (Krugman, 1979), market concentration (Helpman and Krugman, 1989), collusive outcomes (Staiger and Wolak, 1989; Prusa, 1994; Vandenbussche and Veugelers, 1999).

protected firms to innovate quickly only if the cost of the new technology is falling over time and the termination date for safeguard protection is credibly enforced by foreign retaliation. Furthermore, Crowley (2002) suggests that a non-discriminatory safeguard tariff can accelerate technology adoption by a domestic import-competing firm, but will slow down technology adoption by a foreign firm. However for firms far from the technological frontier, safeguard protection can lower present value of exit costs by spreading them over longer periods instead of allowing for catch-up (Hartigan, 2005).

The reminder of this paper is organized as follows. Section 2 briefly overviews US and EU steel industries and presents the event surrounding the imposition of US safeguard protection. In Section 3 we present a simple theoretical framework to provide the intuition for the empirical analysis. Section 4 discusses earlier literature on estimating mark-ups and develops the empirical model based on the Roeger (1995) approach. Further, we describe data and discuss estimation results. Section 5 concludes with a brief summary of our results.

2 The Market for Steel and US Safeguard Protection

2.1 The Steel Industry

One year before US safeguard protection, the world manufacturers were on average exploiting only 77 percent of their capacities and several US integrated manufacturers went bankrupt. Less efficient US steel producers were selling below their production costs and in 2001 experienced on average $57 loss per one tonne of steel manufactured. There are two types of steel producers in the US steel sector, integrated and non-integrated producers or minimills. The latter are flexible and cost effective small producers, specialized in certain products that use newer technologies, enabling higher productivity than integrated producers have. On the other hand, there are large labor and capital-intensive integrated firms producing a broad range of products, using outdated technologies and employing unionized labor force, therefore being cost inefficient and less productive than competitive industries. The level of average production costs for integrated producers has been much higher than for the largest US steel importers. In fact, their efficiency level remained on average rather constant. By contrast, minimills increased their production efficiency by almost 10 percent from 1998 to 2001 and were even more efficient than most of US steel importers (Worldsteel, 2006).

US minimills were in their growth stage, having a five times larger domestic market share than two decades ago, while integrated producers were in their retrenchment state, loosing their domestic market share from about 50 to 25 percent in the same period. The latter are large employers that frequently file petitions to the US International Trade Commission (ITC) and lobby for favorable legislative restrictions (Lenway et al., 1990). Although the primary goal of trade restrictions and domestic subventions regards the maintenance of domestic producers' competitive edge, the integrated producers have remained largely noncompetitive despite $15 billion "green-light" subsidies received in the last two decades.

The EU steel industry has since the eighties undergone a complete restructuring[5]. A market-orientated policy accompanied deregulation, privatization, reduction of government involvement, and removal of most external trade restrictions. The restructuring process required large R&D investments, accounting for EUR 2.5 billion subsidies over 1995-1999. It enabled developing of newer technologies enabling higher cost efficiency and productivity of EU steel producers. A 20 percent production growth in the last decade was accompanied by a 40 percent reduction in the labor force down to about 270 thousands compared to one million employed in the early seventies. The restructuring process also reduced capacity by almost two million tons in the nineties (ECSC, 2005).

In order to understand differences between US and EU industries, it is helpful to obtain further insights from the manufacturing process. Subject products can be manufactured in blast furnaces, basic oxygen or open-heart furnaces, and electric furnaces using either scrap steel or iron ore and coal. In contrast to US integrated producers, the competitive US minimills and EU producers mainly apply newer technologies, i.e. processing scrap steel in electric furnaces, that are less capital and labor intensive and therefore allow for higher cost efficiency and productivity.

An important distinction between US and EU steel industries is that the latter has accomplished its restructuring process without any import restrictions. By accounting for almost two percent of the value added and employing 1.5 percent of employment in the EU steel manufacturing in 2001, the EU's concern can be argued easily. While EU imports have risen by 18 percent through 1998-2002, have US imports of steel fallen by 33 percent. Additional protection of the US steel market could consequently result in diversion of steel from the rest of the world to the EU[6]. An increase

[5] The industry consolidation reached its highest momentum in 2006. The world's steel sector will be in the future dominated by a small number of global steel players. On present trends, Mittal Steel and Arcelor, both headquartered in the EU, will surely be one of them. Once the acquisition of the US International Steel Group is realized, Mittal Steel will be the largest steel producer in the world, with an annual crude steel capacity of 63 million tons. If the current consolidation process with Arcelor succeeds, the merger will represent the world's largest steel corporation in terms of output, assets, and profits, producing more than 110 million tons annually (EC, 2006). Both companies have large expansion plans. Mittal Steel is not only continuing its acquisition strategy in Central and Eastern Europe, the group is the first foreign steelmaker to invest directly in China with the purchase of 37.17% of the shares of the Hunan Valin Tube and Wire mill. Arcelor has an aggressive strategy to increase capacity to 53-55 million tons by the end of 2006, which coinsists with joint ventures with Baosteel in China and Jindal in India, and bids for Erdemir in Turkey and Lucchini-Warsawa in Poland.

[6] In 2002, the EC estimated diversion could be as much as 15 million tons per year or 56 percent of current import level (EC, 2006). Producing 193 million tons of crude steel, the EU accounts for 18% of world production. China is the larger producer with 272 million tons (26% of world production), followed by Japan with 113 million tons and the US with 99 million tons.

in the level of competition in the EU market would then exert a disciplining effect on mark-ups of EU steel producers.

2.2 The Policy Impact

To motivate the theoretical specification and facilitate the discussion of empirical results it is important to briefly summarize the event. US safeguard protection was initiated in March 2002. The enforcement mechanism was up to the Bush administration and was triggered by the US steel industry petition filing for safeguard protection. Safeguard protection was imposed on the grounds of the US International Trade Commission (ITC) examination of competitiveness of the US steel industry. The ITC established that a surge in imports to the US market was causing serious injury to the US steel industry due to steel imports from France, Great Britain, Italy, and South Korea sold at dumping prices[7].

The objective of the US safeguards was to facilitate adjustment to higher unanticipated imports due to the GATT/WTO liberalization agreement and enhance the competitive edge of domestic steel industry that had experienced substantial losses leading to several bankruptcies. The political-economic reasoning for safeguards is in providing governments a means to address their redistributive motives or to demonstrate favor to politically preferred interest groups if those groups have more power than those harmed by the potential use of safeguards (Bown and Crowley, 2005). As a response to the US trade policy action, the European Commission (EC) filed a complaint at the WTO and after a while negotiated the retaliation power[8]. As the US steel industry recovered and retaliation threats of Co-complainants became unsustainable, the Bush administration dropped its support for safeguard protection. Although the protection was initially scheduled to expire after four years, the WTO facilitated its termination by the end of 2003[9].

Safeguard measures took form of tariffs ranging from 8 to 30 percent on 9 categories of steel products as well as a tariff-rate quota on slabs[10]. Table 1 describes subject products analyzed in this paper. The table shows the product, the classification of the product within the Harmonized Tariff Schedule (HTS)[11], the tariff level imposed in two years of safeguard protection, and the average import market share of the subject product as a percentage of total US imports of steel.

[7] Certain prerequisites are required for imposition of safeguard measures: first, the injury determination, and second, the determination of surge in imports either absolutely, relatively to the market or its consumption, unanticipated, or non-attributed, if low industry performance is associated with the economic downturns.

[8] The retaliation power is based upon nullification and impairment of expected benefits from trade agreement.

[9] Safeguard protection is typically imposed for the period of four years with a possible four-year extension.

[10] Slabs refer to cold- and hot-rolled carbon steel plates and sheets.

[11] In December 2001, the ITC provided detailed definitions of products under the Harmonized Tariff Schedule of the United States (HTS) in Appendix A to its determination, set out at 66 Fed. Reg. 67304, 67308-67311. By February 2002, the ITC provided additional information in response to a request by the US Trade Representative under section 203(a)(5) of the Trade Act (19 U.S. 2253(a)(5)).

[Insert Table 1 here]

The highest tariff levels of 30 and 24 percent were imposed on imports of products that represented the largest share in US imports, i.e. flat steel and slabs and different types of bars and rods. Nearly two thirds of US total imports were limited by safeguard protection. We report US import market shares at the beginning of our data sample in 1996 and draw comparisons with a year before and at the end of protection.

There is a decreasing trend of about 13 percentage points in all subject products with respect to total US imports. In particular this is due to a decline in the share of flat steel products and slabs within total US imports. This figure suggests that a part of imports of flat steel and slabs may have been diverted to other markets prior the imposition of safeguards in 2002. Observing a 10 percent drop in import shares of all subject products, it seems that US protection only facilitated trade rerouting of subject products, but not necessarily initiated it in the first place.

In Section 4 we examine to what extent increased demand for steel from China justifies this observation. Between 2001 and 2003, the largest decline is observed in imports of reinforcing bars (i.e. rebars) and flat steel products. The latter can be explained by high tariff levels. High substitutability between rebars and other bars, accounts for the decline of their market shares in total imports. A possible reasoning for protecting different types of bars and rods lies in limiting the substitution between different types of rods and bars by foreign competitors.

The following Figure 1 reveals that not only the share of imported subject products in total US imports decreased, but the latter significantly declined in 2002 as well. The magnitude of the decline is partially due to a large share of subject products in total US imports of steel. Figure 1 graphically presents the evolution of US imports of subject products from the rest of the world. On average, trade in subject products represented roughly 25 million tons in the past decade.

[Insert Figure 1 here]

Two observations come clear from the above figure based on the US ITC trade data (ITC, 2006). Firstly, there was a declining trend in imports since 1998, which questions the fairness of US safeguard protection. Secondly, a sharp decline of US imports of subject products in 2003 below its eight-year value was followed by fast recovery afterwards. Although the trend is largely determined by flat steel products, it is clear that US safeguards contributed to a decline in imports of all subject products. Both sharp downturn and recovery imply trade rerouting in these products. This finding motivates our analysis, implying that mark-ups of European producers of subject products may fall after 2002, firstly, due to decreased import market shares of subject products in the US and secondly, due to trade rerouting in subject products introducing increased competition in the European market for steel. We will consider that European steel producers could have found it profitable to reroute their exports to non-US markets due to US protection.

3 Theoretical Framework

An economic analysis allows a better understanding of the basic nature of administered protection that affects market power of foreign firms. It provides key insights on the effect of US safeguard tariffs on mark-ups of European producers. To illustrate this effect, we base our theoretical considerations on a modification of the existing reciprocal dumping model by Brander (1981) and Brander and Krugman (1983). The novelty of our approach is that it introduces a safeguard tariff imposed by the US government on each unit of European shipments to the US, denoted by τ. This simple model does not intend to provide an exhaustive alternative to existing theoretical models explaining the effects of protection. In contrast, our aim is to point out that US safeguard protection matters for the European producer of a like product and it is likely to adversely affect its mark-ups. We solve for prices and mark-ups as a function of market shares and characterize the channels between the US safeguard tariff and EU mark-ups.

Suppose for example that an US and an EU firm produce one subject product with the same unit variable cost c. Consider that they are located in their home countries, namely the US and the EU. These countries represent each other's largest trading partners in the subject product that is by definition of the "like-product" rule considered as a homogeneous product[12]. Imperfect competition generates trade in this product. While competing in a Cournot fashion in shipments of the subject product, firms face iceberg transport costs, so that the marginal cost of exports is $\frac{c}{g}$, where $0 \leq g \leq 1$. It is essential that US and EU markets are segmented, so firms set prices independently in each market.

The European firm produces the output x for the European and the output x^* for the US market, denoted by the asterisk *. The US firm produces the output y for the European and the output y^* for the US market. Each firm sells its output at the price P in the EU and at the price P^* in the US. Each firm maximizes its profits with respect to the output sold in each market taking into account shipments of the other competitor, that is:

$$\max_{x,x^*} \pi = P(Q)x + P^*(Q^*)x^* - c(x + \frac{x^*}{g}) - F - \tau x^* \tag{3.1}$$

where $p(Q)$ and $p^*(Q^*)$ are the inverse demand functions in EU and US markets, respectively.

[12] According to the "like product" principle, the WTO makes decisions on the basis of appearance, use, and process of production. The first two considerations are emphasized by the WTO, meaning that if subject products look the same and are used in the same way, then are considered to be homogeneous.

The first order conditions for profit maximization imply:

$$p(Q)[1-\frac{x}{\varepsilon Q}]=c \tag{3.2}$$

$$p^*(Q^*)[1-\frac{x^*}{\varepsilon^* Q^*}]=\frac{c}{g}+\tau \tag{3.3}$$

The European firm's market share in the US market is defined by $\sigma^*=\frac{x^*}{Q^*}$ and the US firm's market share in the EU market is defined by $\sigma=\frac{y}{Q}$, where Q and Q^* denote total sales at the output prices P in the EU and P^* in the US. Defining the price elasticity of demand with $\varepsilon=-\frac{P}{Q}\frac{\partial Q}{\partial P}$, the best response functions for both firms in the US market can be implicitly expressed as:

$$x^*(y^*): P^*=\frac{c\varepsilon^*+\tau g\varepsilon^*}{g(\varepsilon^*-\sigma^*-1)} \tag{3.4}$$

$$y^*(x^*): P^*=\frac{c\varepsilon^*}{\varepsilon^*+\sigma^*-1} \tag{3.5}$$

and analogously best reply functions can be derived for the EU market. The above equations imply that the European firm needs to consider the tariff imposed on each unit of its output shipped to the US. The variable cost of the US safeguard tariff thus enters its profit function. The solution of the best reply functions is the trade equilibrium[13].

Comparative Statics for the US Safeguard Tariff

This simple theoretical framework provides us with intuition that the US safeguard tariff will adversely affect the European firm's mark-up. Rewriting best reply functions and solving Equations (3.4) and (3.5) for price levels and market shares with respect to demand elasticities yields expressions for the Nash equilibrium market shares of the EU and the US firm in each other's market:

$$\left.\begin{aligned}\widetilde{\sigma}^* &= \frac{\varepsilon^*(g-1-\frac{\tau g}{c})+1+\frac{\tau g}{c}}{1+g+\frac{\tau g}{c}}\\ \widetilde{\sigma} &= \frac{\varepsilon(g-1)+1}{1+g}\end{aligned}\right\}\widetilde{\sigma}^* < \widetilde{\sigma} \tag{3.6}$$

The equilibrium prices in both markets can then be expressed as:

$$\left.\begin{aligned}\widetilde{P}^* &= \frac{c\varepsilon^*(1+g+\frac{\tau g}{c})}{g(2\varepsilon^*-1)}\\ \widetilde{P} &= \frac{c\varepsilon(1+g)}{g(2\varepsilon-1)}\end{aligned}\right\}\widetilde{P}^* > \widetilde{P} \tag{3.7}$$

The price in the US market will exceed the EU price due to the tariff τ imposed on the US imports. Under free trade both prices would be equal and firms would have sold equivalent shares in exporting markets. By contrast under US safeguard protection, the EU firm will sell less in the

[13] See Appendix for a more detailed description of this model.

US market than the US firm in the EU market, i.e. $\widetilde{\sigma}^* < \widetilde{\sigma}$. Each firm will export as long as it can charge a price that covers the variable cost of each unit shipped. There is an anti-competitive effect of the safeguard tariff, assuming that the price elasticity of demand ε^* falls as the European firm's market share in the US decreases.

The model suggests two channels through which the mark-up of the EU firm is affected, through import penetration and trade costs. We consider the vector of mark-ups, $\widetilde{\mu}$, that consists of the mark-up attributed to the output for the EU market, $\mu = \frac{P}{c}$, and the mark-up attributed to the output exported to the US, $\mu^* = \frac{P^*}{\frac{c}{g}+\tau}$. Let us define the equilibrium import penetration ratio as the share of EU imports over total EU output, that is $\widetilde{m} = \frac{\widetilde{y}}{\widetilde{x}+\widetilde{y}}$. Thus, the mark-up of the EU firm can be expressed as:

$$\widetilde{\mu} = \begin{bmatrix} \mu \\ \mu^* \end{bmatrix} = \begin{bmatrix} [1 - \frac{1-\widetilde{m}}{\varepsilon}]^{-1} \\ [1 - \frac{\widetilde{\sigma}^*}{\varepsilon^*}]^{-1} \end{bmatrix} \tag{3.8}$$

Intuitively, the EU firm exhibits a lower mark-up attributed to its exports due to trade costs, g and τ. Equation (3.8) leads to Proposition 1.

Proposition 1 *An introduction of the US safeguard tariff into the reciprocal dumping model affects the EU mark-up negatively, moreover, the mark-up of the EU firm is:*

1. decreasing with the level of the US safeguard tariff, and
2. decreasing with the US import penetration.

Proof.

1. $\frac{\partial \mu^*}{\partial \tau} = -\frac{g^2}{c(1+g+\frac{g\tau}{c})^2(1-\frac{g}{1+g+\frac{g\tau}{c}})^2} < 0$, given $c \wedge \tau > 0$, where $0 \leq g \leq 1$;
2. $\frac{\partial \mu}{\partial m} = -\frac{m\varepsilon}{(m+\varepsilon-1)^2} < 0$, given $\varepsilon \wedge m > 0$.

■

Now that the model has shown that mark-ups of EU firms are negatively affected by the level of the US safeguard tariff and US import penetration, we take these results to the data to examine the relation between prices and marginal costs. If European steel producers absorb a part of the tariff, we expect the US safeguard tariff to be imperfectly passed through to US price of subject products leading to a decline in μ^*, the mark-up associated with EU exports to the US. Increased competition in turn reduces the mark-up of the EU firm in the EU market.

The US safeguard tariff moreover adversely affects the European firm's profits:

$$\frac{\partial \widetilde{\pi}}{\partial \tau} = -\widetilde{x}^*(\frac{\varepsilon^* - 1}{2\varepsilon^* - 1}) < 0 \tag{3.9}$$

The negative effect of the US tariff on the EU firm's profit will depend on the elasticity of demand in the US and the size of its exports there. The European firm could thus preserve the level of its mark-ups, if it were able to reroute its exports to non-protected markets.

Our theoretical framework provides intuition for the empirical analysis in the next section. Using a large panel of the European steel producers, we expect both import penetration and the US safeguard tariff to have a negative effect on the mark-up of the EU firm[14]. Intuitively, the EU firm faces larger costs per unit of the output shipped than under free trade, so that the US tariff shifts the best response function of the EU firm inwards in the US market and thus diminishes market power of the European firm.

4 Empirical Analysis

In this section we look for empirical evidence that could confirm the predictions above. Earlier literature proposes different approaches to estimate firms' price mark-ups. Our methodology is based upon the Roeger (1995) methodology. This methodology is well suited for our firm-level data and was before successfully applied by Konings and Vandenbussche (2005).

The Roeger approach carries the Hall's (1988) insights regarding decomposition of the Solow residual (Solow, 1957) into a mark-up component and a pure technology component. We find the Hall approach unsuitable for our analysis, because it requires instruments to control for simultaneity bias. Instruments would control for the firm's adjustment of factor demands in response to productivity shocks. However, it is hard to find instruments controlling for pure demand shocks. Further, instruments may potentially be correlated with factor stock growth but not with transitory productivity growth, causing spurious correlation with the trade regime as found out by Abbott, Griliches, and Hausman (1989). Since firms face no adjustment costs in the Hall approach, the measurement error is counter-cyclic and productivity growth tends to be pro-cyclic, leading to downward biased estimates of price mark-ups.

On the other hand, one could think of applying the Bresnahan (1989) approach that uses the New Empirical Industrial Organization techniques to estimate price mark-ups through the responsiveness of prices to changes in demand elasticities and cost components. That structural approach has been already applied in earlier empirical research[15]. But since it requires detailed data on unit prices and quantities to estimate demand elasticities of particular industry it is inappropriate for our study.

[14] The empirical literature provides support that mark-ups fall with import competition, since foreign competition increases the elasticity of demand that domestic firms face. For a more detailed survey of this literature see Feenstra (1995) and Tybout (2003).

[15] Genovese and Wallace (1998) overcome the identification of the demand parameter without complete cost information and measure price mark-ups in the sugar industry by first selecting a type of demand equation, i.e. quadratic, linear, log-linear or exponential, and then deriving the supply function with instrumented demand parameters.

Our research is limited by company accounts data that do not include these figures.

Roeger (1995) and Olley and Pakes (1996) suggest models that go beyond the Hall approach. Olley and Pakes (1996) overcome a simultaneity problem generated by the relationship between productivity and demand for production factors. Their model circumvents the selection and simultaneity biases by developing a semi-parametric estimator for the production function parameters within the behavioral framework[16]. Because their approach requires longer time spans and can be applied only to firms with positive capital investments, it is less appropriate for our case.

Roeger (1995) develops a model that requires neither instrumentation nor deflators for output and production factor prices. His model is based upon the Solow (1957) model that has shown that the change of total factor productivity can be measured from observed data directly for a constant returns technology with the additional assumption of perfect competition[17]. Roeger (1995) similarly to Hall (1988) decomposes the Solow residual, but argues that the dual Solow residual, consisting of output and production factor prices, nests the same productivity term that will cancel out if the dual Solow residual is deducted from the primal Solow residual (Martins et al., 1996; Konings and Vandenbussche, 2005).

Earlier research signalled certain drawbacks of the Roeger methodology. One drawback of his method stems from assuming constant returns to scale. In contrast to Hall (1988), Roeger assumes constant returns to scale (CRS), implying an estimation bias depending on actual returns to scale. Relaxing the CRS assumption, the mark-up should be discounted for the term ξ_{it}, representing the sum of input cost shares in production function, and therefore expressed as $\frac{p_{it}}{c_{it}} = \frac{\mu_{it}}{\xi_{it}}$. This term indicates that there is downward (upward) bias in the mark-up levels under decreasing (increasing) returns to scale. Another drawback may stem from the use of company accounts data. Using aggregated industry-level data like in Roeger (1995), it is more plausible to assume that the unobservable measurement error cancels out. Using firm-level data it may be less accurate to consider that the unobservable measurement term cancels out due to firm-specific productivity differentials.

Taking drawbacks into account we do not aim to present an exhaustive analysis of firms' mark-ups in the steel sector, but would like to indicate whether or not US safeguard measures affected market power of European steel producers. Our primary goal is to indicate the change in the average firm's mark-up controlling for unobservable firm fixed effects and not to explain productivity differentials between heterogeneous firms. Moreover, using the firm-level data, Konings and Vandenbussche (2005) successfully apply the Roeger (1995) approach for estimating mark-up changes of domestic firms subject to EU antidumping policies.

[16] Pavcnik (2002) successfully applies their methodology for estimating the productivity changes following trade liberalization in Chile.

[17] In the same manner, Hulten (1986) calculated the change in total factor productivity using data on output and production factor prices.

4.1 The Empirical Model

We employ the Roeger methodology that allows a direct estimation of price mark-ups to estimate whether US safeguard protection had a negative impact on mark-ups of European steel producers[18]. Similar to Hall (1988) and Konings and Vandenbussche (2005), we consider a linear homogenous production function $G(K_{it}, L_{it}, M_{it})E_{it}$ for output Q_{it}, where K_{it}, L_{it}, and M_{it} are capital, labor and material inputs, and E_{it} is a shift variable representing changes in productivity efficiency for a firm i at time t.

Using the Solow residual, Hall (1988) measures the productivity growth as the output growth net weighted production factors growth, described as:

$$SR_{it} = \triangle q_{it} - (1 - \alpha_{Lit} - \alpha_{Mit}) \triangle k_{it} - \alpha_{Lit} \triangle l_{it} - \alpha_{Mit} \triangle m_{it} \tag{4.1}$$

where small letters refer to logarithms and the shares of labor and material costs in total sales ($P_{it}Q_{it}$) of firm i at time t are denoted by $\alpha_{Lit} = \frac{F_{Lit}L_{it}}{P_{it}Q_{it}}$ and $\alpha_{Mit} = \frac{F_{Mit}M_{it}}{P_{it}Q_{it}}$ with F and P representing input and output prices. The novelty of the Roeger (1995) paper is to show that under imperfect competition, the sum of input shares per unit is below one due to the existence of a mark-up term. Decomposition of the mark-up and the technology component is therefore a crucial step in the Roeger approach and it can be expressed in the following form:

$$SR_{it} = \lambda_{it}(\triangle q_{it} - \triangle k_{it}) + (\xi_{it} - \lambda_{it}) \triangle e_{it} \tag{4.2}$$

where $\lambda_{it} = \frac{P_{it} - c_{it}}{P_{it}}$ is the Lerner index for a firm i at time t. The right hand side is decomposed in the mark-up and the pure technology component. The relationship between the price and the marginal cost is established through the coefficient λ_{it} that is directly related to the mark-up over the marginal cost (μ_{it}), i.e. $\lambda_{it} = \frac{\mu_{it} - \xi_{it}}{\mu_{it}}$, where ξ_{it} denotes the sum of input costs in the firm's cost function and equals 1 under constant returns to scale, as assumed in Roeger (1995)[19]. The price-based or the dual Solow residual (SRP_{it}) is then defined from this relationship between the marginal cost and the output price and it can be expressed in the following form:

$$\begin{aligned} SRP_{it} &= (1 - \alpha_{Lit} - \alpha_{Mit}) \triangle F_{Kit} + \alpha_{Lit} \triangle F_{Lit} + \alpha_{Mit} \triangle F_{Mit} - \triangle p_{it} \\ &= (1 - \lambda_{it}) \triangle e_{it} - \lambda_{it}(\triangle p_{it} - \triangle F_{Kit}) \end{aligned} \tag{4.3}$$

[18] For a detailed overview of the Roeger methodology, refer to Roeger (1995), Martins et al. (1996) and Konings and Vandenbussche (2005).

[19] Roeger shows that the change in marginal cost is a weighted average of changes in input prices (F_{Iit}) with respect to their relative cost shares in the firm's cost function (ϕ_{Iit}), accounting for the change in technology (e_{it}), i.e. $\triangle c_{it} = \phi_{Iit} \triangle F_{Iit} - \triangle e_{it}$. Hence, $c_{it} = P_{it}(1 - \lambda_{it}) \iff \frac{P_{it}}{c_{it}} = \mu_{it} = \frac{1}{1-\lambda_{it}}$.

where F_{Kit} denotes the price of capital employed in the production function. The innovation of Roeger (1995) stems from using SRP_{it} to substitute for a change in productivity efficiency of a firm i at time t, i.e. $\triangle e_{it}$ in Equation (4.2). Similar to Konings and Vandenbussche (2005) we obtain the expression:

$$\begin{aligned} &SR_{it} - SRP_{it} = \\ &\frac{1}{\lambda_{it}}[\triangle q_{it} + \triangle p_{it} - \alpha_{Lit}(\triangle l_{it} + \triangle F_{Lit}) - \\ &\alpha_{Mit}(\triangle m_{it} + \triangle F_{Mit}) - (1 - a_{Lit} - a_{Mit})(\triangle k_{it} + \triangle F_{Kit})] + u_{it} \end{aligned} \tag{4.4}$$

where u_{it} represents the difference between measurement errors in SR_{it} and SRP_{it} and equals zero, since both forms are assumed to have the same unobservable productivity term. Since the Lerner index under the constant returns to scale is defined as $\lambda_{it} = \frac{P_{it}-c_{it}}{P_{it}} = \frac{\mu_{it}-1}{\mu_{it}}$, we rewrite Equation (4.4) to directly estimate the price mark-up (μ_{it}) term:

$$(\triangle q_{it} + \triangle p_{it}) - (\triangle k_{it} + \triangle F_{Kit}) = \mu_{it}(\phi_{Lit} \triangle \Omega_{Lit} + \phi_{Mit} \triangle \Omega_{Mit}) \tag{4.5}$$

where $\triangle\Omega_{Lit}$ and $\triangle\Omega_{Mit}$ represent the growth rates in labor and material costs per value of capital costs in firm i at time t[20]. Our core model is then specified as:

$$\triangle Y_{it} = \mu_{it} \triangle X_{it} \tag{4.6}$$

In line with the Roeger approach that the growth rate in output is explained by the growth rate in inputs times the mark-up term, our left-hand side variable ($\triangle Y_{it}$) represents the growth rate in sales per value of capital for a firm i at time t. The right hand side explanatory variable ($\triangle X_{it}$) stands for a vector of the growth rate in inputs weighted by their shares in total sales.

4.2 Description of Data

The data used in this study are the annual company accounts data compiled from Amadeus (2006) organized by the Bureau van Dijk. The data cover the industry of basic metals across EU-15 countries for the period 1995-2004. We focus our study on those firms that have reported their primary activity in this sector. The additional annual data on control variables, i.e. the real GDP growth rates and the product-level trade data, are downloaded from Ameco and Eurostat.

Industry selection was guided by the official statements from the White House Press on the US Steel Products Proclamation from March 2002. This information is used for identifying the

[20] For brevity reasons we express $\triangle\Omega_{Lit}$ and $\triangle\Omega_{Mit}$ as $\triangle\Omega_{Lit} = (\triangle l_{it} + \triangle F_{Lit}) - (\triangle k_{it} + \triangle F_{Kit})$ and $\triangle\Omega_{Mit} = (\triangle m_{it} + \triangle F_{Mit}) - (\triangle k_{it} + \triangle F_{Kit})$.

products subject to US safeguard protection. From this source, we obtain the necessary information about the type, the level, and the length of US safeguard tariffs. We use the services of the Tariff Information Center to classify protected products according to the 8-digit HTS of the US. Under the Chapter 99 within the Section XXII on Special Temporary Legislation, we identify subject products and match them with products specified in the Section XV on Base Metals and Articles of Base Metal product descriptions. The majority of activities involved in the production of subject products can be classified under the 2-digit HTS 72 code and the minority of activities, i.e. those involved in the production of certain welded tubular products, under the HTS 73 code. Using the convergence key between the HTS and the PRODCOM industry classifications we identify groups of activities at the 4-digit NACE Rev.1.1 level. We denote affected firms as those that are engaged in the production of subject products. Each firm in Amadeus has a trade description that allows for identifying activities pertinent to production of subject products.

The variables used in our econometric model are the following. The firm level operating revenue in each year provided in Amadeus is used to proxy the sales variable. For the value of capital we use the book value of tangible fixed assets for each firm in each year. The labor costs reported in Amadeus proxy the wage bill variable. Material costs variable is simply proxied by the firm-level total material costs consisting of the factor price multiplied by the quantity of materials. We constructed the capital intensity variable using the book value of tangible fixed assets for each firm in each year over the corresponding book value of total assets. The country-level real GDP growth rates, the real long term interest rates, and the price index of investment goods are obtained from the Ameco database from the ECFIN department at the European Commission.

Our firm-level data covers 2,241 firms, among which we distinguish between less and more diversified firms. Firms that do not report any secondary activity are referred to as single-product firms. These are likely to have less diversified production than multi-product firms. Multi-product firms by contrast refer to firms reporting at least one activity under the secondary NACE code. Table 2 presents the structure of the treated industry and some descriptive statistics including main indicators of the average firm's performance, size, and productivity.

[Insert Table 2 here]

The first pass at the data suggests there might be differences in the responsiveness of firms to the US safeguard tariff. The first column describes the number of affected firms in the Roeger specification. Our dataset consists of over two thirds of single-product firms that on average exhibit a bit lower degree of competition for their products than multi-product firms[21]. Regarding the

[21] The Lerner index is proxied by value added over total sales using the price-cost margin (PCM) method that is explained at the end of this section.

structure of the industry, only 19 percent of multi-product firms are active in directly affected industry of basic metals. Multi-product firms predominantly active in basic metals industry were on average larger in terms of sales and employment (L) and performed better, gaining higher returns on assets (ROA) at similar value added per worker (VA/L). An interesting observation is that 21 percent of multi-product firms were active in non-manufacturing sector, i.e. engaged in financial services, retail sector, and others. These were on average among the largest firms.

Descriptive statistics on the price-cost margin (the Lerner index) of an average firm reveal an interesting pattern that motivates our empirical model. Figure 2 presents the evolution of mark-ups for different groups of European steel producers. A sharp decline in mark-ups in 2002 was followed by an upswing one year after. Figure 2 suggests that safeguard protection (denoted by a vertical line) might have contributed to this decline in mark-ups.

[Insert Figure 2 here]

Figure 2 suggests that although European steel producers may indeed be adversely affected by US safeguards in 2002-2003, they recovered rather fast. Increased differentials between output and input prices in production of subject products might have enabled European firms to recover previous mark-up levels[22]. Figures 3 and 4 moreover suggest that it is reasonable to expect an effect of trade rerouting on market power of European steel producers.

[Insert Figures 3 and 4 here]

Figure 3 presents a persistent growth in European external trade flows in subject products during 1995-2004. A closer view into the composition of the trade flows reveals that some European exports of subject products to the US were depressed and rerouted to China and other countries, as observed in Figure 4 that plots the trade flows between the EU-15 and its main trading partners in subject products[23]. Large diversified firms like Thyssen Krupp and Corus, which attribute less than five percent of their production to US exports, could probably rebalance their losses with a greater ease by rerouting their exports to third countries.

By contrast, small and export-orientated producers potentially generated larger losses proportional to their output scales. European steel producers suffered increased import penetration non

[22] The world steel market has become highly competitive and abundant with steel leading to significant price reduction of crude coil from nearly \$500 in 1996 to below \$300 by the end of 2002. However, increased world demand for steel skyrocketed the price of crude coil steel up to \$600 in 2004. By contrast, there has been much less turmoil in the world prices of production factors in steel manufacturing (Datastream, 2006), which offers an explanation to the fast recovery of EU mark-ups in 2004.

[23] According to the EU trade statistics, were Japan (34.8 million tons), the EU-15 (31.8 mt), Russia (30.4 mt), Ukraine (28.2 mt), and China (20.0 mt) the largest steel exporting countries in 2004. The largest steel importing countries at that time were China (33.2 mt), US (32.8 mt), the EU-15 (30.4 mt), and South Korea (17.7mt). There has been a rapid growth in steel production elsewhere in the world, leading to a sharp decline in the EU's traditional trade surplus in iron and steel products. The EU steel imports have increased from 14.5 million tons in 1997 to 24.6 million tons in 2002.

only in their home market after 2001, but also in third country markets. The largest imports of subject products came from Russia. Large Russian producers, like Severstal, that directly compete with US integrated steel producers might have rerouted their exports from the US to the EU market and third markets due to imposition of US safeguard measures[24].

4.3 Results

Our preferred econometric approach is a fixed effects model that allows controlling for unobservable firm-specific fixed effects[25]. As noted above, we estimate separately mark-ups for each group of European producers of subject products by a log-linear model, controlling for industry and year specific effects. The Roeger approach allows us to directly estimate mark-ups of an average European steel producer of subject products. In our basic empirical specification, we estimate whether there was a statistically significant change in mark-ups in the period of US safeguard protection, from 2002 to 2003:

$$\Delta Y_{it} = \alpha_i + \mu_1 \Delta X_{it} + \mu_2 [\Delta X_{it} SG] + \mu_3 [\Delta X_{it} GDP_{jt}] + \beta_1 GDP_{jt} + \varepsilon_{it} \tag{4.7}$$

Our explained variable, ΔY_{it}, represents the output growth per value of capital. Our composite explanatory variable, ΔX_{it}, includes the growth of nominal inputs weighted by factor shares in sales for each firm i at time t. The results for each group of European steel producers are reported in Table 3[26]. In the first column we present our explanatory variables, controlling for business cycles by using real GDP growth rates to proxy for country-level shifts of demand. In the second column we report results of our first model specification (1), where we estimate mark-ups jointly for all European producers of subject products. The coefficient μ_1 refers to the level of mark-ups of European firms. The coefficient is statistically different from 1 and implies that the output price exceeded the marginal cost by around 37 percent.

[Insert Table 3 here]

[24] In response to Russian import penetration, the EU reached the agreement in the form of an Exchange of Letters with the Russian Federation in August 2003, establishing a double-checking system without quantitative limits in respect of the export of certain steel products from the Russian Federation to the EU (EC 22003A0828(01)).

[25] Following the results of the Hausman test we prefer a fixed effects model over a random effects model, although our results did not alter much using different specifications. The F-test indicated that fixed effects were significant in all four model specifications. In models with interaction effects we also include the main effects of the variables that were used to compute the interaction terms to exclude the possibility that main effects and interaction effects are confounded. The selection bias is less of an issue, since mark-ups until 2002 did not exhibit a significant upward or downward trend. In all econometric models we include industry and year fixed effects.

[26] We construct our capital variable in line with Konings and Vandenbussche (2005) as the user cost of capital multiplied by its nominal value. We define the user value of capital as $Z_{jt}(r_t + \delta_{it})$, where we consider a country-level price index of investment goods, Z_{jt}, a long-term real interest rate r_t at time t, and depreciation of capital δ_{it} of the average rate of 10 percent. We simulated the sensitivity of mark-ups towards different depreciation rates, price indices of investment goods, and real interest rates. Allowing for up to 5 percent changes, our point estimates vary within the range of 1 percent, without altering the signs of estimated coefficients.

The coefficient μ_2 is of our main concern, since it denotes a decrease in average mark-ups after imposition of US safeguards. We interact our composite variable ΔX_{it} with a dummy variable SG denoting safeguard measures, taking values 1 in 2002-2003 and 0 otherwise. We cannot reject the hypothesis at the 1 percent confidence level that mark-ups remained unchanged in years 2002 and 2003. The point estimates suggest a decline of 11 percent in average mark-ups following US safeguard protection in 2002. The negative sign on GDP suggests counter-cyclicality of mark-ups consistent with Konings and Vandenbussche (2005)[27]. In specifications (2) and (3), where we consider multi- and single-product firms, we also find highly significant decline in their mark-ups.

The level of mark-ups for multi-product firms (2) is on average larger than for single-product firms during 1995-2004, enabling multi-product firms to suppress mark-ups by more than single-product firms (3). Multi-product firms benefit from scale economies as they spread fixed costs over a larger number of units, thus operating on the downward sloping part of the average cost curve. Single-product firms, however, suffered more from US protection as they on average exhibit lower mark-ups during US protection. Referring to Table 2, around 80 percent of multi-product firms are active in other than basic metal sectors. Their presence in fabricated steel and retail sectors allows them to charge mark-ups accordingly with product characteristics. Exploiting variation in own- and cross-product demand elasticities, enables mark-up differentials between different types of firms[28].

4.4 Discussion and Robustness of Results

4.4.1 Safeguard Tariffs, Import Penetration and Trade Diversion

Figures 1 and 4 suggest that mark-ups of European steel producers may be affected indirectly by rerouted trade flows. To answer the question whether the overall decline in mark-ups in 2002-2003 is associated with the level of US safeguard tariff and the increased EU imports of subject products, we extend the model by decomposing the mark-up change. Following intuition provided by (3.8), we first account for export intensity of an average European steel producer to the US, conditional on tariff levels. Second, we consider increased competition in the EU market due to import penetration. The extended model is specified as:

[27] The real GDP growth rate in our data lies around 2 percent.

[28] Multi-product firms use basic steel intermediates further into fabrication process, allowing for larger mark-up differentials. Further fabrication of steel increases the degree of product differentiation, where firms are able to charge different mark-ups according to product characteristics and quality differences, unobserved to econometrician. See Berry et al. (1995), Goldberg and Verboven (2001), and Verboven (1996) on this point. Further, large multi-product firms are able to operate at lower unit production costs by recycling scrap steel and internalizing the energy and raw material costs.

$$
\begin{aligned}
\Delta Y_{it} &= \alpha_i + \gamma_1 \Delta X_{it} + \gamma_2 [\Delta X_{it} tariff_{kt}] + \gamma_3 [\Delta X_{it} SGm_{kt}] + \gamma_4 [\Delta X_{it} SGx_{kt}] \\
&\quad + \gamma_5 [\Delta X_{it} m_{kt}] + \gamma_6 [\Delta X_{it} x_{kt}] + \gamma_7 [\Delta X_{it} GDP_{jt}] + \beta_1 GDP_{jt} + u_{it} \qquad (4.8)
\end{aligned}
$$

Hence, γ_2 in (4.8) is the mark-up change associated with exports to the US in 2002-2003 and conditional on the tariff level imposed on each exported subject product k in year t, and γ_3 is the mark-up change associated with import penetration, m_{kt}, into EU market of a subject product k in year t in 2002-2003[29]. The estimated coefficient γ_4 denotes the mark-up change associated with the external EU-15 export intensity during US safeguard protection. Further, $\Delta X_{it} m_{kt}$ and $\Delta X_{it} x_{kt}$, control for the mark-up change associated with the external EU-15 import penetration and the external EU-15 export intensity during the period 1995-2004.

A potential problem pervading our estimation strategy is the reverse causality between the growth in the firm's output and trade, arising from the relation between productivity and openness. While low productive EU firms lobby for protectionism, some high productive EU firms self select themselves to export. Similarly, some foreign firms may export to the EU because of the prevailing market structure. We instrument trade flows with product-specific rather than firm-specific measures of import penetration, m_{kt}, and export intensity, x_{kt}, in the following manner[30]:

$$
m_{kt} = \frac{\sum_{k=1}^{K} z_{kt}}{\sum_{k=1}^{K} (z_{kt} + d_{kt})}, x_{kt} = \frac{\sum_{k=1}^{K} \chi_{kt}}{\sum_{k=1}^{K} (z_{kt} + d_{kt})}, k = 1, ..., K
$$

where $\sum_{k=1}^{K} z_{kt}$, $\sum_{k=1}^{K} \chi_{kt}$, and $\sum_{k=1}^{K} d_{kt}$ denote total EU-15 imports, EU-15 exports, and EU-15 production of a subject product k at year t. The results presented in Table 4 indicate that the average mark-up of both multi- and single-product firms is negatively associated with import penetration and export intensity to the US, conditional on the tariff levels. Mark-ups are shown to be decreasing with the level of the US safeguard tariff. For the sample of all firms (1) in Table 4, we indicate that a percentile change in tariffs leads to a statistically highly significant decline in mark-ups of 3 percent.

[Insert Table 4 here]

[29] Import penetration in our data ranges from 10 to 80 percent for scrap and basic steel to tin-mill products, respectively. Export penetration ranges from 10 to 60 percent for same groups of products. On average, both import penetration and export intensity lie around 20 percent over 10 year sample period and across all 4-digit industries. Differences in trade costs explain a great part in variation of openness to trade across industries.

[30] The industry averages of trade flows in tons are aggregated across all firms reporting their activity in the 4-digit sector, where an 8-digit product is produced. The synthetic index of Economic Freedom of the World or the Warner&Sachs index of openness are not appropriate instruments, since they do not directly measure the impact of US safegaurd measures in 2002.

While both multi-product (2) and single-product firms (3) exhibit a 2.5 percent decline in mark-ups associated with exports to the US, multi-product firms (2) respond intensively to US safeguard protection with a 2.6 percent decline in mark-ups associated with import penetration during 2002-2003[31]. Regarding rerouting of trade suggested by Figures 3 and 4, in particular to China after 2002, we control for trade flows in the whole sample period and further interact them with the safeguard dummy, taking 1 in years 2002 and 2003. Mark-ups are decreasing with import penetration of an average magnitude of 6 percent. Overall, import penetration has a disciplining effect on mark-ups of European steel producers throughout the period 1995-2004. During safeguard protection, a percentile increase in export intensity is strongly associated with a percentile increase in mark-ups of multi-product firms and negatively associated with mark-ups of single-product firms.

4.4.2 The Magnitude of the Policy Impact

In this sub-section we discuss factors contributing to the large effect of US safeguard tariffs on mark-ups of EU steel producers. First, US safeguard protection was anticipated already in the beginning of 2001, when the US ITC initiated the investigation of material injury in the US steel industry. Along with exceptionally high preliminary safeguard tariffs of more than 40 percent, early anticipation of the event partially accounts for the fast response of European firms. At that time, safeguard protection was scheduled for 4 years for 10 groups of subject products. Furthermore, the Amadeus data is reported at the end of each year.

Second, even though controlling for surrounding events, the large decrease in EU mark-ups may still partially reflect the compound effect of ongoing antidumping policies associated with subject steel products. Due to limitations of the Amadeus data, where the firm's activity is described at 4-digits, we cannot completely control for all 21 anti-dumping orders against EU exporters that were outstanding on products already covered by US safeguard measures. However, we expect them to magnify the downward effect on mark-ups of EU steel firms. The high magnitude of the effect of safeguards on EU mark-ups partially resembles an overriding effect of antidumping and antitrust policies in the US and the EU market[32].

Finally, the estimated change in mark-ups represents a lower bound value. We do not observe the share of sales of a firm i at time t dedicated to exports in our data and total sales in Amadeus are reported at the 4-digit activity-level and not at the 8-digit product-level. Further identification

[31] Tariffs range from 7 to 30 per cent and are imposed on each unit of subject product imported by the US. Thus, both multi- and single-product firms face equal increase in unit costs of traded steel.

[32] Even though safeguard protection has already been terminated after 2 years, a total of 21 anti-dumping orders against the EU exporters are outstanding on products already covered by the safeguard measures. The termination of safeguard actions does not have any impact on the outstanding AD and CVD orders (EC, 2006). Mark-ups could partially reflect changes in market structure as a result of ongoing consolidation process in the EU steel sector. The merger of Aceralia, Arbed and Usinor into Arcelor, was officially launched in February 2001 and became effective one year later, when the Arcelor share was listed on several stock exchanges.

of export intensive and export less intensive firms would add to the robustness of our results. To circumvent these problems, we could think of estimating product specific mark-ups employing the trade data rather than the firm data[33]. In presence of the increasing returns to scale, estimates of mark-up changes are likely to be downward biased due to the constant returns to scale assumption. Interacting our composite regressor ΔX_{it} with a dummy variable SG, taking 1 in 2002 and 0 otherwise, we find an even larger and a highly significant decrease in mark-ups in model specifications (1), (2), and (3). Assuming the constant returns to scale, the Roeger method leads to overestimated mark-up levels and underestimated mark-up changes in case of the increasing returns to scale[34]. If the unobservable term u_{it} in Equation (4.4) would cancel out, we would be able to explain all variation in the data. However despite the high goodness of fit, about 10 percent of the variance remains unexplained in all model specifications.

4.4.3 Control Group

In order to ensure that mark-ups of EU producers of subject products decreased due to US safeguard protection and not due to some phenomenon in the European manufacturing sector, we construct a control group of firms. We identify firms that are not likely to be directly involved in production of subject products and were not subject to ongoing competition or trade policy investigation. Firms in our counterfactual sample have on average similar characteristics as firms in the treated sample, but do not report to be active in production of subject products or fabricated steel products, using subject products as intermediates. We have experimented with different random counterfactual samples of firms within different industries, obtaining similar results.

In specification (4), we present mark-up estimations for randomly selected firms from the manufacturing sectors unlikely to be affected by US safeguards[35]. Interpreting the coefficient μ_2 in the last column of Table 3, we can reject the hypothesis that mark-ups have declined in 2002 and 2003. Similar to our treated samples (1), (2), and (3) we find mark-ups to be statistically different from 1, implying imperfect competition in the counterfactual industries. We can exclude the possibility that a decrease in mark-ups was driven by a common EU-15 industry effect.

[33] One alternative is motivated by the Goldberg and Knetter (1999) approach. They estimate market power in segmented export markets by the elasticity of residual demand exporters face. The residual demand elasticity is identified by exchange rate shocks which rotate the supply relation of the exporting group relative to other firms in the market. This approach allows the use of product-level data on values and quantities of exports. The described approach would, however, include limited firm specific information and is thus less suitable for our research question.

[34] Further, we only partially capture the magnitude of mark-up change pertinent to products classified at 8-digit level, because we estimate mark-ups on basis of 4-digit firm data. Our data does not provide information on product related sales and factor costs.

[35] Firms within the steel sector are not considered as a control group due to following reasons. First, the steel industry accounted for about one third of all antidumping cases and has been subject to several antitrust investigations in the last decades. It is hard to disentangle the compound effect of different policies concerning basic and fabricated steel products. Secondly, basic steel products subject to US safeguard protection in 2002 are likely to be employed in further processing downstream the production within industries like fabricated steel, transportation vehicles, and IT sector.

4.4.4 Alternative Specifications

To verify the results obtained with the Roeger specification, we discuss here an alternative estimation method. As our core alternative model we borrow a price-cost margin (PCM) approach discussed in Tybout (2003). The empirical model is based upon a simple theoretical pricing model with imperfect competition, assuming static profit maximizing behavior of firms. This approach is based upon the Lerner index, describing a profit maximizing firm's marginal costs ($\frac{P_{it}}{c_{it}}$) at time t as a decreasing function of the price elasticity of demand (ε) that firm i faces when selling the output Q_{it} at price P_{it}, formally expressed as $\frac{P_{it}}{c_{it}} = \mu_{it}\left(\frac{\varepsilon}{\varepsilon-1}\right)$ with the corresponding price mark-up μ_{it}. The intuition implies that US safeguards affect its own protected market elasticity of demand in a negative manner and allow for higher price mark-ups. The price-cost margin (PCM_{it}) can then be expressed as a function of the output price (P_{it}), the output (Q_{it}), and the marginal production costs (c_{it}):

$$PCM_{it} = \frac{(P_{it} - c_{it})\,Q_{it}}{P_{it}Q_{it}} = \frac{(P_{it} - c_{it})}{P_{it}} \tag{4.9}$$

We follow the common estimation approach discussed in Konings and Vandenbussche (2005) and use the observed firm-level price-cost margin defined as sales net of expenditures on labor and materials over sales, i.e. $PCM_{it} = \frac{(P_{it}Q_{it} - P_{Mit}M_{it} - P_{Lit}L_{it})}{P_{it}Q_{it}}$ for firm i at year t. In order to verify the results in Table 3, we estimate mark-ups of a pooled sample of firms, using the following regression equation:

$$PCM_{it} = \alpha_i + \delta_1 SG + \delta_2 KI_{it} + \delta_3 VApw_{it} SG + \delta_4 GDP_{jt} + \xi_{it} \tag{4.10}$$

where α_i represents the unobserved firm specific fixed effects and ξ_{it} a white noise error term. The regressions include controls on capital intensity (KI_{it}) for firm i at time t, defined as a ratio of capital to total assets, the real GDP growth in country j at time t (GDP_{it}), a dummy variable for safeguard measures (SG), taking values 1 for the period 2002-2003 and 0 otherwise, and year dummies. In particular, we are interested in whether firms could maintain the mark-up level by charging higher output prices or by increasing productivity of their labor force. We do not observe data on prices and therefore control for value added created by each employee ($VApw_{it}$). In fact, to disentangle its effect on mark-ups after safeguards were imposed, we interact this variable with SG taking value 1 in 2002-2003. Table 5 presents the results of the PCM model. In the first three model specifications, we indicate a statistically highly significant decrease in mark-ups in 2002-2003.

[Insert Table 5 here]

We obtain even more powerful results, when imposing a safeguard dummy only in the year 2002. In all model specifications we find an average decrease in mark-ups of about 3 percentage points. Furthermore, it seems that an average EU firm increased its value added per employee in 2002-2003. The results are not likely to be driven by a common industry factor, since for our counterfactual sample of firms we can reject the hypothesis that mark-ups have changed in 2002-2003. We experimented also with other model specifications, expressing mark-ups as an input-output ratio. We estimated the average mark-up to be around 15 percent and found a similar negative change in mark-ups in the period 2002-2003.

5 Conclusion

Safeguard measures, together with antidumping measures, have become the prevalent instruments for imposing import restrictions. While previous micro-econometric research focuses on domestic producers, it largely neglects the effects of safeguard measures on foreign exporters. Our study considers the externalities of administered trade protection for foreign exporters. To this end, we show that US safeguard protection on steel in 2002 adversely affected mark-ups of EU steel producers. We find that mark-ups of EU steel producers on average declined by 11 percent during US safeguard protection. Single-product firms saw their markups decline by more than multi-product firms. Our results also suggest that European steel exporters partially absorbed US safeguard tariffs. We show that the higher levels of US safeguard tariffs were associated with larger declines in mark-ups of EU steel producers.

Controlling for unobservable firm heterogeneity with fixed effects, our results are robust to alternative specifications. We can exclude the possibility that the decrease in mark-ups that we find was driven by a common EU industry effect since we do not find a statistically significant decrease in mark-ups for a randomly drawn control group of firms not subject to US safeguard protection.

Our results have some interesting implications. First, safeguard protection aimed at fostering domestic firms induces adverse externalities for foreign exporters. Our evidence further suggests that US safeguard protection triggered domino effects[36]. We find that US safeguard protection resulted in some rerouting of European steel. For example, EU steel producers rerouted some of their exports from the US to China during US protection. This resulted in a call for trade policy action by Chinese steel producers. In 2003, China itself imposed safeguard measures on certain steel products in response to a large influx of the world's steel during US safeguard protection.

Second, the response to US safeguard protection amongst EU steel firms was heterogeneous.

[36] The concept of domino effects in the multilateral trade framework has been introduced into the international trade literature in the early nineties by Baldwin (1993). His paper presents a theoretical model where an established trade agreement can trigger requests from countries that were previously non-members. His model implies that one country's trade policy action can trigger echoing trade actions by other countries.

Single-product firms suffered more from protection and their mark-ups decreased more than those of multi-product firms indicating the larger dependency of single-product firms on adverse market reactions. Multi-product firms appear to be less dependent on individual international markets and seem to have a better ability to adjust their mark-ups to the high-variance trade shocks in the global trade arena.

In conclusion, we find a considerable negative effect of US safeguards on EU mark-ups, suggesting that one country's safeguard protection generates adverse externalities for its trading partners.

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APPENDIX A: Description of the Model in Section 3

An European and an US firm compete in a Cournot fashion and maximize their profit functions of the following form:

$$\pi = P(Q)x + P^*(Q^*)x^* - c(x + \frac{x^*}{g}) - F - \tau x^* \tag{A.1}$$

$$\pi^* = P^*(Q^*)y^* + P(Q)y - c(y^* + \frac{y}{g}) - F^* \tag{A.2}$$

where Q and Q^* reflect the output sold in the EU and the US market. Both firms face iceberg transport costs per unit of their shipments. The European firm's exports to the US are additionally constrained by the US safeguard tariff. Each firm maximizes its own output, which yields first order conditions and implies the best reply functions:

$$\frac{\partial \pi}{\partial x^*} = p^{*\prime}x^* + p^* - \frac{c}{g} - \tau = 0 \Longleftrightarrow x^*(y^*) : p^* = \frac{c}{g} - \tau - p^{*\prime}x^* \tag{A.3}$$

$$\frac{\partial \pi^*}{\partial y^*} = p^{*\prime}y^* + p^* - c = 0 \Longleftrightarrow y^*(x^*) : p^* = c - p^{*\prime}y^* \tag{A.4}$$

where primes denote first derivatives and analogously could be shown for the EU market. Consider now that the market share of the European firm in the US market is denoted by $\sigma^* = \frac{x^*}{Q^*}$ and the elasticity for demand of the product in the US is described by $\varepsilon^* = -\frac{p^*}{Q^*}\frac{\partial Q^*}{\partial p^*}$, then the best reply functions in the US can be implicitly given as:

$$x^*(y^*) : p^* = \frac{c\varepsilon^* + \tau g \varepsilon^*}{g(\varepsilon^* - \sigma^*)} \tag{A.5}$$

$$y^*(x^*) : p^* = \frac{c\varepsilon^*}{\varepsilon^* + \sigma^* - 1} \tag{A.6}$$

and analogously the best reply functions can be derived for the EU market. The equilibrium market shares and prices are then given in the US market as:

$$\tilde{\sigma}^* = \frac{\varepsilon^*(g - 1 - \frac{\tau g}{c}) + 1 + \frac{\tau g}{c}}{1 + g + \frac{\tau g}{c}} \tag{A.7}$$

$$\tilde{p}^* = \frac{c\varepsilon^*(1 + g + \frac{\tau g}{c})}{g(2\varepsilon^* - 1)} \tag{A.8}$$

And the equilibrium in the EU is defined as:

$$\tilde{p} = \frac{c\varepsilon(1+g)}{g(2\varepsilon - 1)} \tag{A.9}$$

$$\tilde{\sigma} = \frac{\varepsilon(g-1)+1}{1+g} \tag{A.10}$$

This result shows that the European firm's market share will be lower in the US market than the US firm's market share in the European market. The US safeguard tariff shifts the best response function of the EU firm inwards in the US market. In fact, the US tariff diminishes the EU firm's market share in the US by more than it increases the US firm's market share in the US.

In equilibrium, the European firm will maintain its market share in the US as long as it will find it profitable to export. In other words, it needs to cover its costs per each unit of product sold in the US, so that $\tilde{p}^* > \frac{c}{g} + \tau > 0 \wedge \tilde{\sigma}^* > 0$. Analogously will the US firm export to the EU market as long as it gilts that $\tilde{p} > \frac{c}{g} > 0 \wedge \tilde{\sigma} > 0$. Rewriting the equilibrium price levels in terms of demand elasticities and market shares, the elasticities of demand can be expressed as:

$$\varepsilon^* < \frac{1 + \frac{\tau g}{c}}{1 - g + \frac{\tau g}{c}} \tag{A.11}$$

$$\varepsilon < \frac{1}{1-g} \tag{A.12}$$

Furthermore, the EU firm will export to the US market as long as the tariff τ is set below its prohibitive level, i.e. as long as $\bar{\tau} < \frac{c(\varepsilon^*(g-1)+1)}{g(\varepsilon^*-1)}$. This is an important implication of the model, showing that the elasticity of demand in the US is lower than in the US due to the US safeguard tariff, i.e. $\varepsilon^* < \varepsilon$. The adverse effect of the safeguard tariff on mark-ups of the European firm can be shown from the inverse relationship between price mark-ups and the price elasticity of demand $\frac{P-\bar{c}}{P} = \frac{1}{\varepsilon^*}$, where $\bar{c} = c + \frac{c}{g} + \tau$ denotes the aggregate marginal costs of the European firm that exceed marginal costs of the US firm by amount of the US tariff imposed.

APPENDIX B: Tables and Figures

Table 1: *Subject products, tariff levels, and US import market shares*

Products	HTS	Tariff		Import share[a), b)]		
	8-digit	2002	2003	1996	2001	2003
Flat steel & slabs	9903.72.30-14	30%	24%	38.75%	28.8%	25.4%
Tin mill products	9903.73.15-27	30%	24%	N/A	N/A	N/A
Hot-rolled, cold-finished, and	9903.73.28-44;	30%	24%	13.8%	17.0%	16.4%
stainless steel bars and rods	9903.73.66-81	15%	12%			
Reinforcing bars (rebars)	9903.73.45-50	15%	12%	1.7%	4.8%	3.4%
Welded tubular products	9903.73.51-62	15%	12%	0.8%	1.0%	1.5%
Fittings & flanges	9903.73.66-72	13%	10%	N/A	N/A	N/A
Stainless steel wire	9903.73.91-96	8%	7%	0.1%	0.1%	0.1%
TOTAL [c)]	9903.73.30-96	/	/	73.9%	67.8%	61.0%
(all subject products)	(excl. .73.73-90)					

Notes:

a) $Import\ share = \frac{US\ general\ import\ tonnes\ of\ subject\ products}{US\ general\ import\ tonnes\ of\ all\ basic\ metal\ products}$

b) Import market share statistics were obtained at the product-level. Notation N/A denotes the data that were not available at the product-level. We report aggregated statistics on import shares of hot-rolled, cold-finished and stainless steel bars.

c) All subject products include also a group of semi-finished products that were under US safeguard protection. This group includes most of subject tin-mill products, fittings and flanges.

Table 2: *Summary statistics and overview of the industry*

Affected firms	Total	Obs.	Lerner	ROA	Sales	L	VA/L
"Single"-product firms	1 662	10 335	0.26	4.0	29 680	110	55
Multi-product firms	579 (100%)	3 793	0.22	4.7	22 060	101	44
Basic metals (NACE 27)	109 (19%)	811	0.22	4.4	52 863	218	56
Fabricated metals (NACE 28)	301 (52%)	1 961	0.23	4.9	6 619	34	40
Manufacturing (NACE 15-37)	457 (79%)	3 053	0.23	5.0	18 575	82	44
Non-manufacturing (else than NACE 15-37)	122 (21%)	740	0.22	3.4	36 437	187	44

Notes:

a) The first column presents total number of firms producing subject products. Percentages in brackets denote the presence of multi-product firms in other sectors.

b) Remaining figures refer to the mean values across the sample of EU-15 countries over 1995-2004. Sales are reported in tons.

Table 3: *Estimation results, the Roeger method (Fixed effects)*

$$\Delta Y_{it} = \alpha_i + \mu_1 \Delta X_{it} + \mu_2 [\Delta X_{it} SG] + \mu_3 [\Delta X_{it} GDP_{jt}] + \beta_1 GDP_{jt} + \varepsilon_{it}$$

Variable	All[a),b)]	Multi-product	Single-product	Counterfactual[c)]
	(1)	(2)	(3)	(4)
ΔX_{it}	1.3728***	1.4531***	1.3591***	1.1863***
	(0.0162)	(0.0326)	(0.0190)	(0.0084)
$\Delta X_{it} SG$	-0.1090***	-0.1435***	-0.0681***	0.1154***
	(0.0155)	(0.0259)	(0.0068)	(0.0087)
$\Delta X_{it} GDP_{jt}$	-0.0699***	-0.0902***	-0.0355***	0.0144***
	(0.0055)	(0.0102)	(0.0058)	(0.0030)
GDP_{jt}	-0.0248***	-0.0134	-0.0355***	-0.0149***
	(0.0046)	(0.0088)	(0.0058)	(0.0025)
R^2	0.90	0.92	0.88	0.85
Observations	9897	2620	7277	46553
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes

Notes:

a) Robust standard errors are reported in brackets. ***/**/* denote statistically significant at the 1/5/10% confidence level.

b) All firms refer to affected firms producing products subject to US safeguard protection.

c) Counterfactual firms refer to firms in the manufacturing sectors that have on average similar characteristics as all affected firms, but were not subject to US safeguard protection.

Table 4: *Estimation results, the Roeger method (Fixed effects)*

$$\Delta Y_{it} = \alpha_i + \gamma_1 \Delta X_{it} + \gamma_2[\Delta X_{it} tariff_{kt}] + \gamma_3[\Delta X_{it} SGm_{kt}] + \gamma_4[\Delta X_{it} SGx_{kt}] + \gamma_5[\Delta X_{it} m_{kt}] + \gamma_6[\Delta X_{it} x_{kt}] + \gamma_7[\Delta X_{it} GDP_{jt}] + \beta_1 GDP_{jt} + u_{it}$$

Variable	All[a),b)]	Multi-product	Single-product
	(1)	(2)	(3)
ΔX_{it}	1.3687***	1.4969***	1.3451***
	(0.0228)	(0.0430)	(0.0280)
$\Delta X_{it} tariff_{kt}$	-0.0343***	-0.0250*	-0.0266**
	(0.0091)	(0.0144)	(0.0122)
$\Delta X_{it} SGm_{kt}$	-0.0076***	-0.0261***	-0.0029
	(0.0024)	(0.0050)	(0.0028)
$\Delta X_{it} SGx_{kt}$	0.0018	0.0089***	-0.0055***
	(0.0017)	(0.0034)	(0.0020)
$\Delta X_{it} m_{kt}$	-0.0060***	-0.0049*	-0.0072***
	(0.0017)	(0.0029)	(0.0021)
$\Delta X_{it} x_{kt}$	0.0016*	-0.0009	0.0026**
	(0.0009)	(0.0018)	(0.0011)
$\Delta X_{it} GDP_{jt}$	-0.0453***	-0.0815***	-0.0349***
	(0.0059)	(0.0105)	(0.0075)
GDP_{jt}	-0.0195***	-0.0119	-0.0280***
	(0.0048)	(0.0092)	(0.0061)
R^2	0.90	0.93	0.90
Observations	8412	2352	6060
Industry dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes

Notes:

a) Robust standard errors are reported in brackets. ***/**/* denote statistically significant at the 1/5/10% confidence level.

b) All firms refer to affected firms producing products subject to US safeguard protection.

Table 5: *Estimation results, the PCM method (Fixed effects)*

$$PCM_{it} = \alpha_i + \delta_1 SG + \delta_2 KI_{it} + \delta_3 VApw_{it} SG + \delta_4 GDP_{jt} + \xi_{it}$$

Variable	All$^{a),b)}$	Multi-product	Single-product	Counterfactual$^{c)}$
	(1)	(2)	(3)	(4)
SG	-0.0307***	-0.0174**	-0.0372***	0.0242
	(0.0056)	(0.0091)	(0.0068)	(0.0255)
KI_{it}	-0.0861***	-0.0406***	-0.1074***	-0.5578***
	(0.0098)	(0.0009)	(0.0113)	(0.0067)
$VApw_{it}SG$	0.0001**	-0.0000	0.0001***	-6.4e-05
	(0.0000)	(0.0000)	(0.0000)	(6.7e-05)
GDP_{jt}	0.0015	-0.0050	0.0019	0.0206**
	(0.0023)	(0.0044)	(0.0028)	(0.0109)
Constant	0.2838***	0.2548***	0.3000***	0.4116***
	(0.0061)	(0.0113)	(0.0072)	(0.0274)
R^2	0.74	0.72	0.73	0.49
Observations	8217	2077	6140	36576
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes

Notes:

a) Robust standard errors are reported in brackets. ***/**/* denote statistically significant at the 1/5/10% confidence level.

b) All firms refer to affected firms producing products subject to US safeguard protection.

c) Counterfactual firms refer to firms in the manufacturing sectors that have on average similar characteristics as all affected firms, but were not subject to US safeguard protection.

Figure 1: *Evolution of the US general imports of subject products*

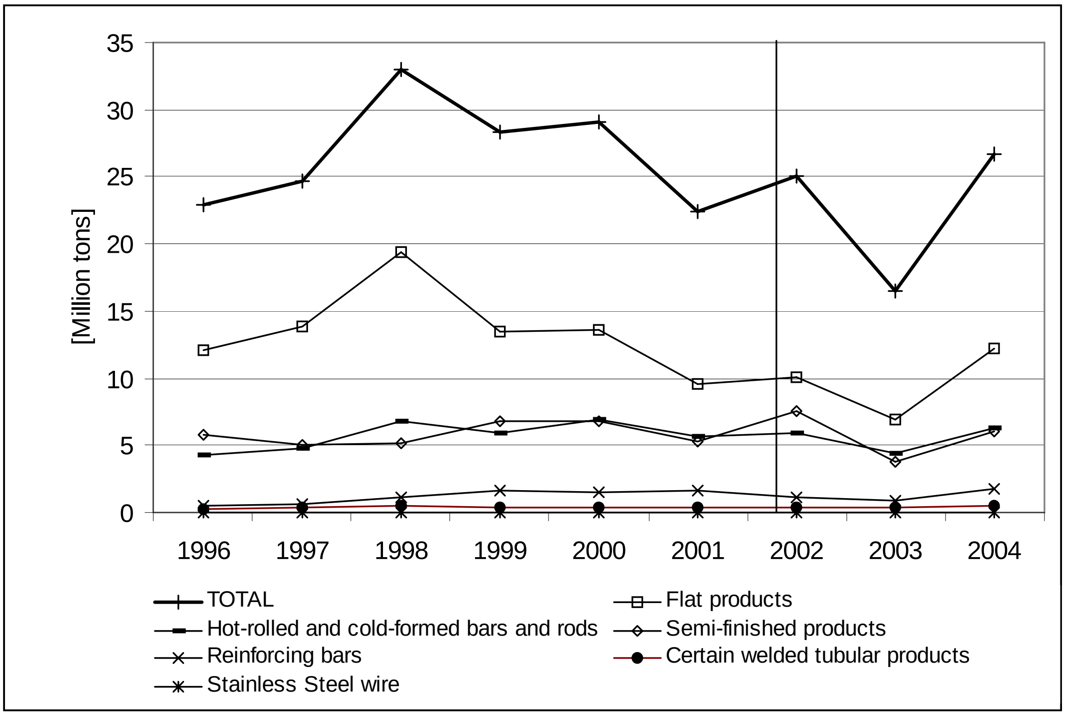

Figure 2: *Evolution of the price-cost margins of the European steel producers*

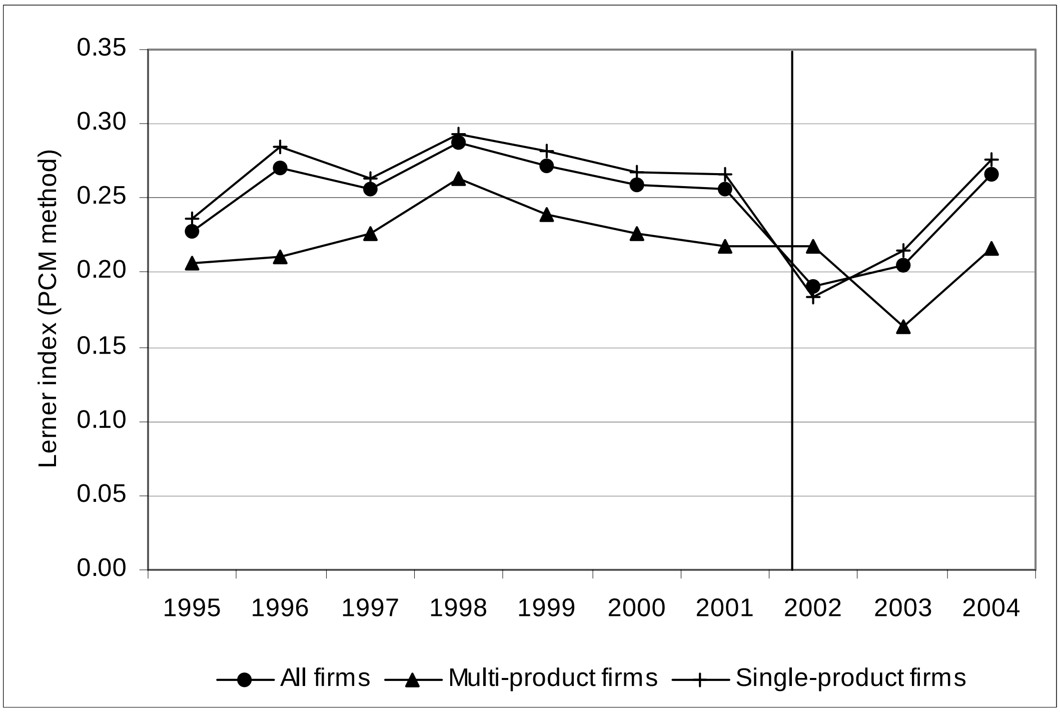

Figure 3: *Evolution of the external EU-15 trade flows in subject products*

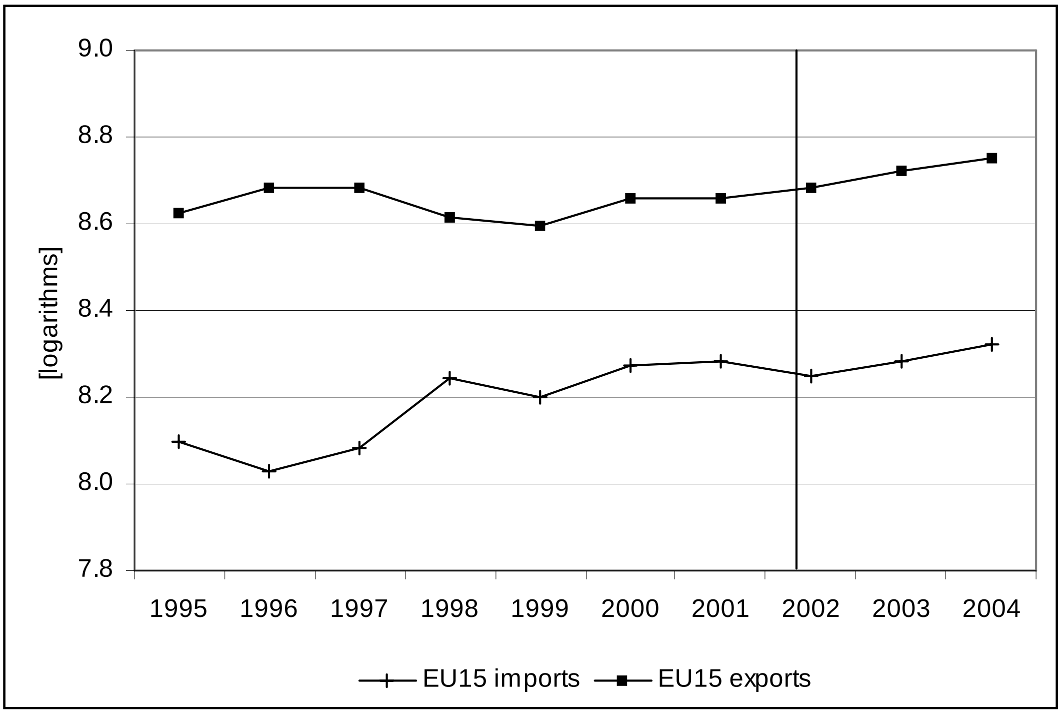

Figure 4: *Evolution of the trade flows in subject products with the EU-15*