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

Bruce A. Blonigen
(University of Oregon and NBER)

Benjamin H. Liebman
(St. Joseph's University)

Justin R. Pierce
(U.S. Census Bureau, Center for Economic Studies)

Wesley W. Wilson* [#]
(University of Oregon)

March 2011

Abstract

Over the past 50 years, 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. Using plant-level Census Bureau data for steel plants from 1967-2002, we find evidence for significant market power effects for binding quota-based protection, but not tariff-based protection. Our results are robust to calculation with two standard measures of market power, control for potential endogeneity of trade policies and highlight heterogeneous responses by different types of steel plants.

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 is 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, are not predicted to have any effect 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 1500 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 U.S. steel-makers. The panel nature of the data allows 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

_____

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 do not have an effect on markups.

Our paper's econometric analysis provides 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) 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 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. When 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 was enacted in 1978.

---

[3] Data from various issues of the American Iron and Steel Institute's *Annual Statistical Yearbook* show that the percent of US domestic steel produced by using EAFs has increased from about 15% in 1970 to over 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.

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 renewed the VRAs for 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 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). We employ the more direct method of estimating market power, which we call the price-cost margin (PCM) as our primary measure. But we also show that our results are robust to using an estimation specification proposed by Roeger (1995), which is an extension of Hall (1988).

We calculate the price-cost markup proxy (PCM_{ijt}) directly for each plant i producing product j in year t as total sales minus variable costs over sales:

$$PCM_{ijt} = \frac{Sales_{ijt} - Mat_{ijt} - Lab_{ijt}}{Sales_{ijt}},$$

where $Sales_{ijt}$ is sales, Mat_{ijt} is expenditures on materials and energy and Lab_{ijt} is expenditures on labor, all at the plant-level.[7] This standard construction of the PCM is clearly a proxy for the price-cost markup since we observe variable costs, but cannot observe marginal cost directly. As such, it has measurement error. However, since it is the dependent variable, it is common to assume that this measurement error is part of the mean-zero error term.

The central 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 regress the PCM on a set of product-specific trade policies (TP_{jt}^{k}) indexed by k. Given our earlier discussions, we expect both quotas and AD duties to significantly increase the PCM, while tariffs and CVDs have

---

[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.

insignificant 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}) as a righthand side covariate so that we can estimate the impact of various trade protection programs on markups controlling for the level of import penetration.[8] We expect the coefficient on import penetration to be negative, as the competitive pressure from import penetration should be expected to lower price-cost margins of U.S. plants. We also include a number of other controls that have been commonly hypothesized to affect the PCM. The first 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. Following past studies, we also include the product's Herfindahl index of market concentration (HI_{jt}) as a control variable, since market structure will affect competitiveness, as well a plant's capital intensity (KI_{ijt}). Finally, we include plant-specific effects (ρ_i) to control for any time-invariant characteristics of the plant that could influence its ability to price above cost. The resulting specification is

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

where v_{ijt} is the assumed mean-zero error term.

Endogeneity of trade policies is a concern that could violate the assumed orthogonality between our error term and our covariate matrix. For example, one obvious source of endogeneity of our trade policy variables is the increased propensity of firms to lobby or petition

---

[7] See, for example, equation 13.2 and related discussion in Tybout (2003) and equation 8 and related discussion in Konings and Vandenbussche (2005).
[8] 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).

for trade relief when facing a degradation of their markups. There are endogeneity issues that one could also raise with some of our other control regressors, including import penetration and Herfindahl Index. Thus, after presenting OLS estimates, we provide instrumental-variables (IV) estimates where we employ a number of instruments to control for the potential endogeneity of our trade policy and other control variables.

These instruments include lags of all our trade policy variables and exogenous control variables. We also include a number of other instruments for our trade policy variables, which are the focus of our analysis. The first is 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 trade policy variables. Second, 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 trade policy 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.[9]

An alternative specification used to examine the effect of various factors on market power stems back to Hall (1988), which was then extended by Roeger (1995) to overcome an endogeneity issue. We examine our hypotheses with this specification to verify the robustness of our results. The methodology involves deriving an expression of a plant's Solow residual using both the primal and dual of the plant's optimization problem, and then first-differencing to

---

[9] At the request of a referee, we also estimated a specification where we excluded a number of control variables that could be endogenous – import penetration, the Herfindahl Index, and capital intensity – and found that this did not qualitatively affect any of our estimated trade policy effects.

eliminate common terms that are a potential source of endogeneity. Applying this Hall-Roeger specification to our current problem yields the following estimation equation:

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

(2)

The dependent variable (ΔY_{ijt}) in equation (2) is a term measuring the growth in sales revenue for a plant adjusted for the growth in capital expenditures, whereas the ΔX_{ijt} term is the weighted average growth in plant's expenditures on variable inputs, labor and materials (adjusting for the growth in capital expenditures).

Regressing ΔY_{ijt} on ΔX_{ijt} yields an estimate of a firm's price-cost ratio (price divided by marginal cost). Thus, to examine the effect of other covariates on this markup term, one must employ a varying coefficient model that leads to the interactive terms one finds in equation 2 between ΔX_{ijt} and our trade policy and control variables.[10] The terms η_i and ε_{ijt} are plant-specific effects and an assumed mean-zero error term, respectively.

There are also potential endogeneity concerns with our trade policy and other control variables in this specification, even though the dependent variable is quite different than the PCM specification. Thus, we rely on the same set of instruments as in the PCM specification.[11] On a final note, the estimated effects of our variables on market power are not directly comparable across the PCM and Hall-Roeger specifications because the PCM specification measures market power as the difference between the price and marginal cost divided by the price, whereas the Hall-Roeger specification measures changes to the ratio of the price to marginal cost.

---

[10] More details on deriving this estimation equation can be found in Konings and Vandenbussche (2005).
[11] 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

3.2. Variables and Data

We use 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,[12] 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.

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

---

specification with our sample, our estimates cannot reject constant returns to scale. Thus, we estimate equation (2), which maintains an assumption of constant returns to scale.

of the steel categories fell under a VRA, making it problematic to separately identify the effect of the VRA on steel plants from an unobserved year effect when estimating on the set of steel plants alone. 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.[13] 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.[14] 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

---

[12] 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.

[13] While the majority of plants in our sample produce in only one SIC5 product category, there is a non-trivial portion of the sample that are multi-product firms. For these plants, we create weighted trade policy variables using the plant's share of sales in each SIC5 category as weights. Our results are qualitatively identical when we instead assign a plant to the SIC5 category that comprises the largest share of its sales.

[14] The NBER Trade Database currently only provides data 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.

period on steel products was in effect from the end of 1984 to early 1992.[15] 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.

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

---

[15] 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*.

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 note that our results are qualitatively equivalent 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 squared 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. Base model estimates

Column 1 of Table 3 presents results from estimating equation (1) – which we term our "base model" of estimates from the PCM specification. The data fit the model well, with an R^2 statistic of 0.61 and an F-statistic that easily rejects the null hypotheses of jointly zero coefficients.

As discussed above, prior theory suggests that the VRA and AD duties have a positive impact on plants' market power, while strictly tariff-based trade policy programs (tariffs, CVDs, and safeguard tariffs) have no effect on market power. The estimated coefficients in column 1 of

Table 3 find mixed evidence for these predictions. While the 1987 VRA variable shows a positive, statistically significant coefficient at the 1% level, the 1972 VRA coefficient and antidumping duty coefficients are insignificant, though positive, as expected. Meanwhile, the tariff variable has a positive and statistically significant coefficient, though the other tariff-based trade policies (safeguard and CVDuty) have unexpectedly negative signs, with the coefficient on the CVDuty variable statistically significant. The coefficients on our control variables are insignificant, with the exception of the capital intensity variable, where a negative coefficient suggests that capital-intensive plants have lower markups.

There are a couple issues with these base OLS regressions that we address sequentially in the next two columns of Table 3. First, our controls may be inadequate to control for economy-wide shocks that could affect not only markups, but also levels of trade protection. Inclusion of year dummies in our specification (column 2) leads to insignificant coefficients on our trade policy variables, though we note that the closest to statistical significance, with a p-value around 0.12, is the coefficient on the 1987 VRA. Import penetration takes the expected negative sign and is now statistically significant in this specification that includes year dummies.

The second issue is endogeneity. In column 3 of Table 3, we report estimates when we include year dummies and instrument for our trade policy and control variables, as discussed above in the methodology section. These results are our preferred estimates and provide quite supportive evidence for the nonequivalence hypotheses. In particular, the coefficient estimates on the VRA and ADDuty variables are all positive, as expected, and the coefficients on the 1987 VRA and ADDuty variables are statistically significant at standard confidence levels. The coefficient on the 1987 VRA says that the VRA led to an average increase in the mark-up (difference between price and marginal cost divided by price) of 6.1 percentage points. Likewise, the coefficient on the ADDuty variable says that each percentage point increase in the ADDuty

increases the mark-up by 0.37 percentage points. These are relatively sizeable effects with an average sample PCM of around 25%.

In contrast, the tariff-based measures all take an unexpected negative sign in our preferred estimates. It is a bit puzzling that the safeguard and CVDuty variables have negative and statistically significant coefficients. One concern with the CVDuty variable is multicollinearity with the ADDuty variable. CVDuty cases rarely occur without a companion ADDuty case on the same product, while ADDuty cases often occur without a companion CVDuty case. This means there is significant independent variation in the ADDuty variable, but identification of the CVDuty coefficient may be driven by just a small number of product-year observations where there was a CVDuty case without a companion ADDuty case.

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, due to a 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, when we eliminate the aluminum, brass, and

copper products from our sample that are the closest substitutes for steel products, we estimate

qualitatively similar empirical results.[16]

4.2. Robustness check: Hall-Roeger estimates

We next turn to estimating market power effects using a Hall-Roeger specification as

presented in equation (2) 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 Hall-Roeger specification also fits

the data well, with an R^2 of 0.91 and an F-statistic that easily suggests coefficient estimates that

are statistically significant. The independent effect of 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 anywhere from 16% to 40% above marginal cost on average.

As with the PCM regressions, there is no evidence for any positive effect of tariff-based

trade policies on market power in these Hall-Roeger estimates. Like the PCM estimates, the

effect of the 1987 VRA is estimated to be sizeable and statistically significant. The 1972 VRA

and ADDuty effects are estimated to be insignificant in the Roeger estimates. As mentioned

above, anecdotal evidence suggests that the 1972 VRAs were less likely to be binding (a

necessary condition for nonequivalence) than the 1987 VRAs.

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

---

[16] A referee also raised the concern that we are estimating significant market power effects associated with VRAs because they are measured as dummy variables, whereas our other trade policy variables are continuous measures. To examine this, we alternatively created dummy variables for our CVD, AD, and safeguard tariff variables for instances where they were above their median values and get very similar results; i.e., we do not estimate positive significant market power effects for these tariff-based variables even when they are specified as dummy variables, and there continues to be evidence for a significant positive 1987 VRA effect.

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 trade policies in the sector affect their input purchases, not just their output markets.

To explore this issue, we re-estimate our column 3 of the PCM specification (IV with year dummies) and include interactions between our regressors and dummy variables for each type of

plant (excluding integrated mills to avoid perfect multicollinearity).[17] Using these estimates we can decompose the trade policy effects by type of plant, 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 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 there is evidence for both a significant market power effect for the 1972 and 1987 VRAs with magnitudes that are quite similar across the integrated and minimill. A similar decomposition by plant type using the Hall-Roeger specification finds very similar results with the exception of finding little support for a significant positive impact of the 1972 VRA on markups.

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

---

[17] 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

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.

---

of capacities in our sample's distribution of plant capacities. We use this feature of the data to identify minimill plants.

References

Ahlbrandt, Roger S., Richard J. Fruehan, and Frank Giarratani. (1996) *The Renaissance of American Steel: Lessons for Managers in Competitive Industries*. New York, NY: Oxford University Press.

Berry, Stephen, James Levinsohn, and Ariel Pakes. (1999) "Voluntary Export Restraints on Automobiles: Evaluating a Trade Policy," *American Economic Review*, Vol. 89(3): 400-30.

Bhagwati, Jagdish N. (1965) "On the Equivalence of Tariffs and Quotas," in R.E. Baldwin et al., eds., *Trade, Growth and the Balance of Payments: Essays in Honor of Gottfried Haberler*, Amsterdam: North-Holland.

Blonigen, Bruce A., Benjamin H. Liebman, and Wilson, Wesley W. (2007) "Trade Policy and Market Power: The Case of the US Steel Industry," NBER Working Paper No. 13671.

Boorstein, Randi, and Robert C. Feenstra. (1991) "Quality upgrading and its welfare cost in US steel imports." In: Helpman, E., Razin, A. (Eds.), *International Trade and Trade Policy*, MIT Press, pp. 167–86.

Bown, Chad P. (2004) "How Different Are Safeguards from Antidumping? Evidence from US Trade Policies Toward Steel," Mimeo, Brandeis University.

Canto, Victor A. (1984) "The Effect of Voluntary Restraint Agreements: A Case Study of the Steel Industry, *Applied Economics,* Vol. 16(2): 175-86.

Chung, Jae W. (1998) "Effects of US Trade Remedy Law Enforcement under Uncertainty: The Case of Steel," *Southern Economic Journal*, Vol. 65(1): 151-9.

Crandall, Robert W. (1981). *The US Steel Industry in Recurrent Crisis*. Washington, DC: Brookings Institution.

de Melo, Jaime, and David Tarr. (1990) "Welfare Costs of US Quotas in Textiles, Autos and Steel," *Review of Economics and Statistics*, Vol. 72(3): 489-97.

Durling, James P., and Thomas J. Prusa. (2006) "The Trade Effects Associated with an Antidumping Epidemic: The Hot-Rolled Steel Market, 1996-2001," *European Journal of Political Economy*, Vol. 22(3): 675-95.

Falvey, Rodney E. (1979) "The Composition of Trade within Import-Restricted Categories," *Journal of Political Economy*, Vol. 87(5): 1105-14.

Feenstra, Robert C. (1988) "Quality Change under Trade Restraints in Japanese Autos," *Quarterly Journal of Economics*, Vol. 103(1): 131-46.

Gallet, Craig A. (1997) "Cyclical Fluctuations and Coordination in the US Steel Industry," *Applied Economics*, Vol. 29 (1997) 29, 279-85.

Goldberg, Pinelopi K., and Frank Verboven. (2001) "The Evolution of Price Dispersion in the European Car Market," *Review of Economic Studies*, Vol. 68(4): 811-48.

Hall, Robert E. (1988) "The Relation Between Price and Marginal Cost in U.S. Industry," *Journal of Political Economy*, Vol. 96(5): 921-47.

Harris, Richard. (1985) "Why Voluntary Export Restraints are 'Voluntary,'" *Canadian Journal of Economics*, Vol. 18(4): 799-809.

Kee, Hiau Looi, and Bernard Hoekman. (2007) "Imports, Entry, and Competition Law as Market Disciplines," *European Economic Review*, Vol. 51(4): 831-58.

Kiers, Luc. (1980) *The American Steel Industry: Problems, Challenges, Perspectives*. Boulder, Colorado: Westview Press.

Kim, Euysung. (2000) "Trade Liberalization and Productivity Growth in Korean Manufacturing Industries: Price Protection, Market Power, and Scale Efficiency," *Journal of Development Economics*, Vol. 62(1): 55-83.

Klette, Tor J. (1999) "Market Power, Scale Economies and Productivity: Estimates from a Panel of Establishment Data," *Journal of Industrial Economics*, Vol. 47(4): 451-76.

Konings, Jozef, and Hylke Vandenbussche. (2005) "Antidumping Protection and Markups of Domestic Firms," *Journal of International Economics*, Vol. 65(1): 151-65.

Krishna, Kala. (1989). "Trade Restrictions as Facilitating Practices," *Journal of International Economics*. 26(3-4): 251-270.

Lenway, Stephanie, Rehbein, Kathleen, and Starks, Laura. (1990) "The Impact of Protectionism on Firm Wealth: The Experience of the Steel Industry," *Southern Economic Journal*, Vol. 56(4): 1079-93.

Lenway, Stephanie, Randall Morck, and Bernard Yeung. (1996) "Rent Seeking, Protectionism and Innovation in the American Steel Industry," *Economic Journal*, Vol. 106(435): 410-21.

Liebman, Benjamin H. (2006) "Safeguards, China, and the Price of Steel," *Weltwirtschaftliches Archiv*, Vol. 142(2): 354-73.

Moore, Michael O. (1996) "Steel Protection in the 1980s: The Waning Influence of Big Steel?" in Anne O. Krueger, ed., *The Political Economy of Trade Protection*. National Bureau of Economic Research Project Report Series. Chicago and London: University of Chicago Press, 15-34.

Nieberding, James F. (1999) "The Effect of US Antidumping Law on Firms' Market Power: An Empirical Test," *Review of Industrial Organization*, Vol. 14 (1): 65-84.

Pierce, Justin R. (2010) "Spare the Rod, Spoil the Firm? A Plant-Level Analysis of the Effects of Temporary Protection," Mimeo, U.S. Census Bureau.

Prusa, Thomas J. (1994) "Pricing in the Presence of Antidumping Law," *Journal of Economic Integration*, 9(2): 260-89.

Rodriguez, Carlos Alfredo. (1979) "The Quality of Imports and the Differential Welfare Impacts of Tariffs, Quotas, and Quality Controls as Protective Devices," *Canadian Journal of Economics*, Vol. 12(3): 439-49.

Roeger, Werner. (1995) "Can Imperfect Competition Explain the Difference between Primal and Dual Productivity Measures? Estimates for U.S. Manufacturing," *Journal of Political Economy*, Vol. 103(2): 316-30.

Scheuerman, William. (1986) *The Steel Crisis: The Economics and Politics of a Declining Industry*, New York, NY: Praeger.

Staiger, Robert W. and Frank Wolak. (1989) "Strategic Use of Antidumping Law to Enforce Tacit Collusion," NBER Working Paper Number 3016.

Tybout, James R. (2003) "Plant- and Firm-level Evidence on "New" Trade Theories." In: E. Kwan Choi and James Harrigan (Eds.), *Handbook of International Trade*. Blackwell Publishing, Malden, Oxford, UK, 388-415.

Veugelers, Reinhilde, and Hylke Vandenbussche. (1999) "European Anti-dumping Policy and the Profitability of National and International Collusion," *European Economic Review*, Vol. 43(1): 1-28.

Winkelmann, Liliani and Ranier Winkelmann. (1998) "Tariffs, Quotas, and Terms of Trade: The Case of New Zealand," *Journal of International Economics*, Vol. 46(2): 313-32.

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 termina-
ted for comprehensive VRAs.

1984-1989   Comprehensive VRAs with all signi-
ficant import sources.

1989-1992   Extension of VRAs.

1992-1993   AD and CVD cases filed against sig-
nificant 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: 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	0.0027**	0.0014	-0.0021
		(0.0008)	(0.0013)	(0.0033)
1972 VRA_{jt}	+	0.0061	0.0044	0.0147
		(0.0075)	(0.0091)	(0.0343)
1987 VRA_{jt}	+	0.0361***	0.0165	0.0610*
		(0.0069)	(0.0106)	(0.0336)
$ADDuty_{jt}$	+	0.0003	-0.0004	0.0037*
		(0.0006)	(0.0007)	(0.0030)
$CVDuty_{jt}$	0	-0.0018***	0.0006	-0.0091***
		(0.0007)	(0.0007)	(0.0030)
$Safeguard_{jt}$	0	-0.0011	-0.0011	-0.0051**
		(0.0010)	(0.0012)	(0.0023)
Other Controls				
IM_{jt}	-	-0.0002	-0.0004*	-0.0009***
		(0.00021)	(0.0002)	(0.0003)
GR_{jt}	+	-0.0001	0.0024	0.0031
		(0.0003)	(0.0018)	(0.0023)
HI_{jt}	+	0.0300	0.0131	-0.0052
		(0.0480)	(0.0493)	(0.3063)
KI_{ijt}	?	-0.0199**	-0.0201**	-0.0344***
		(0.0086)	(0.0087)	(0.0034)
Year Dummies		No	Yes	Yes
R^2		0.61	0.61	
F-Test (or Chi-Squared)		5.78***	7.76***	41439.32***
Observations		14555	14555	13302

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: Hall-Roeger Estimation of the Effects of Various Trade Policies on Steel Plant Markups

	Predicted Sign	OLS Estimates	OLS Estimates	Instrumental Variable Estimates
ΔX_{ijt}	+	1.1692^{***}	1.1555^{***}	1.4017^{***}
		(0.0544)	(0.0532)	(0.2559)
Trade Policy Effects				
$\text{Tariff}_{jt} \times \Delta X_{ijt}$	0	-0.0049	-0.0066	0.0225
		(0.0062)	(0.0061)	(0.0339)
$1972\ \text{VRA}_{jt} \times \Delta X_{ijt}$	+	0.3940	0.3896	-0.1668
		(0.2489)	(0.2623)	(0.5565)
$1987\ \text{VRA}_{jt} \times \Delta X_{ijt}$	+	0.1525^{***}	0.1036^{*}	0.4977^{**}
		(0.0546)	(0.0540)	(0.2450)
$\text{ADDuty}_{jt} \times \Delta X_{ijt}$	+	-0.0016	-0.0013	0.0024
		(0.0054)	(0.0055)	(0.0271)
$\text{CVDuty}_{jt} \times \Delta X_{ijt}$	0	0.0021	0.0028	0.0114
		(0.0024)	(0.0023)	(0.0313)
$\text{Safeguard}_{jt} \times \Delta X_{ijt}$	0	0.0023	0.0030	0.0255
		(0.0082)	(0.0084)	(0.0587)
Other Controls				
$\text{IM}_{jt} \times \Delta X_{ijt}$	-	-0.0003	-0.0001	0.0014
		(0.0009)	(0.0008)	(0.0046)
$\text{GR}_{jt} \times \Delta X_{ijt}$	+	-0.0082^{***}	-0.0049^{*}	-0.0359^{*}
		(0.0018)	(0.0028)	(0.0189)
$\text{HI}_{jt} \times \Delta X_{ijt}$	+	0.4366	0.3968	0.0828
		(0.4554)	(0.4596)	(2.0007)
$\text{KI}_{ijt} \times \Delta X_{ijt}$	?	0.0023	0.0035	-0.0423
		(0.0058)	(0.0060)	(0.0330)
Year Dummies		No	Yes	Yes
R^2		0.91	0.92	
F-Test (or Chi-Squared)		1019.38^{***}	869.84^{***}	12903.80^{***}
Observations		7898	7898	7898

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
Tariff$_{jt}$	**-0.0321**[*]	**0.0009**	**-0.0347**[*]
	(0.0182)	(0.0025)	(0.0188)
1972 VRA$_{jt}$	**0.0843**[**]	**0.1056**[*]	**0.0047**
	(0.0373)	(0.0588)	(0.0690)
1987 VRA$_{jt}$	**0.0821**[***]	**0.0744**[**]	**0.0080**
	(0.0243)	(0.0350)	(0.0309)
ADDuty$_{jt}$	**-0.0015**	**0.0000**	**-0.0017**
	(0.0025)	(0.0023)	(0.0034)
CVDuty$_{jt}$	**-0.0032**	**-0.0055**[**]	**-0.0251**
	(0.0045)	(0.0025)	(0.0274)
Safeguard$_{jt}$	**-0.0110**[***]	**-0.0046**	**-0.0040**
	(0.0040)	(0.0032)	(0.0052)

Notes: Robust standard errors in parentheses. ***, **, and * denote statistical significance of a coefficient at the 1%, 5% and 10% levels, respectively. These estimated effects come from IV estimation of the PCM specification with year dummies, controls, and plant-specific fixed effects included (as in column 3 of Table 3), as well as interactions of all trade policy variables and controls with dummy variables for "minimill" and "processor" plant type.