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Are All Trade Protection Policies Created Equal? Empirical Evidence for Nonequivalent Market Power Effects of Tariffs and Quotas
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ABSTRACT

Over the past decades, the steel industry has been protected by a wide variety of trade policies, both tariff- and quota-based. We exploit this extensive heterogeneity in trade protection to examine the well-established theoretical literature predicting nonequivalent effects of tariffs and quotas on domestic firms' market power. Robust to a variety of empirical specifications with U.S. Census data on the population of U.S. steel plants from 1967-2002, we find evidence for significant market power effects for binding quota-based protection, but not for tariff-based protection. There is only weak evidence that antidumping protection increases market power.

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1. Introduction

An extensive literature dating back to at least Bhagwati (1965) demonstrates that tariffs and quotas that limit imports in an identical way may have nonequivalent effects on economic behavior and outcomes. One of the most well-known examples of this nonequivalence is that tariffs and quotas can have quite different effects on the degree of market power exercised by domestic and foreign firms. This result was demonstrated by Harris (1985) and Krishna (1989) in oligopoly settings where a foreign firm and a domestic firm compete for the domestic market. The key result is that the strict quantitative limit set by a quota restricts the foreign firm's best response in a systematic way that facilitates collusive pricing by the firms, therefore raising prices, market power and profits. In contrast, tariffs do not impose any binding constraints on prices and quantities and, thus, have no predicted effects on market power.

Despite this theoretical literature establishing the nonequivalent market-power effects of quotas vis-à-vis tariffs, there has been virtually no work to examine this hypothesis empirically.[1] A number of studies, including Berry, Levinsohn, and Pakes (1999) and Goldberg and Verboven (2001), have estimated significant market impacts of quantitative restrictions on exports of automobiles in U.S. and European markets, but they do not examine whether tariffs have equivalent effects. Winkelmann and Winkelmann (1998) use the experience of a large trade protection liberalization event in New Zealand to estimate significant negative terms-of-trade effects to New Zealand for products that were formerly protected by quotas, but no such effects for those that were tariff-protected. However, since the authors do not have cost data and identify estimates from primarily cross-sectional variation, it is difficult to connect their results to market power effects. Kim (2000) estimates the impact of trade protection programs on productivity,

[1] A predecessor paper to this one by a subset of the authors (Blonigen, Liebman and Wilson, 2007) also considers these issues, but with industry-level data that does not allow the precision and robustness of this paper's results using highly detailed plant-level data.

market power, and scale efficiency for the Korean industrial sectors from 1966 through 1988. The analysis finds that quotas have a statistically significant impact on market power, whereas price-based forms of protection do not, but cannot conclude that their impacts are different due to the size of the standard errors.

In this paper, we directly examine the hypothesis of nonequivalent market-power effects of quotas and tariffs using a detailed panel of US steel plants and a control group of non-ferrous metal plants from 1967 through 2002. The US steel industry has been the recipient of practically every form of trade protection over this time period (see Table 1 for a timeline of events). In fact, the steel industry accounts for over one-third of the over 1400 US AD and CVD cases since 1980, and steel is one of only a few high-profile industries that have enjoyed quotas or safeguard remedies. In addition, there has been significant heterogeneity in trade protection across various steel products and at different points in time, providing a rich variation to identify our estimates. Our plant-level data includes detailed measures of inputs, production, and prices, allowing us to use well-established techniques to estimate market power for the population of U.S. steel-makers, and the panel nature of the data allow us to control for unobserved plant-level fixed effects. We are also careful to account for the potential endogeneity of trade protection and market power.

While a primary focus of our analysis is the difference in market-power effects of tariffs and quotas, our data allow us to also estimate market-power effects of a variety of other trade protection programs, including antidumping (AD) duties and countervailing duties (CVD).[2]

[2] There is a literature that has analyzed the impacts of various trade protection programs in the steel industry, though the frequent focus is to analyze just one type of trade protection program, rather than compare effects across trade protection programs. Crandall (1981) and Canto (1984) examine the effect of the US VRAs from 1969-1974, finding that these VRAs had only a very modest effect in raising import prices for US steel firms. Lenway, Rehbein and Starks (1990) and Lenway, Morck, and Yeung (1996) provide event study analysis evidence that steel firms' profitability was increased by the announcement of voluntary restraint agreements (VRAs) in 1982 and 1984. More recently, Chung (1998) finds that AD and CVD duties from 1982 through 1993 had only modest impacts on import penetration, while Bown (2004) and Durling and Prusa (2006) find that AD and safeguards significantly decrease trade in targeted products. Liebman (2006) finds little evidence that the 2002-2003 safeguard actions affected US steel prices. In addition to the literature cited that uses econometric techniques to evaluate trade policies *ex post*, there is also a significant literature that examines these policies with computable general (or partial) equilibrium models,

Staiger and Wolak (1989), Prusa (1994), and Veugelers and Vandenbussche (1999) provide models that indicate that the structure of AD investigations and duty determination can facilitate collusion amongst domestic and foreign firms serving a domestic market and, thus, also raise market power of these firms. Konings and Vandenbussche (2005) analyze a firm-level data set of European firms who petitioned and received AD protection in the 1990s and find that there was a significant increase in market power of firms after the imposition of AD duties. Similarly, Pierce (2010) finds that U.S. manufacturing plants responded to antidumping duties by increasing prices and markups. In contrast, Nieberding (1999) examines whether the withdrawal of 1982 US AD cases against imported steel affected market power for three large US steel producers and finds only mixed evidence for any positive effects.

We are unaware of any theoretical models that suggest CVDs would increase market power. CVDs are designed to countervail subsidization by a foreign government and, therefore, the calculation of the CVD is unaffected by firm behavior. In contrast, the calculation of AD duties are directly affected by foreign firm pricing behavior, and it is these well known rules by which AD duties adjust to foreign firm pricing that allows the domestic and foreign firms to potentially coordinate collusive pricing. Given this, we propose a second related nonequivalence hypothesis that AD duties increase market power of domestic firms, whereas CVDs do not. Our analysis will be able to directly examine whether there are any differential market-power effects of AD duties and CVDs, as well as the extent to which these trade protection programs differ in their effects from tariffs and quotas.

Unlike AD or CVD duties, which are country and even firm-specific, safeguard tariffs provide protection across a wide array of import sources and are applied uniformly against foreign firms in targeted countries. Thus, individual foreign firms have little incentive to alter

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including de Melo and Tarr (1990) and many US federal government agency reports. These studies also typically their pricing behavior in order to reduce their tariffs, as contrasted with the previously discussed dynamics that may arise with foreign firms facing AD duties. Thus, our expectation is that safeguard tariffs will not have an effect on markups.

Our paper's econometric results provide a number of important results. First, we find significant support for nonequivalent effects of quotas and tariffs as theory would suggest. The various forms of tariff-based protection programs (*ad valorem* tariffs, CVD duties, and safeguard tariffs) show no evidence of positive market power effects, while quantitative restrictions in the form of voluntary restraints agreements (VRAs) in our sample (when binding) are associated with increases in market power that are both statistically and economically significant. The evidence suggests that the significant market power effects associated with quotas are similar for both types of steel production plants (minimill and integrated), but do not exist for steel processing plants where broad-based quota programs affected not only their final product, but also their purchased primary steel inputs. The evidence for a market power effect of AD duties is less conclusive. We estimate a significant positive effect of AD duties using one of the two main methods by which we estimate market power effects, but not when using the other method.

The remainder of the paper proceeds as follows. In the next section, we briefly describe the US steel industry and its substantial history of trade protection. Section 3 describes our empirical methodology and data, section 4 presents our empirical results, and section 5 concludes.

focus on only single trade protection instances and do not explore differing effects of trade protection programs.

2. US Steel Industry and Its History of Trade Policies

2.1. US Steel Producers

The US steel industry is composed of two major types of producers: integrated mills and mini-mills. Integrated mills use large blast furnaces to make pig iron from iron and coke, which is then melted into raw steel in basic oxygen furnaces. Until recently, integrated mills accounted for the majority of steel production in the United States. Integrated mills often include on-site or nearby finishing and rolling mills that further finish the semi-finished steel forms, such as ingots, slabs, and billets, into finished products, such as bars and sheets. Over time, a process of "continuous casting", whereby molten steel is formed directly into finished products has spread throughout the industry. Examples of integrated steel companies include US Steel and Bethlehem Steel.

The past three decades have also seen an ever-increasing share of steel production due to mini-mill steel plants which melt recycled steel scrap with electric arc furnaces (EAFs) into raw steel and steel products.[3] There are a number of cost efficiencies possible from mini-mill production, particularly in the much smaller plant size and hence, capital costs, required for an EAF. Historically, mini-mill producers have primarily produced lower-quality steel products, such as wire rods and steel bar products, because of the greater impurities in steel made from recycled scrap steel, rather than iron ore. However, over time, technologies have been developed that have begun to allow mini-mill producers to break into higher-quality steel markets, such as plate and sheet products. While Nucor is the well-known example of a mini-mill-based steel company, there are scores of smaller mini-mill steel plants across the United States.

In addition to these steel producing plants, there are also steel processing plants that produce many of the same basic steel products as the integrated and minimill plants using purchased steel. Steel processors differ substantially from integrated and minimill plants, however, in that they do not produce raw steel and instead purchase it from steelmaking plants for use as their primary input. Products that are made at steel processors include steel pipes and tubes, as well as wire and related wire products.

Since trade policies do not discriminate on the type of plant producing these products, we include all three types of steel plants in our analysis. However, there are certainly economic reasons to suggest that the effect of trade policies may differ across these types of plants. This is particularly true of the processors, since steel trade policies may not only raise import protection on their final good, but also their main input. After presenting full sample results, we will also explore heterogeneity in trade policy impacts across these three types of steel plants.

2.2. Brief History of US Steel Trade Policies

Prior to the 1960s, the US steel industry was far more concerned with fending off anti-trust charges than securing trade relief from the federal government.[4] A string of factors, however, led to the industry's permanent shift from dominant world exporter to net importer.[5]
In reaction to pressure from the large, integrated steel producers and the United Steel Workers Union (USW), President Johnson negotiated the industry's first VRA with Japan and the European Community (EC) in 1969. While the VRA expired in 1974, a surge of imports in 1977 led to renewed calls for quantitative restrictions as well as AD and CVD petitions. In order to avoid either outcome, President Carter implemented the Trigger Price Mechanism (TPM), which

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[3] Data from various issues of the American Iron and Steel Institute's *Annual Statistical Yearbook* show that percent of US domestic steel produced by using EAFs has increased from about 15% in 1970 to around 50% today.
[4] This confrontation even led to President Truman's unsuccessful attempt to nationalize the industry in 1952.
[5] These factors included: 1) a crippling strike in 1959 that required downstream users to seek non-domestic sources, 2) increasingly efficient, subsidized European and Japanese operations, 3) the discovery of large iron ore deposits outside the US, and 4) a strong dollar. As such, between 1960 and 1968, US import penetration climbed from 4.7 percent to 16.7 percent of total US steel consumption. See Moore (1996) for a more detailed discussion of the history of steel trade protection in the US through the early 1990s.

was implemented in 1978. Under the TPM the domestic industry agreed to refrain from filing AD and CVD petitions as long as import prices did not fall below Japanese production costs (the world's lowest-cost industry) plus an 8 percent profit margin.

The TPM was renewed in 1980, but the industry was convinced that the policy was failing to provide sufficient protection from subsidized European imports and began filing petitions for AD and CVD protection in January of 1982 which terminated the TPM program. In order to avoid trade frictions that would result from significant AD and CVDs, President Reagan negotiated VRA agreements across a wide range of steel products with the EC in October of 1982.

Although European steel imports were not permitted to exceed 5.5 percent of the US market, overall import penetration remained high due to a strong dollar and import diversions to non-EC sources. This likely contributed to the industry filing a large set of AD and CVD petitions in early 1984 and ultimately filing a safeguard petition (historically known as a Section 201 Escape Clause action in the US) in 1984. These trade protection actions led to the negotiation of a comprehensive VRA for all finished steel products and limiting total import market share to 18.4 percent in the last couple months of 1984. The VRAs were put into place for a roughly five-year period to end in October of 1989.

In late 1989, citing the industry's strong performance, President George H. Bush decided to renew the VRAs for only two-and-a-half additional years, rather than the full five years requested by the industry. When the VRAs ended in early 1992, the steel industry immediately filed a large number of AD and CVD petitions once again. While many industry observers expected intervention by the administration, President Bush instead allowed the cases to reach their completion. In July of 1993, affirmative AD and CVD determinations were ruled in favor of the domestic industry in only about a half of the value of imports under review. In several instances, competition from mini-mills, rather than imports, were seen as the real cause of injury by the US International Trade Commission. The ruling was perceived as a major defeat for the industry and was cited by Moore (1996) as an indication of the industry's loss of political clout.

Through the rest of the 1990s, steel producers used AD and CVD actions targeted at a limited number of specific products to secure trade relief. One possible reason for such limited action was the strong economy and modernized US operations. For the first time in decades, integrated producers were globally competitive, touted by some experts as an industry that had survived its austere, rationalization period and which was now enjoying a much-deserved "renaissance." (Ahlbrandt, Fruehan, and Giarratani, 1996)

A string of unexpected shocks in 1998 brought this period quickly to an end. Most notable were currency crises in East Asia and Russia which led to import surges and subsequent AD and CVD filings in the late 1990s. By the early 2000s, about one-third of the industry had fallen into bankruptcy, leading President George W. Bush to implement safeguard tariffs ranging from 8-30% on many major steel products in 2002. However, a number of major import sources were excluded including Canada and Mexico, as well as less-developed countries. Moreover, downstream industries successfully lobbied for exceptions over the ensuing safeguard period further watering down the amount of affected imports. Finally, the safeguard tariffs were terminated prematurely in early 2004 due to a WTO dispute panel ruling against the US safeguard action.

3. Methodology and Data

3.1. Empirical Specification

Our focus in this paper is on the ability of US steel plants to price above marginal cost and how this ability varies with trade policy changes.[6] There are a couple standard ways in which the previous literature estimates market power using plant- or firm-level data (see Tybout, 2003) and we employ both of them here.

The first method stems back to Hall (1988), which was then extended by Roeger (1995) to overcome an endogeneity issue. Konings and Vandenbussche (2005) use this Roeger methodology in their estimation of the effect of AD duties on mark-ups and we use their notation here to sketch out the model and resulting estimating equation.

Assume that each plant *i* producing product *j* in year *t* has a production function, $F(N_{ijt}, K_{ijt}, M_{ijt})$, that is linear homogeneous in three factors – labor (N_{ijt}), capital (K_{ijt}), and materials (M_{ijt}) – and that output (Q_{ijt}) for a plant is given by

$$Q_{ijt} = \Theta_{ijt} F(N_{ijt}, K_{ijt}, M_{ijt}), \qquad \textbf{(1)}$$

where Θ_{ijt} is a plant- and year-specific productivity shock.

From this set-up, Hall (1988) derives the Solow residual for plant *i* in product *j* in year *t* (SR_{ijt}) as

$$SR_{ijt} = \hat{Q}_{ijt} - \alpha_{N_{ijt}} \hat{N}_{ijt} - \alpha_{M_{ijt}} \hat{M}_{ijt} - (1 - \alpha_{N_{ijt}} - \alpha_{M_{ijt}}) \hat{K}_{ijt} = \beta_{ijt} (\hat{Q}_{ijt} - \hat{K}_{ijt}) + (1 - \beta_{ijt}) \hat{\Theta}_{ijt}, \qquad \textbf{(2)}$$

where the cavats denote growth rates, α's are the associated factor shares of total revenues, and $\beta_{ijt} = 1 - (1/\mu_{ijt})$. The variable $\mu_{ijt} = P_{ijt} / c_{ijt}$, where P_{ijt} is the price and c_{ijt} is the marginal cost, and thus measures the price-cost markup for plant *i* in product *j* in year *t*. As in Hall (1988), one

[6] While the theory also suggests that trade policy may affect foreign firms' market power, we do not examine this because we do not have the data to do so.

can estimate equation (2), though much care needs to be taken to control for potential endogeneity, as the productivity shock term may be at least partly composed of anticipated shocks that affect the plant's choice of inputs.

Due to the difficulty of finding appropriate instruments to control for this endogeneity issue, Roeger (1995) derives an equation to estimate the markup that is free from this source of endogeneity. The methodology is to simply derive a dual Solow residual and difference the primal and dual expressions for the Solow residual to eliminate the common productivity shock term in each. In particular, the dual Solow residual (DSR_{ijt}) can be derived as

$$DSR_{ijt} = \alpha_{N_{ijt}} \hat{P}_{N\,ijt} - \alpha_{M_{ijt}} \hat{P}_{M\,ijt} - (1 - \alpha_{N_{ijt}} - \alpha_{M_{ijt}}) \hat{R}_{ijt} - \hat{P}_{ijt} = -\beta_{ijt} (\hat{P}_{ijt} - \hat{R}_{ijt}) + (1 - \beta_{ijt}) \hat{\Theta}_{ijt}, \qquad \textbf{(3)}$$

where $P_{M\,ijt}$, $P_{N\,ijt}$, and R_{ijt} are the factor prices for materials, labor, and capital, respectively. Differencing equations (2) and (3) and re-arranging yields

$$(\hat{Q}_{ijt} + \hat{P}_{ijt}) - (\hat{K}_{ijt} - \hat{R}_{ijt}) = \mu_{ijt} \{ \alpha_{N_{ijt}} [(\hat{N}_{ijt} + \hat{P}_{N\,ijt}) - (\hat{K}_{ijt} - \hat{R}_{ijt})] + \alpha_{M_{ijt}} [(\hat{M}_{ijt} + \hat{P}_{M\,ijt} - (\hat{K}_{ijt} - \hat{R}_{ijt})]) \}, \textbf{(4)}$$

This equation can easily be estimated using our plant-level data and has a number of nice properties. First, the productivity shock term has been differenced away and, thus, is no longer a source of endogeneity bias. Second, assuming a mean-zero error term, it is easily interpretable as the regression of sales growth on weighted factor expenditure growth after netting out capital expenditure growth from both sides, with the regression coefficient a direct estimate of the price-cost markup.

Our hypotheses in this paper concern the differential impacts that trade protection policies imposed on foreign competitors of the plants in our sample can have on a plant's ability to price above marginal cost. To empirically examine this, we propose a varying-coefficients model where the estimated markup parameter in equation (4) is a function of an intercept and a linear combination of K product-specific trade policies (TP_{jt}^{k}),

$$\mu_{jt} = \theta_0 + \sum_{k=1}^{K} \theta_k TP_{jt}^k, \qquad \textbf{(5)}$$

where the θ's are parameters to be estimated. Given our earlier discussions, we would expect both quotas and AD duties to significantly increase the markup parameter, μ_{jt}, while tariffs and CVDs have no significant effect. An important feature of the theoretical analysis proposing nonequivalence between tariffs and quota is that these types of protection programs have different effects on market power for the same level of import penetration. Thus, we also include an import penetration measure (IM_{jt}) on the right-hand side of equation (5) so that we can estimate the impact of various trade protection programs on markups controlling for the level of import penetration.[7] We expect the coefficient on import penetration to be negative. An additional variable that we add to the right-hand side of equation (5) is a measure of downstream demand growth (GR_{jt}). Gallet (1997) finds that markups in the steel industry can vary with the business cycle and Konings and Vandenbussche (2005) also finds this is an important control variable for their estimation. We also include the product's Herfindahl index of market concentration (HI_{jt}) as a control variable, since market structure will affect competitiveness and, hence, markups. Finally, we include a plant's capital intensity (KI_{ijt}), as it is typically included (especially in what we call the PCM estimation approach described below) as a control in past studies.

Denoting the left-hand side of equation (4) as ΔY_{ijt}, the term in brackets on the right-hand side of equation (4) as ΔX_{ijt}, a mean-zero error term as ε_{ijt}, and incorporating our varying coefficients modeling of the effects of trade policies, import penetration, downstream demand growth, Herfindahl index and capital intensity, we obtain the final Roeger-style estimating equation that we will take to the data:

$$\Delta Y_{ijt} = \theta_0 \Delta X_{ijt} + \sum_{k=1}^{K} \theta_k (TP_{jt}^k \times \Delta X_{ijt}) + \theta_{k+1}(IM_{jt} \times \Delta X_{ijt}) + \theta_{k+2}(GR_{jt} \times \Delta X_{ijt}) + \theta_{k+3}(HI_{jt} \times \Delta X_{ijt}) + \theta_{k+4}(KI_{ijt} \times \Delta X_{ijt}) + \eta_i + \varepsilon_{ijt}. \quad \textbf{(6)}$$

The estimated parameter, θ_0, provides a baseline estimate of the price-cost markup by plants in our sample, while the other estimated θ parameters measure how much these other variables (trade policies, import penetration, downstream demand growth, and Herfindahl index) increase or decrease a plant's baseline markup. We also include plant-level fixed effects, η_i.

One limitation of the Roeger derivation is an assumption of constant returns to scale. Klette (1999) provides an extension to the approach of Hall and Roeger to relax this assumption. However, when we implement Klette's specification with our sample, our estimates cannot reject constant returns to scale. Thus, we follow the simpler Roeger specification for our analysis.

An alternative specification to the Roeger approach to estimate the effect of various factors on a firm's or plant's markup (and perhaps even more common in the literature) is to simply construct a proxy for the markup using observable accounting data and regress this on explanatory factors. Following previous studies we construct the price-cost markup proxy (PCM_{ijt}) as total revenues minus variable costs over sales and estimate the following PCM regression equation[8]:

$$PCM_{ijt} = \gamma_0 + \sum_{k=1}^{K} \gamma_k TP_{ijt}^k + \gamma_{k+1} IM_{jt} + \gamma_{k+2} GR_{jt} + \gamma_{k+3} HI_{jt} + \gamma_{k+4} KI_{ijt} + \rho_i + \nu_{ijt} \quad \textbf{(7)}$$

where ρ_i are estimated plant-level fixed effects and ν_{ijt} is an assumed mean-zero error term.

For both the Roeger and PCM specifications, endogeneity of trade policies is a concern. One obvious source of endogeneity is the increased propensity of firms to lobby or petition for

[7] There is a related literature that looks at imports as "market discipline," in that greater import penetration likely correlates with a more competitive market, lower markups for all firms/plants (e.g., see Kee and Hoekman, 2007).
[8] See, for example, equation 13.2 and related discussion in Tybout (2003) and equation 8 and related discussion in Konings and Vandenbussche (2005).

trade relief when facing a degradation of their markups. This would bias us from identifying a positive effect of trade policies on markups. After presenting our base estimates below, we then provide instrumental-variables (IV) estimates where we employ a number of instruments to control for the potential endogeneity of our trade policy variables. These instruments include lags of all our trade policy variables and exogenous control variables. We also include a dummy variable for any year prior to the completion of the Uruguay Round, after which quota-based trade protection programs were essentially eliminated for use by member countries, as well as interactions of this variable with our lagged variables as instruments. Finally, we include a dummy variable for years after the conclusion of a major General Agreement on Tariffs and Trade (GATT) round, when specific trade protection reductions were being phased in, as well as interactions with our lagged variables. Years after GATT rounds lead to mandated decreases in some of the trade protection programs, but may then create increased demand for trade protection programs not covered by the recent GATT round.

3.2. Variables and Data

We rely on the U.S. Census Bureau's Census of Manufactures (CM) for the data used in this analysis. The CM is conducted every five years and collects plant-level data for all U.S. manufacturers[9] including the total value of shipments, book value of capital, raw material usage and employment. In addition, the CM tracks the full set of products produced by each plant, which allows us to identify the plants producing steel products that received trade protection. Our panel dataset includes CM data from 1967, 1972, 1977, 1982, 1987, 1992, 1997 and 2002.

[9] The CM collects limited data for small manufacturers, which are referred to as "administrative records." Because output and input data may be imputed for these plants, however, they are excluded from this analysis, as is standard in research utilizing the CM.

Our sample consists of two main groups of plants. The first is our focus group of U.S. steel plants producing products in SIC 331 (Steel Works, Blast Furnaces, and Rolling and Finishing Mills). A few of the steel wire-related products also have associated SIC 349 (Miscellaneous Fabricated Steel Products) product codes when the product is produced by a steel processor, rather than a steel-producing plant. For example, wire cloth produced by a steel-producing plant is coded as SIC 33157, whereas wire cloth produced by a steel-processor plant is coded as SIC 34964. This distinction is what allows us to identify steel processors from steel producers in our data.

The second group of observations is plants producing non-ferrous metal and primary products listed under SIC categories 333, 334, and 335 (Primary Nonferrous Metal, Secondary Nonferrous Metal, and Nonferrous Rolling and Drawing, respectively). These non-ferrous metal producing plants are included to serve as a control group. The level of trade protection activity in these products is quite minimal relative to the steel (i.e., ferrous) metal industries, yet they have analogous product categories and production processes as the steel plants in SIC 331. Having a control group is particularly important with respect to the VRA trade policies where virtually all of the steel categories fell under a VRA, making it problematic to identify the effect of the VRA on steel plants from an unobserved year effect. While using the full CM as a control group might provide an interesting robustness check, data availability and collection difficulties make this infeasible.

We then match trade policy and other control variables to the plants' 5-digit SIC product codes within the SIC three-digit categories 331, 333, 334, and 335. There are five different types of protection programs that were applied to steel products in our database over our sample period. The first program we examine is standard *ad valorem* tariffs ($Tariff_{jt}$), which were in place for the majority of the sample, though some had fallen to zero by the last year of the sample. The relevant data were collected from the NBER Trade Database (www.nber.org/data/) and tariff duties were calculated by dividing duties collected by the customs value of the imports for the associated product codes.[10] Tariffs by import product codes (Tariff Schedule of the United States of Annotated (TSUSA) or Harmonized System (HS)) were aggregated to five-digit SIC (SIC5) categories using concordances in various issues of *Current Industrial Reports: Steel Mill Products*, published by the U.S. Census Bureau of the U.S. Department of Commerce.

Second, are voluntary restraint agreements or quotas (VRA_{jt}), which happened over two distinct periods. The first was from 1969 through 1974, which were placed on all steel products, including steel pipes and tubes. Only one year of our sample is during this period, 1972, and, thus, we create a "1" for any product subject to a VRA in 1972 and a "0" otherwise. The second VRA period on steel products was in effect from the end of 1984 to early 1992.[11] Again, only one year of our sample fully overlaps with this period, 1987, and, thus, we create a "1" for any product subject to a VRA in 1987 and a "0" otherwise. A key condition for nonequivalence between tariffs and quotas with respect to market power is that the quota truly constrains (or binds) the total quantity imported. It is difficult to measure how much a quota binds. However, there is anecdotal evidence that the steel VRAs in 1972 did not significantly constrain imports (see Kiers, 1980, and Scheuerman, 1986), while 1987 was a year when quota "fill rates" of the VRAs across all covered steel products were at their peak and, thus, quite binding (see Moore, 1996). Thus, our *ex ante* expectations are that it is more likely that we find significant market power effects of VRAs in 1987 than in 1972.

[10] The NBER Trade Database currently only goes through the year 2001, and so we rely on purchased official merchandise import data from the Foreign Trade Division of the U.S. Census for the year 2002.
[11] Products covered under the VRAs are listed in the U.S. International Trade Commission (USITC) publication 1729 (August 1985), *Annual Survey Concerning Competitive Conditions in the Steel Industry and Industry Efforts to Adjust and Modernize*.

The third and fourth types of protection programs were antidumping (AD_{jt}) and countervailing duties (CVD_{jt}). Information on these investigations and duties were gathered from relevant *Federal Register* notices. In particular, we gather information on affected import product codes (TSUSA or HS), foreign country source, applied duty rates and length of time these duties were in place, and then construct average trade-weighted AD and CVD duty rates for our SIC5 sectors using the import volume of the affected product and country source in the year prior to the case available from the NBER Trade Database and the concordance between import product codes and SIC5 products available in *Current Industrial Reports: Steel Mill Products*, mentioned above.

The fifth trade protection program during our sample that we examine is the steel safeguard tariffs ($SafeTariffs_{jt}$) that were put into place in March 2002; i.e., early in the last year of our sample. Steel safeguard tariff rates are reported and available from the U.S. Department of Commerce at http://www.ita.doc.gov/media/FactSheet/0303/fs_steel_ex_032103.html. We constructed trade-weighted average safeguard tariffs for our SIC5 products in the same fashion as our AD and CVD duties, being sure to take into account the imports from country sources that were exempt from the safeguard remedy, such as the North American Free Trade Agreement partner countries.

There are a few trade protection programs applied to the steel industry during our sample years that we do not include in our reported regression estimates. The TPM ran from January 1978 to January 1982, and thus does not overlap with any of our sample's closest years – 1977 or 1982. Second, there were two special safeguard actions that led to trade protection in the form of tariff-rate quotas on wire rods and circular welded line pipe from March 2000 to March 2003. These programs overlap with our last sample year, 2002. However, they also pertain to very specific products that comprise only a small share of one of our SIC5 products, particularly circular welded line pipe. Not surprisingly, when we include dummy variables indicating the affected SIC5 products in 2002, we estimate statistically insignificant effects on markups and none of our other variables are qualitatively affected. Thus, we do not present results from specifications with these variables in our empirical tables below.

Beyond the trade protection variables, we rely on four main control variables. The first is a measure of import penetration for a product in a given year (IM_{jt}), which we construct as the share of imports in the sum of imports plus domestic shipments. We rely on data from various annual yearbooks of the American Iron and Steel Institute for products where there is a direct correspondence to our SIC5 products. For a handful of our products (particularly wire-related products), there is not a clear correspondence, and so we use data on imports from the NBER Trade Database for imports and *Current Industrial Reports: Steel Mill Products* for domestic shipment data.

The second control variable is a real demand growth measure which we calculate as the weighted average of real GDP growth by downstream sectors. We gather real GDP growth by sector and year from table B-13 of the *Economic Report of the President*, 2006, and then weight by the share of total shipments purchased by the downstream sector as reported in the 1992 U.S. input-output tables. The product codes in the input-output tables are not as detailed as our SIC5 products, so we often have to apply the same demand growth values across multiple SIC 5 product codes. We construct changes in growth over the prior year, but also report estimation results below when we calculate growth over the prior 5 years. Table 2 provides a list of the SIC5 products covered in our sample and average trade policy coverage over our sample years by product and trade policy.

The third and fourth variables—product-level Herfindahl index and plant-level capital intensity—are calculated using data from the CM. The product-level Herfindahl index is calculated as the sum of plant-level market shares for all plants producing the product in a given year. Capital-intensity is defined as plant-level book value of capital divided by total value of shipments.

4. Empirical Results

4.1. Roeger estimates

Column 1 of Table 3 presents results from estimating equation (6) – which we term our "base model" of estimates from the Roeger specification. The data fit the model well, with an R^2 statistic of 0.91 and an F-statistic that easily rejects the null hypotheses of jointly zero coefficients. The coefficient on the ΔX_{ijt} variable is highly statistically significant and also statistically greater than 1.0, suggesting that the steel plants in our sample enjoy the ability to price about 18.3% above cost on average.

The next set of regressors listed in Table 3 is our main focus in this paper – the trade policy variables. As discussed above, prior theory suggests that the VRA and AD duties will have a positive impact on plants' market power, while strictly tariff-based trade policy programs – tariffs, CVDs, and safeguard tariffs – to show no effects on market power. Our estimated coefficients in Column 1 of Table 3 largely support these predictions. Both the 1972 and 1987 VRAs show positive, statistically significant coefficients at the 10% level, while the estimated coefficients on strictly tariff-based trade policy variables are not statistically different from zero at standard confidence levels. The estimated effects of the VRAs are economically significant, suggesting that VRAs were associated with a 14.6 percentage point higher price-cost markup in 1987, while the VRAs raised markups by 38.1 percentage points in 1972. The one unexpected result in our base results is that we do not find any significant effects of AD duties on markups, inconsistent with prior theory and empirical work. One issue with both AD and CVD trade protection is that they can be quite targeted to narrowly defined products or a subset of import sources. This may make it difficult to identify the impacts of these programs with our data. On the other hand, such narrow targeting would also limit the ability of the trade action to have a significant impact on the market and, thus, make our findings not unexpected.

The final regressors listed in Table 3 control for import penetration, downstream demand growth, the Herfindahl index, and capital intensity. While the coefficients on import penetration and the Herfindahl index take the expected sign, they are both statistically insignificant from zero. The coefficient on downstream demand is surprisingly negative and statistically significant. This runs counter to Gallet (1997) that finds that market power goes up in periods of greater demand. To explore this more, we tried alternative measures of real demand growth, including a 5-year change in our downstream demand variable (rather than a one-year change) and get qualitatively identical estimates.

A more general way to control for not only demand growth changes, but any other macroeconomic factors affecting all products and plants, is to include year dummies. We add year dummies to our base specification and report results in Column 2 of Table 3. Coefficient estimates are qualitatively similar to those in Column 1, though the coefficient on the 1987 VRA falls enough (0.1464 to 0.1004) to be below standard levels of statistical significance. Relatedly, the coefficient on the 1987 year dummy variable is statistically significant and suggests that all plants experienced almost a 9% increase in price-cost markups that year, ceteris paribus.

We note that it is possible that our control group of firms – non-ferrous metal producing plants – is not ideal for identifying the impact of a broad-based trade protection program (like the VRAs) on our focus (steel plants) from other macroeconomic events. A number of the non-ferrous metals (e.g., aluminum and copper) are reasonably close substitute products for steel in a number of downstream industries. Thus, when a trade protection program raises market power broadly across steel products, it may also do so in non-ferrous substitutes from the demand shift into non-ferrous products. In this way, our control group may bias our estimates from verifying a significant positive effect of the VRAs. We think this is much less of an issue for AD and CVD trade protection programs in our sample where only a very specific product (e.g., steel wire) is targeted, as identification comes from a much larger set of unaffected non-ferrous and steel products which are clearly not substitute products. However, we note that we estimate qualitatively similar empirical results when we eliminate the aluminum, brass, and copper products from our sample that are the closest substitutes for steel products.

These base results ignore the possible endogeneity of trade policies and markups. For example, as discussed above, firms may be more likely to lobby for and gain trade protection when market power is low. This would bias us from finding positive effects of trade policies on price-cost markups. Column 3 of Table 3 provides our IV estimates for the Roeger specifications with year dummies included. As before, the coefficients for tariff-based measures of protection continue to be statistically insignificant. The VRA effect in 1987 is now estimated to be significant at the 10% level and substantially larger in magnitude than before (47.8 percentage point increase in the price-cost markup over a base of 32.7%). In contrast, the estimated impact of the VRA in 1972 is insignificant. This difference in the VRA impact in 1987 and 1972 may be related to the anecdotal evidence that the VRAs were not binding in 1972, in contrast to high fill rates in 1987.

4.2. PCM estimates

We next turn to estimating market power effects using a PCM specification as presented in equation (7) above. Table 4 presents results in analogous fashion to Table 3; Column 1 presents base results, column 2 presents estimates when we include year dummies, and column 3 presents our IV estimates with year dummies included. The pattern of coefficients from the PCM estimates provides similar evidence on our hypotheses as those of the Roeger estimates, with a few differences. Tariff-based trade protection programs do not have positive effects on price-cost margins as hypothesized, though some are not insignificant, but unexpectedly negative (in the IV estimates). Once again, the VRA effect in 1987 is positive and statistically significant at the 10-percent level, even after controlling for year dummies in the IV estimates. The 1972 VRA effect, however, is insignificant in all specifications in Table 4, which – again – is consistent with the anecdotal evidence that the VRAs were not binding that year. Unlike the Roeger estimates, there is evidence for a significant positive effect of AD duties on price-cost margins in our IV specification.

The estimated market power effects in the PCM specification are generally smaller in magnitude than the Roeger estimates, though still economically significant. Using the IV estimates, the 1987 effect of the VRAs is a price-cost markup that is 5.9 percentage points higher, whereas each percentage point increase in the AD duty increases the price-cost margin by 0.3 percentage points. These are economically significant relative to an estimated base markup of around 33% for the sample. The control variables have generally insignificant coefficient estimates, except for evidence that higher capital intensity is associated with lower price-cost markups.

In summary, we find no significant positive effects of tariff-based trade protection programs on market power, while finding positive and significant effects of VRAs in a year (1987) when the anecdotal evidence suggests they were binding. Importantly, these results are robust to calculation of markups with two different methodologies, which have been used extensively in the empirical literature examining the effects of policy changes on market power. The results are thus consistent with the theoretical literature that has demonstrated the non-equivalent market-power effects of tariffs and quotas. We find some evidence that antidumping duties are associated with an increase in market power, although this result is only present when measuring markups with the price-cost margin.

4.3. Differences across integrated, minimill, and processing steel plants

An important issue for our estimates is one of heterogeneous effects across types of steel plants. Particularly in the beginning of our sample, the large integrated steel producers were often the only type of firms publicly instigating petitions for trade protection. While this may suggest they were the ones most likely to gain from trade protection, it may also be due to their relatively large size in the industry and incentives for smaller minimill plants to free ride even though the benefits from trade protection were proportionally as large as for the integrated plants. Also, as mentioned, processing plants are quite different from the other two because they purchase basic steel—their primary input—rather than produce it on-site. With trade protection often applied simultaneously across a number of steel products, the processing plants' reliance on purchased steel may translate into different market power effects as well, as both their input and output products may gain varying levels of trade protection.

To explore this issue, we re-estimate our earlier specifications (including year dummies) and include interactions between our regressors and dummy variables for each type of plant (excluding one type to avoid perfect multicollinearity).[12] Using these estimates we can decompose the trade policy effects by type of plant for both the Roeger and PCM specifications, which we present in Table 5.

There are a number of results to highlight in Table 5. First, there continues to be no evidence of positive market power effects from tariff-based protection. Second, the significant

[12] Minimill plants are not explicitly identified in the CM data. However, production capacities of minimill plants are significantly smaller than for integrated plants – a fact that is well documented and can be seen in the bi-modal nature of capacities in our sample's distribution of plant capacities. We use this feature of the data to identify minimill plants.

market power effects of the binding VRAs in 1987 are clearly for the steel-producing plants (integrated and minimills), not for the steel-processors. This is consistent with the notion that the VRAs are increasing costs for the primary steel products purchased by the steel-processors, mitigating the impact of VRAs on their final product. An interesting result is that the evidence suggests that both the integrated and minimill producers gained from the VRA in 1987. The estimated effects for the minimill producers are smaller, but we cannot reject the hypothesis of equal effects across integrated and minimill producers for both the PCM and Roeger specifications. As before, there is little evidence for any market-power effects of the VRA in place in 1972, consistent with the anecdotal evidence that they were not binding at that point in time. Finally, our PCM estimates show the positive market power effects of AD duties to be limited to integrated producers, while the Roeger estimates do not find significant AD duty effects for any of the different types of steel plants.

5. Conclusion

This paper provides one of the first empirical analyses of the hypothesis of nonequivalent market power effects of tariffs and quotas using a more comprehensive and detailed dataset than any previous study on this issue. We use plant-level Census data to examine changes in the market power of U.S. steel plants as they were buffeted by a wide variety of trade protection policies during our sample years of 1967 through 2002. We find evidence that binding quantitative restrictions significantly increase market power, while tariff-based policies do not. These results are consistent with a theoretical literature that predicts that binding quotas, unlike tariffs, can facilitate collusive pricing by domestic and foreign firms. As expected, these results hold for the steel-producing plants in our sample, but not for the steel-processing plants that rely on purchased steel for inputs. We find only weak evidence that AD duties have positive effects on market power, a possibility that has been discussed in a prior literature.

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Table 1: US Steel Trade Protection Events

1969-1974	Voluntary Restraint Agreements (VRAs) with Japan and the EC.
1978-1981	Trigger Price Mechanism applied to all imports.
1982	Antidumping (AD) and countervailing duty (CVD) cases filed against EC countries. Subsequently terminated for VRAs on EC imports.
1984	AD and CVD cases filed against non-EC countries. Subsequently terminated for comprehensive VRAs.
1984-1989	Comprehensive VRAs with all significant import sources.
1989-1992	Extension of VRAs.
1992-1993	AD and CVD cases filed against significant import sources after VRAs expire. AD and CVD remedies applied to only subset of products.
1998-2000	Multiple AD and CVD cases against Japan and other Asian countries.
2002-2003	Safeguard remedies in form of tariffs placed on steel imports, excluding FTA partners and developing countries.

Table 2: Average Values of Trade Policy Variables Over Sample Years by Product

SIC5	Product	Tariff Rate Ad Valorem	AD Duty Ad Valorem	CVD Ad Valorem	1987 VRA Binary	1972 VRA Binary	Safeguard Tariffs Ad Valorem
33122	Steel ingot, blooms, slabs, etc	5.50%	0.00%	0.00%	0.125	0.125	0.00%
33126 & 33170	Steel pipe and tubes	4.19%	3.45%	0.03%	0.125	0.125	0.73%
33123	Hot-rolled steel sheet and strip	6.05%	3.86%	0.13%	0.125	0.125	1.93%
33124	Hot-rolled steel products	3.84%	5.33%	0.63%	0.125	0.125	1.16%
33125 & 33155	Steel wire	5.23%	0.00%	0.00%	0.125	0.125	0.01%
33127 & 33167	Cold-rolled steel sheet and strip	6.81%	4.92%	0.42%	0.125	0.125	2.39%
33128 & 33168	Cold-formed steel bars	6.40%	2.16%	0.07%	0.125	0.125	1.97%
3312C	Steel rails	0.52%	5.05%	15.89%	0.125	0.125	0.00%
33151 & 34961	Steel wire rope, cable, and strand	5.25%	0.43%	0.00%	0.125	0.125	0.00%
33152	Steel nails and staples	0.92%	2.78%	0.00%	0.125	0.125	0.00%
33156 & 34966	Steel fencing and gates	0.54%	0.00%	0.00%	0.125	0.125	0.00%
33157 & 34964	Steel wire cloth	7.39%	0.00%	0.00%	0.000	0.125	0.00%
33311	Copper smelter products	0.77%	0.00%	0.00%	0.000	0.000	0.00%
33312	Refined primary copper and copper-base alloy	1.18%	0.00%	0.00%	0.000	0.000	0.00%
33347	Aluminum ingot	1.61%	0.00%	0.00%	0.000	0.000	0.00%
33348	Aluminum extrusion billet	1.61%	0.00%	0.00%	0.000	0.000	0.00%
33391	Zinc residues and other zinc smelter products	4.34%	0.00%	0.00%	0.000	0.000	0.00%
33392	Refined primary zinc	1.87%	0.00%	0.00%	0.000	0.000	0.00%
33395	Precious metals and precious metal alloys	0.00%	0.00%	0.00%	0.000	0.000	0.00%
33398	Other primary nonferrous metals, N.E.C.	0.97%	0.43%	0.06%	0.000	0.000	0.00%
33412	Copper (secondary refining)	1.18%	0.00%	0.00%	0.000	0.000	0.00%
33413	Lead (secondary refining)	2.96%	0.00%	0.00%	0.000	0.000	0.00%
33414	Zinc (secondary refining)	1.87%	0.00%	0.00%	0.000	0.000	0.00%

33415	Precious metals and precious metal alloys (secondary refining)	0.00%	0.00%	0.00%	0.000	0.000	0.00%
33416	Other nonferrous metals, N.E.C. (secondary refining)	0.77%	0.00%	0.00%	0.000	0.000	0.00%
33417	Aluminum ingot (secondary refining)	1.61%	0.00%	0.00%	0.000	0.000	0.00%
33418	Aluminum extrusion billet (secondary refining)	1.61%	0.00%	0.00%	0.000	0.000	0.00%
33511	Copper wire, bare and tinned (non-electrical)	4.04%	0.02%	0.00%	0.000	0.000	0.00%
33513	Copper and copper-base alloy rod, bar, and shapes	2.87%	0.05%	0.00%	0.000	0.000	0.00%
33514	Copper and copper-base alloy sheet, strip, and plate	3.10%	5.45%	0.29%	0.000	0.000	0.00%
33515	Copper and copper-base alloy pipe and tube	2.51%	0.00%	0.00%	0.000	0.000	0.00%
33531	Aluminum plate	3.27%	0.00%	0.00%	0.000	0.000	0.00%
33532	Aluminum sheet and strip	3.27%	0.00%	0.00%	0.000	0.000	0.00%
33533	Plain aluminum foil	4.87%	0.00%	0.00%	0.000	0.000	0.00%
33534	Aluminum welded tube	6.79%	0.00%	0.00%	0.000	0.000	0.00%
33541	Extruded aluminum rod, bar, and other extruded shapes	2.83%	0.36%	2.41%	0.000	0.000	0.00%
33542	Extruded and drawn aluminum tube	6.79%	0.00%	0.00%	0.000	0.000	0.00%
33551	Aluminum and aluminum-base alloy wire and cable (except covered or insulated) - Produced in rolling mills	3.50%	0.00%	0.00%	0.000	0.000	0.00%
33552	Rolled aluminum bar and rod	2.76%	0.48%	3.15%	0.000	0.000	0.00%
33553	Aluminum ingot	1.61%	0.00%	0.00%	0.000	0.000	0.00%

33554	Aluminum extrusion billet	1.61%	0.00%	0.00%	0.000	0.000	0.00%
33561	Nickel and nickel-base alloy mill shapes (including nickel-copper alloys)	5.34%	0.00%	0.00%	0.000	0.000	0.00%
33562	Titanium and titanium-base alloy mill shapes (excluding wire)	13.70%	0.00%	0.00%	0.000	0.000	0.00%
33563	Precious metal mill shapes	0.40%	0.00%	0.00%	0.000	0.000	0.00%
33569	All other nonferrous metal mill shapes	7.13%	0.00%	0.00%	0.000	0.000	0.00%
33571	Aluminum and aluminum-base alloy wire and cable (except covered or insulated) - Produced in drawing mills	3.50%	0.00%	0.00%	0.000	0.000	0.00%
33572	Copper and copper-base alloy wire, strand, and cable (for electrical transmission)	4.81%	0.00%	0.00%	0.000	0.000	0.00%
33573	Other bare nonferrous metal wire	5.69%	0.00%	0.00%	0.000	0.000	0.00%
33575	Nonferrous wire cloth and other woven wire products	6.36%	0.00%	0.00%	0.000	0.000	0.00%

Table 3: Roeger-style Estimation of the Effects of Various Trade Policies on Steel Plant Markups

	Predicted Sign	OLS Estimates	OLS Estimates	Instrumental Variable Estimates
ΔX_{ijt}	+	1.183***	1.171***	1.327***
		(0.071)	(0.071)	(0.183)
<u>Trade Policy Effects</u>				
$Tariff_{jt} \times \Delta X_{ijt}$	0	-0.006	-0.008	0.013
		(0.008)	(0.008)	(0.023)
1972 $VRA_{jt} \times \Delta X_{ijt}$	+	0.381*	0.377*	0.026
		(0.204)	(0.218)	(0.519)
1987 $VRA_{jt} \times \Delta X_{ijt}$	+	0.146*	0.100	0.478**
		(0.082)	(0.073)	(0.241)
$ADDuty_{jt} \times \Delta X_{ijt}$	+	-0.003	-0.002	-0.007
		(0.007)	(0.007)	(0.026)
$CVDuty_{jt} \times \Delta X_{ijt}$	0	0.002	0.003	0.004
		(0.002)	(0.002)	(0.023)
$Safeguard_{jt} \times \Delta X_{ijt}$	0	0.004	0.004	0.078
		(0.009)	(0.010)	(0.083)
<u>Other Controls</u>				
$IM_{jt} \times \Delta X_{ijt}$	-	-0.000	-0.000	0.001*
		(0.000)	(0.000)	(0.001)
$GR_{jt} \times \Delta X_{ijt}$	+	-0.008***	-0.005	-0.026*
		(0.002)	(0.003)	(0.015)
$HI_{jt} \times \Delta X_{ijt}$	+	0.382	0.344	-0.233
		(0.495)	(0.494)	(0.976)
$KI_{ijt} \times \Delta X_{ijt}$	?	0.002	0.003	-0.003
		(0.007)	(0.007)	(0.002)
Year Dummies		No	Yes	Yes
R^2		0.91	0.92	
F-Test (or Chi-Squared)		2781.04***	2700.51***	12866.92***
Observations		7893	7893	7893

Notes: All regressions include plant-specific fixed effects. Robust standard errors are in parentheses and ***, **, and * denote statistical significance of a coefficient at the 1%, 5% and 10% levels, respectively.

Table 4: Price-Cost Margin (PCM) Estimation of the Effects of Various Trade Policies on Steel Plant Markups.

	Predicted Sign	OLS Estimates	OLS Estimates	Instrumental Variable Estimates
Trade Policy Effects				
$Tariff_{jt}$	0	0.003**	0.001	-0.006
		(0.001)	(0.002)	(0.003)
1972 VRA_{jt}	+	0.006	0.004	-0.026
		(0.005)	(0.009)	(0.040)
1987 VRA_{jt}	+	0.034***	0.014	0.059*
		(0.010)	(0.017)	(0.033)
$ADDuty_{jt}$	+	-0.000	-0.001	0.003*
		(0.001)	(0.001)	(0.002)
$CVDuty_{jt}$	0	-0.002***	0.000	-0.006***
		(0.001)	(0.001)	(0.002)
$Safeguard_{jt}$	0	-0.001	-0.001	-0.005**
		(0.001)	(0.001)	(0.002)
Other Controls				
IM_{jt}	-	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)
GR_{jt}	+	-0.000	0.002	0.003
		(0.001)	(0.002)	(0.002)
HI_{jt}	+	0.021	0.008	-0.441
		(0.074)	(0.068)	(0.275)
KI_{ijt}	?	-0.020*	-0.020*	-0.035**
		0.011)	(0.012)	(0.003)
Year Dummies		No	Yes	Yes
R^2		0.61	0.61	
F-Test (or Chi-Squared)		3.67***	3.70***	41053.94***
Observations		14542	14542	14542

Notes: All regressions include plant-specific fixed effects. Robust standard errors are in parentheses and ***, **, and * denote statistical significance of a coefficient at the 1%, 5% and 10% levels, respectively.

Table 5: Trade Policy Effects on Market Power by Integrated, Minimill, and Processor Steel Plants

Variable	Integrated	Minimills	Processors
<u>Roeger Specification</u>			
$Tariff_{jt}$	**-0.012**	**0.030**	**-0.041**
	(0.634)	(0.494)	(0.659)
1972 VRA_{jt}	**1.111**	**-1.265**	**0.116**
	(0.384)	(0.441)	(0.733)
1987 VRA_{jt}	**0.885***	**0.492**	**-0.081**
	(0.059)	(0.102)	(0.793)
$ADDuty_{jt}$	**-0.012**	**-0.022**	**-0.001**
	(0.735)	(0.373)	(0.982)
$CVDuty_{jt}$	**0.004**	**0.022**	**-0.296**
	(0.884)	(0.208)	(0.628)
$Safeguard_{jt}$	**0.118**	**0.019**	**0.050**
	(0.238)	(0.788)	(0.371)
<u>PCM Specification</u>			
$Tariff_{jt}$	**-0.007****	**-0.002**	**-0.007**
	(0.033)	(0.623)	(0.115)
1972 VRA_{jt}	**-0.167***	**0.009**	**-0.001**
	(0.098)	(0.842)	(0.964)
1987 VRA_{jt}	**0.155****	**0.108*****	**0.011**
	(0.014)	(0.000)	(0.538)
$ADDuty_{jt}$	**0.005***	**0.000**	**-0.001**
	(0.088)	(0.966)	(0.672)
$CVDuty_{jt}$	**-0.006*****	**0.002**	**0.010**
	(0.003)	(0.651)	(0.724)
$Safeguard_{jt}$	**-0.008****	**-0.007***	**0.003**
	(0.028)	(0.062)	(0.145)

Notes: P-values in parentheses. ***, **, and * denote statistical significance of a coefficient at the 1%, 5% and 10% levels, respectively.