Exchange Rates and Industry Demands for Trade Protection

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Abstract: The recent confrontation between China and the United States over currency policy illustrates a broader phenomenon: exchange-rate misalignments tend to spill over into trade policy. While previous studies have shown that aggregate protectionist activity is positively related to the level of the real effective exchange rate, we explore this relationship at the industry level. We argue that several industry-specific characteristics determine the protectionist response to changes in the exchange rate, including the degree of exchange-rate pass-through, the level of import penetration, and the share of imported intermediate inputs in total industry inputs. We evaluate our conditional arguments by estimating a negative binomial model of industry-level anti-dumping petitions and find that greater exchange rate pass-through increases the marginal effect of currency appreciation on the demand for trade protection. We find weaker evidence that the protectionist response to real appreciations is positively conditioned by the level of import penetration in a given industry.

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Introduction

The ongoing confrontation between China and the United States over currency policy illustrates a broader phenomenon: exchange-rate misalignments tend to spill over into trade policy. Just as the United States has threatened to impose trade barriers on imports from China and other countries that maintain "fundamentally undervalued" currencies, protectionism increased during previous exchange-rate controversies.[1] During the Great Depression, deficit countries that resisted devaluing their currencies also increased their trade barriers.[2] In the Bretton Woods era, at least nine major industrial countries – including Canada, France, Sweden, and the United Kingdom – imposed "import surcharges" (uniform tariffs) in the hope of avoiding exchange rate changes.[3] Similarly, the appreciation of the U.S. dollar in the early 1980s provoked the U.S. Congress to ramp up anti-dumping restrictions and other "administrative" trade barriers.[4]

While previous studies have shown that protectionist activity is positively related to the level of the real exchange rate, we demonstrate that this elasticity varies *by industry*.[5] We argue that several industry-specific characteristics determine the protectionist response to changes in the exchange rate, including the extent of exchange-rate pass-through, the level of import penetration, and the share of imported intermediate inputs in total industry inputs. We predict that industries with higher pass-through, larger import penetration ratios, and lower ratios of

[1] In September 2010, the House of Representatives passed *The Currency Reform for Fair Trade Act* (H.R. 2378), which would allow the U.S. to impose anti-dumping injunctions against China and other countries that maintain "fundamentally undervalued" currencies.

[2] Eichengreen and Irwin 2010; Irwin 2012.

[3] Bergsten 1977; Irwin 2011.

[4] Kaempfer and Willett 1987; Bergsten and Williamson 1983; Grilli 1988.

[5] See Knetter and Prusa 2003, and Oatley 2010.

imported intermediate inputs to total inputs will demand more trade protection in response to currency appreciations.

Section 2 illustrates the puzzle that motivates our analysis: why is it that some industries systematically demand more trade protection than others? We use antidumping petitions filed at the United States International Trade Commission (ITC) to measure industry demand for protection because they can be traced to specific products and vary discretely over time.[6] We match these antidumping petition counts to real exchange rate data from the Federal Reserve to show that certain industries, such as primary metals manufacturing, are more likely to seek trade protection during currency appreciations than others.

In Section 3, we draw on an existing political economy literature to develop arguments about the sensitivity and position of a given industry to exchange-rate fluctuations. More specifically, we relate industry *sensitivity* to currency appreciations to the extent of exchange rate pass-through in an industry. Our theory suggests that firms in high pass-through industries are more likely to demand trade protection during periods of currency appreciation because they compete mainly on price. With respect to *position*, we argue that currency appreciation harms industries with higher import penetration ratios but helps industries with greater imported intermediate inputs as a share of total costs.

In Section 4, we evaluate these conditional hypotheses by constructing a dataset of antidumping petitions at the three-digit North American Industry Classification System (NAICS) level. Using a negative binomial model with several interaction terms, we find that pass-through has a significant positive effect on the protectionist response by a given industry to an appreciation in the real exchange rate. We also find weaker evidence that the protectionist

[6] See Hansen, W. 1990.

response to real appreciations is positively conditioned by the level of import penetration in a given industry and negatively conditioned by an industry's dependence on imported intermediate inputs. In one of several robustness checks, we control for standard political economy variables that may be correlated with our variables of interest: to control for collective action costs, we include industries' concentration ratios; to control for business cycle effects, we include industries' capacity utilization rates; and to control for the fact that advanced industrial countries tend to protect their low-skilled, labor-intensive sectors, we include industries' capital-labor ratios. Lastly, to control for the political influence of industries in the anti-dumping administrative process, we include industries' previous success rates in attaining favorable rulings from the ITC, as this may affect industries' decisions to file a petition.[7] Our main results are largely unaffected by these controls.

In Section 5, we summarize and discuss the wider implications of our research on exchange rates and trade protection. To illustrate the relevance of our industry-level arguments, we highlight lobbying patterns on recent congressional legislation to impose trade barriers on China for its policy of "currency manipulation." We observe that the trade and labor associations that explicitly voice support for this legislation tend to represent industries that manufacture standardized products subject to high exchange-rate pass-through. This is consistent with our findings from the realm of antidumping petition filings and emphasizes the point that exchange rates only affect competitiveness when pass-through is high.

2. Exchange Rates and Protectionism

[7] See Drope and Hansen (2004) for evidence that lobbying activities and campaign contributions significantly affect the likelihood of obtaining favorable rulings from the antidumping bureaucracy.

A number of studies have examined the overall relationship between currency appreciation and protectionism. Irwin (2012) and Eichengreen and Irwin (2010) show that aggregate protectionism during the Great Depression was the favored policy response in countries that kept their currencies fixed to gold, once partner countries devalued their own currencies. Oatley (2010) examines "waves" of protectionism in six industrialized countries since the 1970s and connects these protectionist cycles to movements in real exchange rates. Knetter and Prusa (2003) provide similar evidence for the United States, the European Union, Australia and Canada. Their estimates suggest that a one-standard deviation real appreciation of the domestic currency increases anti-dumping filings by 33 percent. Niels and Francois (2006) find that antidumping complaints are systematically related to movements in the exchange rate and the current account in Mexico. Bergsten and Williamson (1983), Grilli (1988), and Irwin (2005) all show that protectionist legislation and anti-dumping petitions in the United States vary with the real exchange rate. However, none of these studies explore the relationship between exchange rates and trade barriers at the industry level of analysis.

In **Figure 1,** we reproduce the basic association between the level of the real effective exchange rate of the U.S. dollar and aggregate protectionism, as proxied by anti-dumping cases investigated by the ITC. We use the real effective exchange rate (REER) because it internalizes the currencies of multiple trading partners and adjusts for differences in price levels across countries. We use anti-dumping cases investigated by the ITC because they provide year-to-year variation on the demand for relief from trade competition. These data clearly indicate that the number of anti-dumping cases increases when the dollar appreciates. The one outlier—1992—is the exception that tests the rule. On July 8, 1992, the steel industry filed 47 separate anti-dumping petitions on various countries for four types of steel products. If we reduce these 47

cases to four—since this flurry of steel-related cases were not independent—this positive correlation becomes even more significant.[8]

This relationship is meaningful in a substantive sense as well. Simulating the effect of increasing the REER by one standard deviation above its mean—a roughly 10 percent real appreciation of the dollar—increases the number of anti-dumping petitions filed at the ITC by about 10 cases per year (the 95 percent confidence interval ranges from about 3 to 17 cases). Given that 39 cases are filed per year on average, this suggests that a 10 percent real appreciation leads to a 26 percent increase in anti-dumping activity.[9]

One indication that exchange rates have different effects on different industries is the large number of anti-dumping petitions filed by firms in the Primary Metal Manufacturing industry (NAICS 331). In the U.S., firms in this industry initiated 45 percent of all anti-dumping cases between 1979 and 2009, and the vast majority of these cases were from firms producing basic steel commodities: steel plate, pipe, and wire products. The asymmetry between the primary metals industry and other industries is so large that if we drop all NAICS 331 cases from the sample, as in **Figure 2**, the relationship between exchange rates and anti-dumping petitions decreases in magnitude and loses its statistical significance.

Why does appreciation of the exchange rate seem to induce a stronger protectionist response from the primary metals industry than it does from other industries? While a number of previous studies emphasize the prevalence of steel and metals manufacturing in anti-dumping investigations, few pay sufficient attention to understanding why this industry is different. Some

[8] The significance of the relationship moves to $t = 3.85$ and the fit of the model improves to $R^2 = 0.31$.

[9] This effect accords with Knetter and Prusa (2003), who find that a one standard deviation real appreciation leads to a 33 percent increase in anti-dumping filings in Australia, Canada, the European Union, and the United States.

scholars include a dummy variable to control for the fact that steel and steel-related cases are overrepresented in the data; others re-estimate their models excluding the steel investigations.[10] But these empirical strategies say little about the factors that contribute to such industry-level differences.

Given that exchange rate fluctuations appear to significantly affect the demand for protection in some industries but not others, our goal is to identify structural variables that could potentially explain this asymmetry. For example, the primary metals industry might share certain characteristics with other industries, which would allow us to make generalized conclusions about industry behavior across the manufacturing sector. In other words, which industry-specific characteristics determine the protectionist response to currency appreciations?

3. The Industry-Specific Effects of Exchange Rates

The existing political economy literature has demonstrated that real exchange rate fluctuations have a substantial, but uneven, impact on the profitability and performance of industries.[11] Movements in the exchange rate may cause price changes that: (1) reallocate resources between traded and non-traded goods industries; (2) alter the competitiveness of export industries and import-competing industries; (3) change the input costs of industries that use imported intermediate inputs; (4) alter the input prices of firms that import foreign goods for resale in the domestic market; and (5) change the value of assets denominated in foreign currencies. Because of this diverse set of influences, exchange-rate movements can be expected to have very different effects across industries.

[10] Drope and Hansen 2004; Knetter and Prusa 2004; Niels and Francois 2006.

[11] Frieden 1991; Bodner and Gentry 1993; Broz and Frieden 2006.

At the broadest level, changes in the exchange rate affect non-traded goods industries differently than traded goods industries. Non-traded goods have transportation costs that are high enough to render international trade unprofitable. A real appreciation leads to a rise in the relative price of non-tradable goods and thereby shifts resources from the tradables to the non-tradables sector.[12] More specifically, a real appreciation increases the cost of producing tradable goods and decreases the costs of producing non-tradable goods. As such, it causes the profit and market valuation of non-traded goods industries to rise relative to the profit and market value of traded goods industries.[13] This suggests an asymmetric relationship between real appreciations and industrial performance: appreciation helps non-traded goods producers and harms traded goods producers.

Within the traded-goods sector, an industry's response to exchange-rate movements depends on its international position and market structure. An appreciation lowers the amount of home currency needed to purchase an equivalent unit of foreign currency, resulting in a lower home-currency price of foreign goods and a higher foreign-currency price of home goods. In general, this harms exporters and import-competing industries, as declining competitiveness at home and abroad reduces revenues, and helps importers (wholesalers and retailers) as input costs decline. But the overall sensitivity and position of export and import-competing industries regarding currency appreciations are moderated by three factors: the degree to which changes in the exchange rate pass through to the price of traded goods, the amount of import penetration relative to domestic consumption, and the extent to which an industry depends on imported intermediate inputs.

[12] Dornbusch 1974.

[13] Bodner and Gentry 1993.

First, we expect that greater pass-through in an industry will increase its sensitivity to exchange rate fluctuations. Pass-through refers to the elasticity of import and export prices to changes in the real exchange rate. This is an important economic concept because changes in the exchange rate can only impact international competitiveness if they are "passed through" to the price of traded goods.[14] For the same reason, pass-through is politically important because firms are more likely to demand trade protection if their competitiveness is adversely affected by currency appreciations.

Complete pass-through means that market prices change one-for-one with the exchange rate: a 10 percent appreciation of the home currency leads to a 10 percent reduction in import prices and a 10 percent increase in export prices. Therefore, import-competing firms and exporters in high pass-through industries are very sensitive to the exchange rate because it directly affects their competitiveness. By contrast, zero pass-through means that prices remain unchanged in response to changes in exchange rates. Where pass-through is low, producers absorb most or all of exchange rate fluctuations in their profit margins to avoid changing their prices. Low pass-through is also referred to as "pricing-to-market" because exporters adjust their mark-ups to create price stability in the local currency of importers.[15]

The level of exchange rate pass-through depends largely on the market structure and the degree of product differentiation in an industry.[16] Pass-through tends to be highest in competitive industries where firms produce homogenous goods and compete mainly on the basis of price (e.g., basic metal products, minerals, textiles). Consumers are relatively price-sensitive given the large number of available substitutes, and this high elasticity of demand forces producers to

[14] Goldberg and Knetter 1997; Campa and Goldberg 1999.

[15] Krugman 1987; Knetter 1993.

[16] Dornbusch 1987; Marston 1990; Knetter 1993; Yang 1997.

discipline their pricing behavior. By contrast, pass-through tends to be lowest in imperfectly competitive industries where producers compete on quality and reputation rather than simply on price. These market characteristics are typically found in industries that produce differentiated and specialized goods with few substitutes. Because demand is relatively inelastic, producers are able to keep prices stable in foreign markets even with exchange rate volatility (i.e., pricing-to-market). Low pass-through industries are better insulated from the effects of exchange rate fluctuations since product differentiation prevents foreign goods from being close substitutes for domestic goods.[17]

A simple example illustrates the impact of pass-through on an industry's sensitivity to exchange rate fluctuations. Consider trade between the United States and the Eurozone and assume that the dollar appreciates from $1.25 per euro to parity. Furthermore, assume that Eurozone producers charge a set price of €10 for each unit sold. In a situation of complete exchange rate pass-through, the import price for U.S. consumers decreases from $12.50 to $10.00. If Eurozone goods are close substitutes for American goods, U.S. consumers will adjust their consumption by consuming relatively more Eurozone goods. A similar mechanism is triggered in the Eurozone, where the price of the U.S. good increases from €10 to €12.50. In this example of complete pass-through, dollar appreciation harms the competitiveness of U.S. producers and thereby increases imports from the Eurozone and decreases U.S. exports to Europe.

Now, consider the opposite extreme of zero pass-though. Under the full pricing-to-market assumption, appreciation of the dollar does not affect the quantity of goods shipped to the U.S. because European producers do not change their prices and U.S. consumers do not shift

[17] Goldberg and Knetter 1997.

their expenditures to European goods. Similarly, within the Eurozone, imports from the U.S. would be unchanged as European consumers would not substitute towards domestic goods. In other words, changes in consumption patterns are now absent as consumer prices in both markets are completely insulated from exchange-rate fluctuations. However, although quantities shipped across borders do not respond to exchange-rate changes, U.S. exporters will still suffer a fall in revenues when the dollar appreciates. With prices set in dollars and no change in demand, the U.S. exporter receives the same amount of euros as before the appreciation took place. This payment has less value in dollar terms, thereby decreasing the revenues of U.S. exporters (revenues from domestic sales are unaffected).

To summarize, exchange-rate changes affect international competitiveness when pass-through is high. This implies that producers in high pass-through industries are very sensitive to the exchange rate and hold clear preferences: appreciation harms their competitiveness and reduces profits, while depreciation improves their competitiveness and raises profits. By contrast, producers in low pass-through industries will be less concerned about changes in exchange rates because such changes do not induce proportional changes in prices, competitiveness, expenditure-switching, and quantities shipped across borders. The political economy implication is that high pass-through industries will be more likely to make political demands for protectionism during appreciations than industries with low pass-through.

Two additional industry characteristics shape the demand for trade protection during appreciations: the level of import penetration and the ratio of imported inputs to total inputs. We hypothesize that higher import penetration in a given industry will increase that industry's protectionist response to currency appreciations. Import penetration has long been associated

with the demand for protection.[18] Furthermore, some studies have found that the amount of protection an industry receives is higher when an industry has high import penetration, or has experienced a recent increase in import penetration, or is in decline (declining industries tend to have higher import-penetration levels).[19] However, the existing evidence on the relationship between trade protection and import penetration is mixed.[20] We build on this literature by arguing that the responsiveness of industries to exchange rate appreciation is conditioned by the import penetration rate.

The import penetration rate is the percentage of domestic demand fulfilled by imports—an industry has greater import penetration when imports represent a larger share of domestic consumption. Industries with high import penetration rates face strong competition from foreign producers in the home market. Because of their exposure to import competition, their domestic revenues are particularly vulnerable to changes in competitiveness.[21] Therefore, we expect currency appreciations to generate more harm to import-competing domestic industries the higher the import penetration rate. A high degree of foreign penetration in domestic markets means that industry revenues are highly exposed to exchange-rate shocks. An industry with high import penetration (such as apparel and textiles, leather and leather products, industrial machinery and equipment, and electronic equipment) experiences greater pressure on its ability to compete in the domestic market when its competitiveness—and its revenues—fall sharply with currency appreciation. Thus, we expect that an appreciation of the real exchange rate will induce more protectionist pressure in industries with higher import penetration rates.

[18] Rodrik 1995; Maggi and Rodríguez-Clare 2000.

[19] Herander and Schawartz 1984; Trefler 1993; Finger and Harrison 1996; Lee and Swagel 1997.

[20] Maggi and Rodríguez-Clare 2000.

[21] Campa and Goldberg 1997.

Not all manufacturing industries are harmed by currency appreciation, however. The most notable exception to the rule is an industry that imports a large proportion of it intermediate inputs from abroad. For such an industry, currency appreciation lowers input costs and may thereby offset the negative effect of appreciation on competitiveness and revenues. In fact, this benefit may outweigh the adverse revenue effects of a real appreciation in some traded goods industries.[22]

We thus expect greater dependence on imported inputs to *decrease* the demand for trade protection in response to exchange rate appreciation. Imported input dependence refers to the level of imported inputs relative to the total value of production. Since currency appreciation provides offsetting benefits to industries that depend heavily on imported inputs (by lowering input costs), we expect less protectionist pressure from such industries during real appreciations.

Our argument is salient because imported inputs have come to play an increasingly important role in the U.S. economy. By 2006, imported intermediate inputs reached $1.2 trillion and accounted for over half of all U.S. imports—imports of parts and components now exceed imports of final goods. In manufacturing, the import share of intermediate inputs surpassed 20 percent on average, with some industries more reliant on imported inputs than others.[23] We take account of the growing use of imported intermediate inputs in production and leverage its across-industry variation to explore the impact of the real exchange rate on manufacturing industries' demands for protection. In industries that buy more of their inputs from foreign producers, we expect less protectionist pressure in response to currency appreciations.

The argument that imported input dependence tempers industries' demand for protection resonates with other work on the political economy of protectionism. Scholars have pointed to

[22] Campa and Goldberg 1997.

[23] Yuskavage et al 2008.

the rise of global production networks, vertical specialization, intra-firm trade, and the offshoring of services as factors that mitigate protectionism.[24] With vertical specialization and global sourcing, components and parts have to cross borders several times. For example, Japan exports raw steel to Mexico, where the steel is stamped and processed and then exported to the U.S., where it is manufactured into farm equipment and then exported again.[25] The interconnectedness of production processes across several countries gives firms and industries that engage in it an interest in "resisting protectionism."[26] Manufacturers that rely on imported inputs may resist higher protectionism because it pushes up the prices of those inputs and thereby makes the domestic industry less competitive. In other words, vertical specialization provides a counterbalance to protectionism. We extend this reasoning to protectionist demands that are motivated by exchange rate appreciation. For industries that make use of vertical supply chains for imported inputs, we expect currency appreciation to evoke less protectionism.

Figure 3 summarizes the effects of exchange-rate changes on industries along the two dimensions discussed above: position and sensitivity. The first dimension – position – represents how an industry is affected by the level of the real exchange rate. Industries that benefit when the exchange rate is "high" (appreciated) are located in the east cells of the figure; industries that prefer a "low" (depreciated) exchange rate are positioned in the cells to the west. The second dimension – sensitivity – reflects the degree of pass-through in an industry. Industries that are more sensitive to movements in exchange rates are industries where pass-through is high: industries producing standardized goods sold in competitive markets on the basis of price.

[24] Destler and Odell 1987; Milner 1988; Nollen and Quinn 1994; Grossman and Rossi-Hansberg 2008.

[25] This example is discussed in Hummels et al (2001).

[26] Milner 1988.

Industries that are less sensitive to exchange-rate movements are industries where pass-through is low: industries that produce differentiated goods sold in less competitive markets where firms command some pricing power.

4. Industry-Specific Exchange Rates and Antidumping Investigations

We use the number of antidumping petition filings for a given industry to proxy for that industry's overall demand for protection. The advantage of using antidumping petition filings is that they are measured discretely over time and can be easily traced to specific industries. Therefore, our dependent variable AD_{it} represents the number of antidumping petitions to the ITC filed by industry i in year t. These data were collected from the Global Antidumping Database (GAD) from 1978-2010.[27] Industries in the GAD are categorized by either TSUSA or HS codes, which are too disaggregate for the scope of our analysis. Therefore, we map the GAD data to modern three-digit NAICS code using the following procedure:

First, we convert each of these respective codes to SIC codes using publicly available concordance files.[28] We replace missing SIC codes with those from the NBER Antidumping Database.[29] In addition, we reduce some HS codes to four significant figures to increase the number of SIC matches, since the former is far more disaggregated. Next, we convert these SIC classifications to NAICS codes.[30] Some of the concordances required manual overriding. For

[27] Bown 2010. Available at http://econ.worldbank.org/ttbd/gad/

[28] TSUSA to SIC: http://cid.econ.ucdavis.edu/usixd/wp5515d.html; HS to SIC: http://faculty.som.yale.edu/peterschott/sub_international.htm

[29] http://www.nber.org/antidump/

example, we mapped SIC 3312 to NAICS 331 based on bridge files from the Census Bureau.[31] The GAD reports multiple entries for antidumping petitions associated with more than one product. We drop duplicate cases with the same case identification number and NAICS-6 code to avoid over-counting these "omni-petitions," which were often filed in the primary metals manufacturing industry. Finally, we construct a panel of antidumping petitions per year by collapsing the dependent variable by NAICS-3 code.

The first modeling decision is to select a distribution for the dependent variable that reflects the non-negative integer nature of antidumping petitions. The data reveals that the number of antidumping petitions across industries is highly skewed, which suggests evidence of over-dispersion. In addition, nearly 70% of our observations in the panel equal zero. Several goodness-of-fit tests indicate that the variance of our dependent variable far exceeds the mean, which violates the strict assumptions of the Poisson distribution. Therefore, we conclude that the negative binomial distribution is most appropriate for modeling antidumping petitions at the three-digit NAICS industry level.

Our primary explanatory variable is an industry-specific measure of the real effective exchange rate. Industry-specific exchange rates are crucial to our analysis since we are interested in changes in competitiveness and protectionist lobbying at the industry level. While aggregate REER indexes use the weights of each partner country in the total international trade activity of the entire U.S. economy, industry-specific exchange rates are constructed by weighting partner currencies by the shares of partners in U.S. trade in a specific industry. The

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30 http://www.macalester.edu/research/economics/page/haveman/trade.resources/tradeconcordances.html#FromusSIC

31 http://www.census.gov/epcd/ec97brdg/E97B1331.HTM

Federal Reserve Bank of New York provides industry-specific REER indexes for manufacturing industries by three-digit NAICS code from 1989-2010 on its public website.[32] These data are weighted by imports, exports and overall trade, which is an *ad hoc* convention of averaging import and export weights.[33] We use the import-weighted exchange rate (*mer*) in our empirical analysis because antidumping measures are protectionist barriers on imports, which is constructed as follows:

$$mer_t^i = \sum_c w_t^c * rer_t^c \text{ . where } w_t^c = \frac{M_t^{ic}}{\sum_c M_t^{ic}}$$

and where *rer* represents the bilateral exchange rate and *M* represents the value of imports for industry *i* from country *c* at time *t*.[34] Therefore, we expect that industries will file more antidumping petitions when their import-weighted real exchange rate appreciates, which has the effect of reducing the competitiveness of domestic producers relative to foreign producers.

Table 1 presents the results of a preliminary effort to parameterize the positive relationship between antidumping petition filing behavior and the real exchange rate. Model 1 confirms the previous findings discussed in Section 2 with industry and year fixed effects. Model 2-4 show that firms in the primary metals sector are still more responsive to currency appreciations than other industries after switching to an industry-specific measure of the real exchange rate. Model 2 introduces a statistically significant control for the metals industry, which leaves our basic results unchanged, although we cannot include fixed effects to accommodate our time-invariant dummy variable. Models 3-4 retain fixed effects but trim our

[32] http://www.newyorkfed.org/research/global_economy/industry_specific_exrates.html

[33] Campa and Goldberg 1997.

[34] Goldberg 2004.

sample to include only metals and non-metals industries, respectively. This introductory exercise confirms our graphical evidence that the positive relationship between antidumping petitions and currency appreciation only appears to hold in the metals industry.

To understand this asymmetry, we also collect data for our three conditioning explanatory variables. We exploit the observation that pass-through tends to be high for standardized goods produced in competitive markets, and low for differentiated goods produced in imperfectly competitive markets. Rauch (1999) classifies products into three distinct categories: homogenous, reference priced, and differentiated products. Homogeneous products are highly substitutable and producers compete mainly on price, which is set in organized exchanges. Reference priced products have some unique attributes but remain essentially substitutable, and producers take their prices from industry guides and trade journals. Differentiated products vary across supplier to meet specific consumer needs, and thus producers compete on quality and other attributes, rather than just on price. We collapse these product classifications into NAICS-3 industries and generate a dummy variable that equals one if pass-through is high and producers complete on price (homogenous and reference priced goods) and zero if pass-through is low and producers do not complete on price (differentiated goods).

More specifically, we collect Rauch (1999) "conservative" product classifications from Jon Haveman's public website.[35] We assign a pass-through value of 0 to differentiated products, 1 to reference priced products, and 2 to homogeneous products traded on an organized exchange. This design ensures that larger magnitudes reflect a greater degree of exchange rate pass-through based on the theory presented in this paper. Because the raw data is organized by SITC industry

35 http://www.macalester.edu/research/economics/page/haveman/trade.resources/tradedata.html#Rauch

codes, we use publicly available concordance files to categorize the data by 1999 NAICS codes.[36] Then, we convert these outdated NAICS codes to their 2002 equivalents to ensure consistency with our other explanatory variables.[37] We construct average pass-through values for each industry in our sample by collapsing the data by NAICS-3 code. Finally, we construct a dummy variable for high pass-through that equals 1 if the average is greater than or equal to 0.5, which reflects the fact that both reference priced and homogenous goods are produced by industries that compete mainly on price.

Our method for constructing import penetration is relatively straightforward. We simply compute the ratio of imports to a proxy for domestic consumption devised by Campa and Goldberg (1997) as follows:

$$MSHARE_{it} = 100 * \left(\frac{M_{it}}{S_{it} - X_{it} + M_{it}} \right)$$

where M represents the value of imports, X represents the value of exports, and S represents total shipments for industry i in year t. We collect both trade and shipments data by NAICS-3 industries from Schott (2008), which are available on his public website.[38]

Previous papers have measured imported input dependence by multiplying total spending on input p by the economy-wide import share for that input.[39] However, this approach relies on an assumption of import comparability, which states that the economy-wide import share for

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[36] http://www.nber.org/lipsey/sitc22naics97/

[37] http://www.macalester.edu/research/economics/page/haveman/trade.resources/tradeconcordances.html#FromNAICS

[38] http://faculty.som.yale.edu/peterschott/sub_international.htm

[39] Campa and Goldberg 1997.

good *p* is equal to the import share for good *p* in a particular industry.[40] We improve upon this methodology by relaxing the import comparability assumption and constructing a direct ratio of imported inputs to total intermediate inputs by industry. The numerator, which equals the sum of all imports by industry containing the keyword "parts" in the product description, comes from Schott (2004) and is available on his public website. The denominator is provided by the Bureau of Economic Analysis (BEA) at the three-digit NAICS level.

Intuition suggests that industries will incorporate information about the success of their previous petitions when comparing the costs and benefits or filing an additional petition at the margin.[41] Since industries choose whether or not to petition the ITC for protection, they may base that choice on their perceived likelihood of receiving an affirmative ruling from the bureaucracy. But, as Drope and Hansen (2004) demonstrate, the covariates of "success" are both endogenous to industries' political efforts (e.g., lobbying and campaign contributions), and exogenous to such efforts (e.g., industries' geographical location in the districts or states of powerful oversight committee members, the merits of the case, etc). Rather than attempting to incorporate the multitude of political and economic factors that affect the likelihood of a positive policy decision from the ITC, we attempt to capture all such influences with a variable based on industries' previous success in gaining positive rulings.[42] We are able model this "success rate" because the GAD includes the final decision of each antidumping petition, which we use to construct a variable measuring the success rate for any given industry.

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[40] Feenstra and Jensen 2009.

[41] We thank an anonymous reviewer for raising this issue.

[42] Data limitations constrain Drope and Hansen's (2004) dataset to just 108 antidumping petitions filed between 1996 and 1999. Our data covers 1,122 petitions filed between 1978 and 2010.

Decisions are not always reached in the same calendar year as the initial filing, so it is useful to think of this success rate as a cumulative ratio that gets updated with new information each year. Therefore, we can express the success rate for industry *i* at time *t* as follows:

$$SR_{it} = \frac{100 * \sum_{\tau=1978}^{t-1} \left(AD_{i\tau} \mid d = 1 \right)}{\sum_{\tau=1978}^{t-1} AD_{i\tau}}$$

where $AD_{i\tau}$ represents the number of antidumping petitions filed by industry *i* in year τ and *d* represents the decision made by the ITC regarding any given petition. Our expectation is that an increase in the success rate of a given industry will increase the expected value of future investigations and thus induce the filing of more petitions in subsequent years. Similarly, a decrease in the success rate of a given industry should induce fewer petitions.[43]

We incorporate the success rate and our three conditional hypotheses about the effect of exchange rates on the industry-level demand for protection in the following negative binomial model:

$$Y_{it} = \exp\left(\alpha_{it} + \lambda SR_{it} + \beta X_{it} + \sum_{j=1}^{3} \psi_j Z_{jit} + \sum_{k=1}^{3} \gamma_k \left(X_{it} * Z_{kit} \right) + \rho M_{it} + \eta \Delta \ln\left(C_{it} \right) + \sum_{n=1}^{2} \mu_n W_{nit} + \varepsilon_{it} \right)$$

where *Y* represents the number of antidumping petitions; *SR* represents the antidumping petition success rate defined above, while the parameter λ represents the "learning rate" of a given industry; *X* represents the level of the industry-specific and import-weighted real exchange rate; Z represents the *k*th conditional variable, which equals either the pass-through rate, import share,

[43] However, the number of antidumping petitions filed by a given industry and its cumulative success rate may, in fact, be inversely related. A marginal increase in the success rate might lead to fewer petitions because successful firms have more efficient production functions. In other words, there is a certain marginal cost associated with filing petitions, and more successful industries can file relatively fewer petitions to achieve the same overall level of protection. We thank Peter Rosendorff for suggesting this inverse relationship.

or dependence on imported inputs; *M* represents a dummy variable indicating whether a given industry belongs to the primary metals sector; *C* represents the log difference of manufacturing capacity utilization from the Federal Reserve Board; and *W* represents a vector of standard political economy covariates including capital-labor ratios[44] and concentration ratios measured by the share of the value of total shipments accounted for by the four largest companies in industry *i* in year *t*.[45] The error term is assumed to be uncorrelated with our dependent variables.

Table 2 evaluates our industry-specific arguments about the causal link between exchange rates and protectionism. We start by using a random effects model to allow us to interpret the coefficient on the component term for pass-through, which does not vary over time. Model 1 shows that the real exchange rate has an insignificant effect on the rate of antidumping petitions after controlling for industry-level success rate, pass-through, import share, and dependence on imported inputs. Although the effect our success rate variable is insignificant in this model, the negative sign may reflect the alternate hypotheses described above.

However, this model is incomplete because it assumes that each regressor has an independent effect on our dependent variable. To evaluate the conditional hypotheses generated above, Model 2 includes three interaction terms to go along with our component terms. We observe that β remains slightly negative and insignificant, which indicates the effect of *X* when our modifying variables are equal to zero. Next, we interpret the coefficients on Z_j as the effect

[44] Capital-labor ratios are constructed by dividing the net stock of private fixed assets (Table 3.1E from the BEA) by the number of full-time and part-time employees by NAICS-3 industry. Employment data is available on the GDP-by-Industry section of the BEA website (http://www.bea.gov/industry/gdpbyind_data.htm).

[45] Concentration ratios are publicly available on the U.S. Census Bureau website (http://www.census.gov/econ/concentration.html) for the 2007, 2002, and 1997 Economic Censuses for manufacturing industries at the NAICS-3 level. We apply the ratios from each Census to all preceding gap years in which a Census was not conducted.

of our modifying variable j when X is equal to zero. The signs are the opposite of what we expect, but this is not crucial to our analysis since a real exchange rate, import share, or dependence on imported inputs of zero is a highly improbable scenario.[46]

Instead, we turn to the coefficients in vector γ, which directly test our conditional hypotheses above. We find that pass-through has a significant positive effect on the protectionist response by a given industry to an appreciation in the real exchange rate. Perhaps surprisingly, this variable provides most of the explanatory power in our model. The interactions with import share and imported input dependence with the real exchange rate carry the expected signs. However, we cannot reject the null hypothesis that either is significantly far away from zero to generate any substantive conclusions about their effect on the demand for protection. Furthermore, we cannot rule out the possibility that their lack of statistical significance is due to some degree of measurement error. Future research should make use of new data being constructed by Feenstra and Jensen (2009) to fully understand the effect of imported input dependence.

We explore the significance of pass-through in **Figure 4** by showing a scatter plot of antidumping petitions and the industry-specific real exchange rate. We can see that most of the observations occur at low levels of antidumping petitions and that the import-weighted real exchange rate is somewhat normally distributed with a few outliers. The scatter plot is overlaid with two linear prediction plots drawing from mutually exclusive and collectively exhaustive samples: one where pass-through equals zero and the other when pass-through equals one. It is clear that the bivariate relationship between industry demands for protection and levels of the

[46] Brambor et al. (2006) strongly caution against interpreting constitutive terms as if they were unconditional marginal effects.

real exchange rate is positive for industries with high-pass through and essentially flat – if not slightly negative – for industries with low-pass through.

Another way to visualize the contribution of our pass-through variable is to plot the average marginal effects (AME) of pass-through (PT) on the number of antidumping petitions (Y) for representative values of the real effective exchange rate (χ) using the coefficients estimated by our negative binomial model. These marginal effects can be expressed as the discrete change in the predicted response as a result of a change in the categorical variable averaged over *n* sample observations:

$$AME_{\chi}^{PT} = \frac{\sum_{i=1}^{n}\left(\hat{Y}_i \mid PT = 1\right) - \left(\hat{Y}_i \mid PT = 0\right)}{n} \mid X_i = \chi$$

Figure 5 shows that the marginal effect of pass-through increases as the exchange rate appreciates. However, this effect is only statistically significant when the entire confidence interval lies above the zero line, which occurs approximately when the exchange rate is larger than its median value. In these cases, the magnitude of the marginal effect is quite substantial and can exceed the mean value of our dependent variable. This result is consistent with our hypothesis that the protectionist response by industries is more pronounced during periods of especially steep currency appreciation.

Next, we test the robustness of our results to a dummy variable that controls for the effect of unobserved characteristics associated with the primary metals industry. This technique should help us disentangle the independent effect of pass-through from other traits that might explain the overrepresentation of petitions filed by the primary metals industry in our sample.[47] We also

[47] We use the dummy variable method because removing the primary metals sector from our sample would dramatically reduce the variation in our already zero-inflated dependent variable.

include several control variables commonly found in the literature on the political economy of trade protection.[48] Empirical studies have repeatedly documented the countercyclical nature of trade protection: trade barriers tend to rise in recessions and fall in booms.[49] Since our analysis is conducted at the industry level of analysis, we use the change in natural logarithm of industry capacity utilization to measure such business cycle effects. Another empirical regularity is that advanced industrial countries tend to protect their low-skilled, labor-intensive sectors, a consequence of the fact these are their import-competing sectors.[50] We measure industry labor-intensity as being inversely related to the industry capital-labor ratio.[51] Lastly, we control for industry concentration ratios on the grounds that several studies have found a positive relationship between producer concentration and trade protection.[52] Presumably, industry concentration reduces the free-rider problem and lowers the organizational costs of lobbying.

As indicated in Model 3, our core results are robust to these four control variables. The interaction between the real effective exchange rate and pass-through remains significant at the 5 percent level, while our primary metals indicator variable is statistically insignificant. In addition, we observe that capital-labor ratios appear to be positively and significantly correlated with the number antidumping petitions, which is the opposite of our prediction. However, we are careful not to draw any causal inference from this relationship as capital-labor ratios tend to

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In addition, this approach allows us to explicitly measure the significance of the primary metals industry in our empirical analysis without sacrificing valuable information.

[48] For a review of this large literature, see Rodrik 1995.

[49] Gallarotti 1985; Cassing, McKeown and Ochs 1986; Grilli 1988; Hansen, J. 1990.

[50] Caves 1976; Marvel and Ray 1983; Anderson and Baldwin 1987; Finger and Harrison 1994.

[51] See fn 44 for more information on this variable.

[52] Pincus 1975; Marvel and Ray 1983; Trefler 1993. See fn 45 for more information on the construction of this variable.

be strictly increasing over time in our sample. In other words, we cannot disentangle the independent effect of increasing capital-labor ratios from the effect of a simple linear time trend. We see no other reason *ex ante* for why an increase in the capital-labor ratio – and thus a decrease in labor intensity – would lead to an increase in the demand for protection at the industry level. Finally, the log change of manufacturing capacity utilization and industry concentration ratios appear to have no significant effect on the rate of antidumping investigations initiated by manufacturing industries.

However, our models of count data thus far can only explain antidumping petitions per industry as a function of industry-level characteristics, which ignores the possible effect of omitted variables that could influence the overall rate of petitioning activity. For example, it is possible that broad changes in antidumping regulations or the geopolitical landscape could increase the demand for protectionism across all industries in the same year. Because these regime changes are largely unobserved, it is nearly impossible to model them explicitly. Therefore, we construct an alternate dependent variable to measure the number of antidumping petitions per industry as a share of total manufacturing petitions in a given year. The denominator inherently controls for all possible trends in protectionist activity in the manufacturing, which allows us to isolate changes in the demand for protection at the NAICS-3 industry level more precisely.

Model 4 shows that our results are robust to these unobserved trends over time in a random effects linear model. We now observe an even more highly significant positive effect of pass-through on the protectionist response to exchange rate appreciations at the 1 percent level, and our import share interaction term is now slightly positive at the 5 percent level. We also observe that the value our "learning rate" parameter λ becomes positive and marginally

statistically significant at the 10 percent level when we switch to using petition shares as our dependent variable. In addition, the positive coefficient on our primary metals control is now substantively and statistically significant, which is consistent with our expectation and yet does not change our main results.

Finally, we can conduct a similar exercise to control for the possibility that our dependent variable is in part determined by unobserved trends in a particular year. While the time-invariant nature of our pass-through component term makes it impossible to explicitly control for industry fixed effects, this does not prohibit us from including year fixed effects. Model 5 retains the specification from our shares model and includes a series of dummy variables representing each year in our panel, whose coefficients are suppressed in the table to conserve space. We observe that this additional robustness check yields essentially identical results. The interaction between the real exchange rate and pass-through remains positive and highly significant at the 1 percent level, suggesting that industries with high pass-through are more likely to file antidumping petitions during periods of currency appreciation. In addition, our import share interaction term retains its positive sign at the 5 percent level, which suggests that industries characterized by high import penetration also exhibit a greater protectionist response to increases in the real effective exchange rate.

5. Conclusions and Implications

Casual observation suggests that some industries demand more trade protection than others. For example, the primary metals manufacturing industry accounts for nearly half of all anti-dumping petitions filed in the United States over the past thirty years. Furthermore, the elasticity of this demand to changes in the exchange rate varies widely across industries. We

presented a framework for identifying the positions and sensitivities of industries to exchange-rate fluctuations and evaluated our conditional hypotheses using industry-specific measures of the demand for protection. We found that greater exchange rate pass-through increases the marginal effect of currency appreciations on the number of anti-dumping petitions filed by manufacturing industries.

Our research moves scholarship on the relationship between exchange rates and trade protection in a new direction. While prior studies have established a basic connection between currency appreciations and increases in overall protection, we disaggregate exchange rates and protectionist demands to the industry level in order to evaluate more precise conditional hypotheses. We also model variation in this elasticity of demand by exploiting certain industry-level characteristics such as exchange rate pass-through, import penetration, and dependence on imported inputs.

Despite these innovations, we note several opportunities for improvement. First, and most importantly, we can improve the precision of our estimates with even more disaggregation of the data. We measure our variables of interest at the 3-digit NAICS level, which classifies industries into just 33 broad categories such as "chemicals," "wood products" and "transportation equipment." These categories group together an enormous diversity of industries, which introduces a great deal of measurement error in our data. Moving towards 6-digit NAICS codes would allow us to expand our panel to 466 distinct industries. However, the Federal Reserve Bank of New York only constructs industry-specific exchange rates for NAICS-3 industries at this time. In addition, our current measures of imported input dependence are still imprecise even after relaxing the import comparability assumption. Future research should take

advantage of new estimates that incorporate data from input-output tables in both the numerator and denominator of this ratio.

In closing, we note that our arguments have implications for the analysis of "currency wars," such as the ongoing conflict over China's policy of accumulating reserves to keep the Renminbi undervalued relative to its market value.[53] In the United States, this policy has provoked a protectionist backlash from certain industries and the U.S. Congress is considering legislation to impose retaliatory trade barriers on China as punishment for its "mercantilist" currency policy.[54] Our arguments suggest that lobbying in support of such protectionist legislation should come mainly from high pass-through industries--those producing standardized goods that compete mainly on the basis of price. In industries where pass-through is high, China's undervaluation policy causes Chinese exports to the United States to become relatively inexpensive, which in turn diminishes the competitiveness of U.S. producers.

Causal observation suggests that our arguments have external validity here. Just as with antidumping filings, the producers that support trade sanctions on China disproportionally represent the primary metals manufacturing industry. According to MapLight.org, a nonprofit research organization that collects data on the influence of money on politics, four of the six industry groups that explicitly voiced support for *The Currency Reform for Fair Trade Act of 2010* (H.R. 2378) were in this sector.[55] They included the American Iron & Steel Institute (which represents U.S. steel manufacturers), the United Steelworkers (representing labor in this industry), the Aluminum Extruders Council (the trade association of the aluminum processing

[53] See Copelovitch and Pevehouse 2011.

[54] For a discussion of the issues facing Congress, see Morrison and LaBonte (2008).

[55] H.R. 2378 provides a mechanism to determine when a foreign country is engaging in currency manipulation and imposes U.S. trade policy remedies to offset the adverse effects of this manipulation. H.R. 2378 passed the House by a roll-call vote of 348-79 on September 29, 2010.

industry) and the Alliance for American Manufacturing (a coalition of manufacturers in metals processing industries).[56] It is noteworthy that industries supporting the legislation belong to the same high pass-through industry that is so heavily overrepresented in anti-dumping petitions. More generally, exchange rates appear to provoke protectionist lobbying only where high pass-through implies a strong negative impact on industry competitiveness.

[56] To identify the positions of industries on H.R. 2378, the research staff at Maplight.org searched public documents, congressional testimony, industry web sites, and news databases. When researchers found an industry group that registered explicit support or opposition to the legislation, they posted the original source material to their website. See http://maplight.org/us-congress/bill/111-hr-2378/876668/contributions-by-vote

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Table 1: Antidumping Petitions and Exchange Rates by Industry

	(1) All Industries	(2) All Industries	(3) Metals	(4) Non-Metals
Real Exchange Rate (MER)	0.013**	0.015**	0.044***	0.009
	(0.006)	(0.006)	(0.012)	(0.006)
Primary Metals		0.592**		
		(0.290)		
Constant	-2.033***	-2.320***	-4.899***	-1.707**
	(0.614)	(0.633)	(1.362)	(0.677)
Observations	660	660	33	627
Groups	20	20	1	19
Model	xtnbreg	xtnbreg	xtnbreg	xtnbreg
Fixed effects	Yes	No	Yes	Yes
P-Value	0.019	0.010	0.000	0.137
Chi-squared	5.505	9.200	12.79	2.214

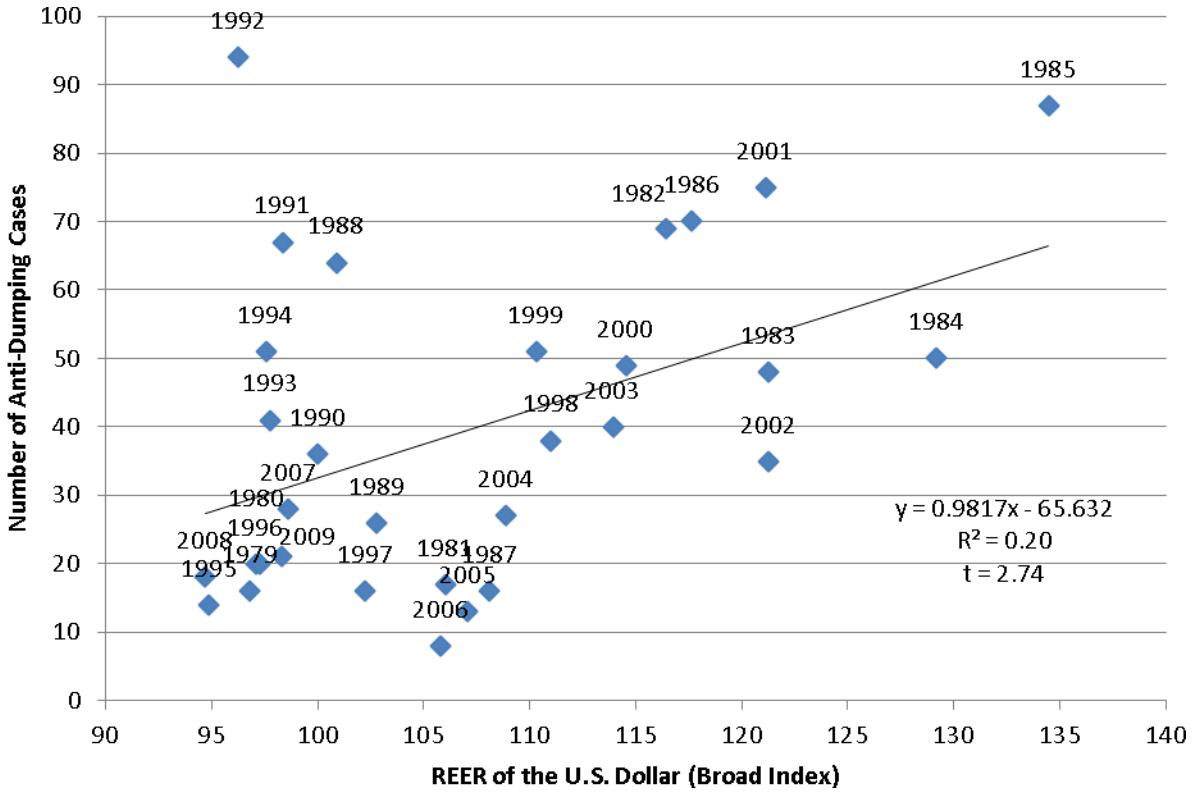
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Determinants of Protectionist Response to Currency Appreciation

	(1) AD Count	(2) AD Count	(3) AD Count	(4) AD Share	(5) AD Share
AD Success Rate (%)	-0.002	-0.000	-0.004	0.061*	0.062
	(0.008)	(0.008)	(0.009)	(0.037)	(0.039)
Real Exchange Rate (MER)	-0.002	-0.061*	-0.073**	-0.374**	-0.428*
	(0.011)	(0.033)	(0.033)	(0.146)	(0.233)
Pass-Through (PT)	0.672*	-6.083**	-6.675**	-37.949***	-39.526**
	(0.390)	(2.755)	(2.734)	(14.545)	(15.704)
Import Share (%)	-0.024	-0.155	-0.209*	-1.044**	-1.077**
	(0.017)	(0.108)	(0.114)	(0.461)	(0.495)
Imported Inputs (%)	0.020	0.169	0.217	1.110	1.236
	(0.016)	(0.239)	(0.239)	(1.370)	(1.428)
MER*PT		0.065**	0.059**	0.376***	0.392***
		(0.027)	(0.026)	(0.138)	(0.151)
MER*Import Share		0.001	0.002	0.010**	0.010**
		(0.001)	(0.001)	(0.004)	(0.004)
MER*Imported Inputs		-0.002	-0.002	-0.010	-0.011
		(0.002)	(0.002)	(0.014)	(0.014)
Primary Metals			0.322	36.181***	35.941***
			(0.604)	(5.287)	(5.682)
Δln(Capacity Utilization)			-2.039	-10.586	-18.160
			(2.130)	(13.701)	(18.668)
Capital-Labor Ratio (%)			0.190***	0.420	0.455
			(0.073)	(0.421)	(0.494)
Concentration Ratio (%)			0.030	-0.035	-0.031
			(0.034)	(0.095)	(0.099)
Constant	-0.072	6.119*	6.816**	38.559**	43.603
	(1.147)	(3.417)	(3.382)	(15.248)	(28.209)
Observations	283	283	283	283	283
Year Fixed Effects	No	No	No	No	Yes
P-Value	0.110	0.013	0.002	0.000	0.000

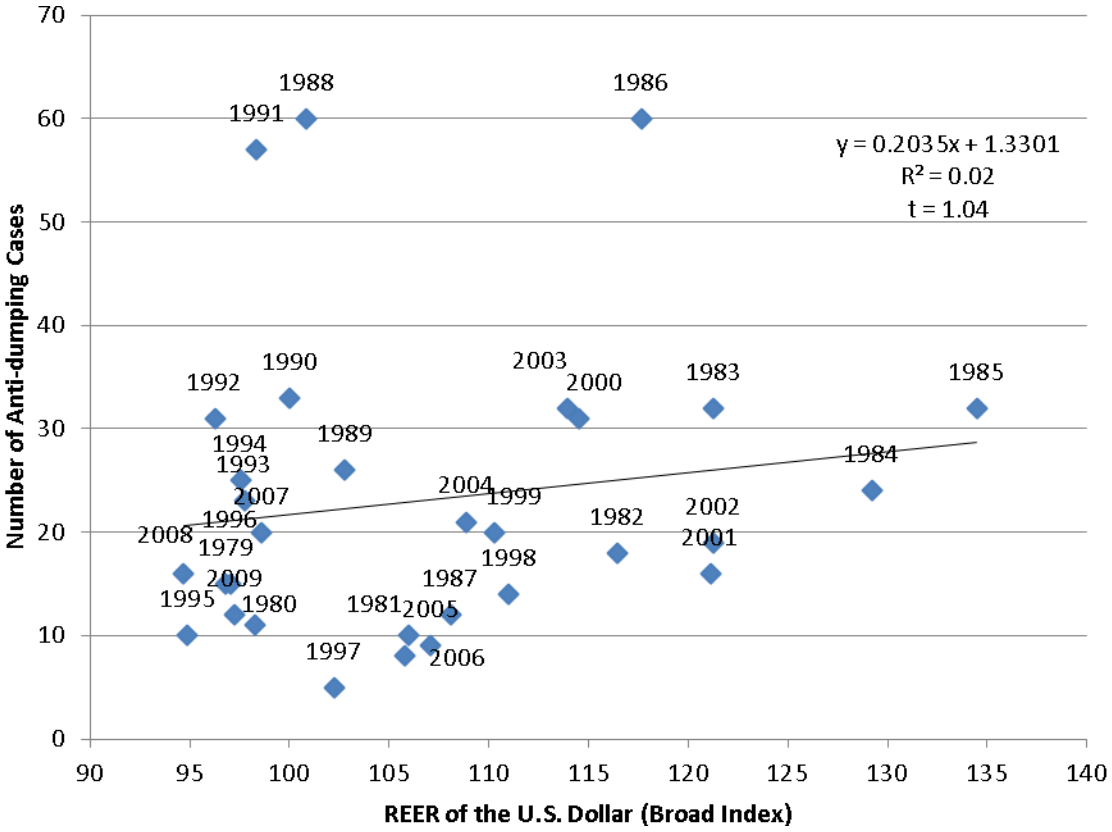
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 1: Exchange Rates and Anti-Dumping Investigations, 1979-2009



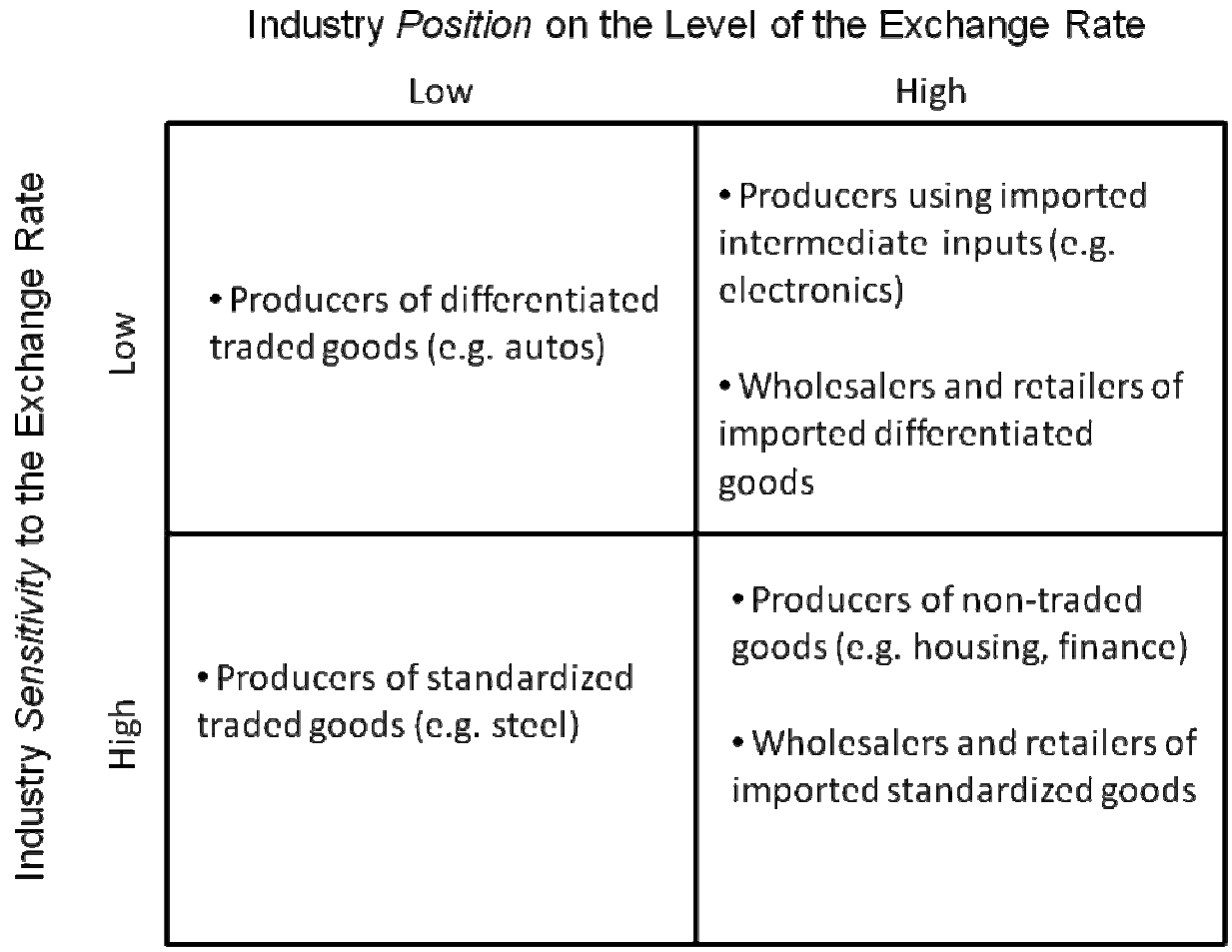
Notes: The figure plots the association between the number of anti-dumping cases investigated by the International Trade Commission and the Real Effective Exchange Rate (REER) of the U.S. dollar. Data on anti-dumping investigations are from Bown (2010). The REER data are from the Federal Reserve Board's "Broad" index. The broad index is a weighted average of the foreign exchange values of the U.S. dollar against the currencies of a large group of major U.S. trading partners. The index weights, which change over time, are derived from U.S. export shares and from U.S. and foreign import shares.

Figure 2: Exchange Rates and Anti-Dumping Investigations, dropping the Primary Metals Manufacturing Industry



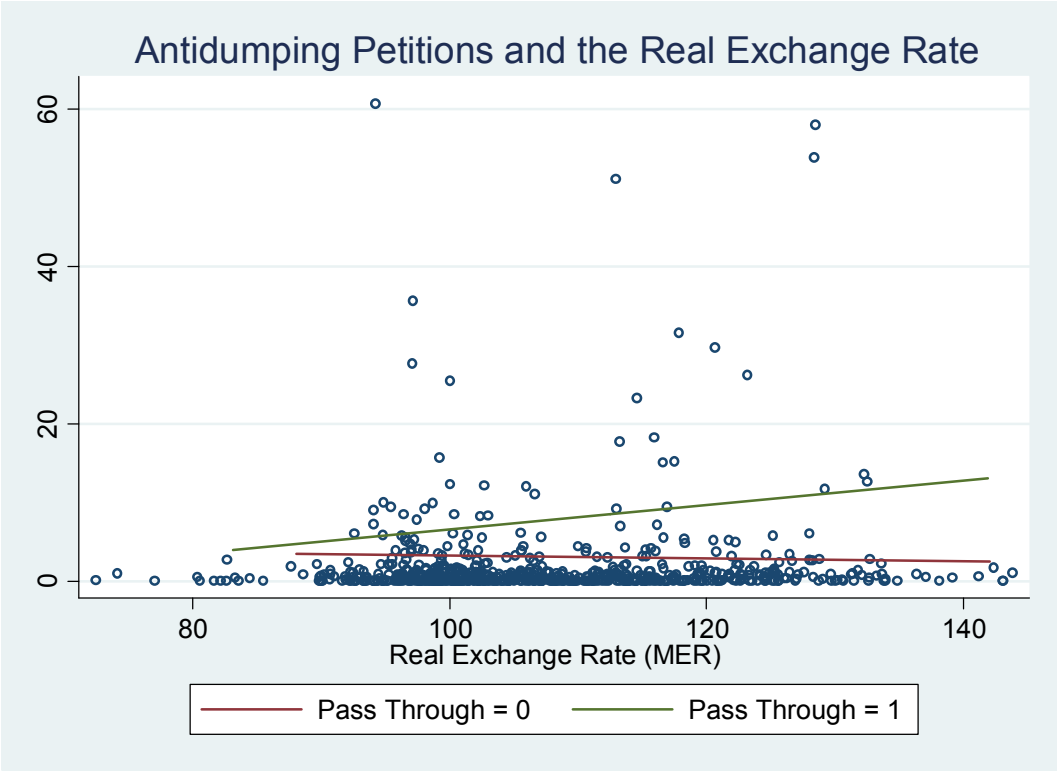
Notes: The figure plots the association between the REER and anti-dumping cases initiated by firms in all industries except the Primary Metals Manufacturing industry (NAICS 331). Data on anti-dumping investigations are from Bown (2010). The REER data are from the Federal Reserve Board's "Broad" index.

Figure 3: Industry Positions and Sensitivities to the Real Exchange Rate



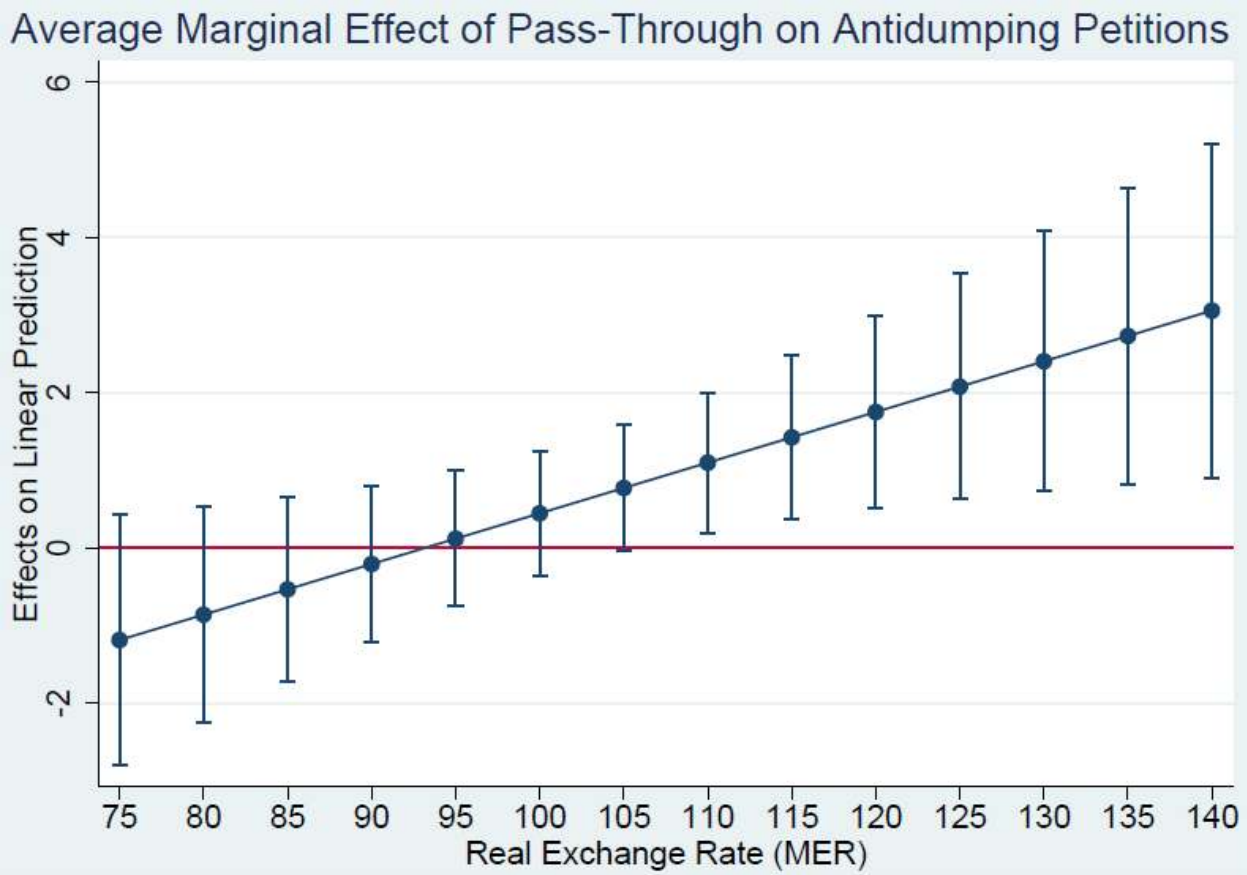
Notes: This figure summarizes the effects of exchange-rates on industries along two dimensions: position and sensitivity. "Position" represents how an industry is affected by the level of the real exchange rate. Industries that benefit when the exchange rate is "high" (appreciated) are located in the east cells of the figure; industries that prefer a "low" (depreciated) exchange rate are positioned in the west cells. "Sensitivity" reflects the degree of pass-through in an industry. Industries that are more sensitive to movements in exchange rates are industries where pass-through is high, i.e., industries producing standardized goods sold in competitive markets on the basis of price.

Figure 4: Scatter Plot with Linear Predictions



Notes: This figure shows the effect of pass-through on the relationship between antidumping petitions and the industry-specific real effective exchange rate. For industries where pass-through is high, the slope is positive, indicating that industry demands for protection rise with levels of the real exchange rate. The slope is essentially flat for industries with low-pass through.

Figure 5: Marginal Effects Plot



Notes: This figure shows that the marginal effect of pass-through increases as the real effective exchange rate appreciates. This effect is statistically significant when the entire confidence interval lies above the zero line, which occurs approximately when the exchange rate is larger than its median value of 106.