Macroeconomic Factors and Anti-Dumping Filings: Evidence from Four Countries

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1. Introduction

The GATT/WTO anti-dumping statute requires two criteria to be met in order to impose duties on foreign suppliers named in anti-dumping suits. First, there must be evidence that the domestic industry has suffered "material injury" as a result of foreign imports. Second, the foreign suppliers must be found to be pricing at "less than fair value" (LTFV). This latter criterion can be determined in either of two ways: (1) by showing that the price charged in the domestic market by the foreign suppliers is below the price charged for the same product in other markets or (2) by showing that the price charged in the domestic market is below an estimate of cost plus a normal return.

The focus of this paper is on how macroeconomic factors in general, and fluctuations in real exchange rates in particular, can affect the determination of each of these criteria. While there appears to be some folk wisdom that a strong domestic currency can precipitate filings, the existing empirical literature reaches

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1

the opposite conclusion.[2] Furthermore, at a theoretical level it is not obvious how real exchange rates will affect filing behavior, given the criteria laid out above. For example, when the domestic currency strengthens, the normal response of foreign firms is to increase the foreign currency price of shipments to the domestic market relative to other destinations, but by less than the appreciation of the domestic currency.[3] An increase in the price of shipments to the domestic market obviously reduces the chance that the foreign firm is guilty of LTFV pricing. Thus, a strong domestic currency makes it less likely that the foreign firm is guilty of LTFV pricing. Using dataset based on U.S. filings from 1980-86 Feinberg (1989) finds support for this relationship.

However, since the price increase in foreign currency units does not typically offset the full effect of the domestic currency appreciation, the domestic currency price of foreign goods will fall. This would be expected to reduce the profits of domestic producers in the same industry by lowering their margins or market share.[4] Thus, a strong domestic currency should increase the likelihood of a

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[2]Feinberg (1989) finds that filings increase with a weaker dollar. However, in its March 26, 1999 *Economic Analyst* publication, Goldman Sachs documents a rise in AD cases associated with an increase in the value of the trade-weighted U.S. dollar.

[3]The relationship between exchange rate fluctuations and destination-specific pricing of exports is known as pricing-to-market behavior. The evidence on pricing-to-market varies by industry (see Goldberg and Knetter (1997)), but the median price response to a real exchange rate change across industries studied in the literature is close to 50%—i.e., half of the movement in the real exchange rate is offset by destination-price adjustment.

[4]Note that the dollar price of imported goods will fall relative to domestic goods with a real appreciation of the dollar provided the foreign firm does not completely offset the relative cost change with a markup change. The special case in which markups are adjusted to fully offset the effects of currency movements is known as "complete Pricing-to-market" in the literature. The opposite case, in which exchange rate changes are fully passed-through to foreign buyers is known as "full pass-through."

finding of material injury to the domestic industry, while a weak dollar would reduce it. This conclusion is inconsistent with Feinberg (1989), but supportive of claims found in the business press.

Fluctuations in economic activity, both in the importing country and the exporting country, might also affect filing decisions. Clearly, a slump in economic activity in the importing country makes it more likely domestic firms perform poorly which may facilitate a finding of material injury. Also, a weak economy in the importing country might naturally lead foreign firms to reduce prices on shipments to the importing country. This could increase the likelihood of pricing below fair value. Thus we would expect that import country GDP will be negatively related to filings. It is less clear how export country GDP is related to filings. One possibility is that a weak foreign economy increases the likelihood that foreign firms will cut prices on exports to maintain overall levels of output. While such behavior might cause injury to domestic firms, it is not clear that it would trigger pricing below "fair value" in the price-based sense, since foreign firms would presumably be lowering prices to all markets (especially their own home market). It is possible, however, that generally low prices would increase the chance of LTFV using the "constructed value" method.

The conventional wisdom on these issues seems to be that the more difficult test to pass for a successful anti-dumping filing (i.e., one that leads to duties being imposed on the foreign firm) is the material injury criterion. For instance, over the past 20 years only 28 of 800 U.S. cases received negative LTFV determinations; by contrast, there have been over 300 negative injury determinations. This

fact might suggest that more anti-dumping cases would be filed when exchange rates or output fluctuations improve the odds of an affirmative material injury decision—i.e., when the domestic currency is strong in real terms or when the domestic country is in recession. However, the exact relationship will depend on the sensitivity of prices and profits to exchange rates changes and the correlation between exchange rates and other macroeconomic variables, in addition to the way in which the criteria are implemented. It is therefore an empirical issue.

Our goal is to determine the relationship between filings, real exchange rates, and economic activity. First, we develop a model that links currency fluctuations and other macro factors to the criteria for dumping. Then, we investigate the empirical relationship between filings and macro factors since 1980 for four of the primary AD users (Australia, Canada, the European Union, and the U.S.) in order to evaluate the theory. We believe systematic evidence that macro factors are related to filings would be further ammunition for the view that anti-dumping law is a tool of protectionism that is frequently abused. While fluctuations in real GDP and real exchange rates are certain to affect industry equilibria, they are unlikely to be systematically associated with malevolent behavior by foreign firms. A finding that dumping allegations are related to macro factors would seem to suggest that foreign firms are potentially being held responsible for the impact of factors beyond their control.[5]

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[5]This view is echoed in the Goldman Sachs *Economic Analyst* which claims that "the correlation between the number of AD cases initiated and the change in the GS trade-weighted dollar index suggests that domestic producers have been seeking protection against adverse market conditions, not against anti-competitive dumping."

2. The Model

This section will setup a two-period duopoly model that identifies how AD law complicates the foreign firm's pricing decision. We begin by assuming that there are two firms, one domestic and one foreign. In each period, the firms produce differentiated products that are close, but not perfect, substitutes for one another. The domestic firm services the domestic market with local production while the foreign firm exports to the domestic market.

For simplicity we will ignore the foreign firm's behavior in its own home market. This assumption can be justified on two grounds. First, it avoids needless complication without much cost. As we show in an appendix, the difficulties created by AD law on pricing-to-market behavior are present whether or not the foreign market is explicitly modeled. Second, in the majority of AD investigations the foreign firm's home market pricing is not directly relevant to the investigation. This is the case, for instance, when a constructed value approach is used to calculate the LTFV margin.[6] When home market sales are too small (or do not exist), or when the exporter operates in a centrally planned economy, the dumping calculation will be based on sales of a comparable product sold by a third party in another market. In all these circumstances the home market price used in the AD investigation is largely outside the control of the foreign firm.

As discussed by McKinnon (1979) and Giovannini (1988) the foreign firm faces

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[6]Clarida (1992) reports that about two-thirds of US AD cases use the constructed value method. Messerlin (1989) reports an even higher percentage of EU cases use the constructed value method.

a decision as to which currency to use when announcing its price. We will not analyze that problem here, but rather follow Feenstra (1989) and assume that the foreign firm sets its price in the domestic currency and then uses the exchange rate to convert into foreign currency units. Let e_t denote the bilateral exchange rate at time t, expressed as foreign currency to domestic currency. Let q_t (p_t) denote the foreign (domestic) firm's price and $y(q_t, p_t)$ ($x(q_t, p_t)$) denote the foreign (domestic) firm's quantity in period t, $t = 1, 2$. Let $\varphi(X_t(\cdot))$ and $\phi(x_t(\cdot))$ denote the foreign and domestic firms' costs of production.

If AD duties are not present, the domestic firm will earn profit $\pi_t(q_t, p_t)$, and the foreign firm will earn $\Pi_t(q_t, p_t, e_t)$,

$$\pi_t(q_t, p_t) = p_t x(q_t, p_t) - \phi(x(q_t, p_t)) \tag{1}$$

$$\Pi_t(q_t, p_t, e_t) = e_t q_t y(q_t, p_t) - \varphi(y(q_t, p_t)) \tag{2}$$

It is important to realize that π is denominated in the domestic currency while Π is denominated in the foreign currency.

When firms compete under the specter of AD law, the foreign firm's pricing decision is complicated by the LTFV and injury determinations. We will say that the foreign firm has sold at LTFV if its price in the domestic market during the first period is less than some benchmark price (denominated in the foreign currency). In other words, LTFV sales are said to occur if $e_1 q_1 < q_H$, where we are implicitly assuming that the benchmark price is calculated using the constructed value method.

At this point we will assume that both the domestic and foreign firms only know the general rules by which q_H is constructed. In other words, the distribution governing q_H, $F(\cdot)$, is common knowledge. We also assume that $F(\cdot)$ is twice-continuously differentiable on support $[0, \overline{q}]$. The probability of a LTFV determination can be written as

$$\rho^L(q_1, e_1) = \text{Prob}(e_1 q_1 < q_H) = \int_{e_1 q_1}^{\overline{q}} F'(x)\, dx.$$

An injury determination must also be made before duties can be levied. For simplicity, we will say that the domestic firm has been injured if $\pi_1(q_1, p_1) \leq \pi^I + \mu$. In other words, we interpret the injury criterion as establishing a minimum profit level, π^I. However, factors beyond the firms' control—the political environment, the general state of the economy, etc.—create a random component to the injury decision, μ, which we assume is drawn from a twice-continuously differentiable distribution $G(\cdot)$. We assume that $G(\cdot)$ is common knowledge and has zero mean. Thus, the probability that injury occurs is

$$\rho^I(q_1, p_1) = \text{Prob}(\pi_1(q_1, p_1) \leq \pi^I) = \int_{\pi_1(q_1, p_1) - \pi^I}^{\infty} G'(x)\, dx.$$

The timing of play is as follows: (1) The exchange rate, e_1 is realized; (2) firms announce their first period prices; first period sales and profits are realized. (3) If it desires, the domestic firm can initiate an AD investigation at a cost of C. (4) If a petition is initiated, the government determines whether or not both criteria

7

are satisfied and announces its decision. (5) The exchange rate, e_2 is realized; (6) If dumping is found, a dumping duty charged; in a manner consistent with current WTO rules, we will model the dumping order as establishing a minimum price, below which the foreign firm cannot sell in the domestic market. We will denote this price as q_D; the foreign firm collects only q_1. If dumping is not found, the firms simply announce their second period prices; (7) second period sales and profits are realized.

Equilibrium Pricing and Pricing-to-Market without Antidumping Law

Without the threat of AD the firms simply maximize their profit in each period. Letting δ denote the common discount factor we can write the firms' objectives as

$$\max_{\{p_1,p_2\}} \pi = \pi_1(q_1, p_1) + \delta \pi_2(q_2, p_2), \tag{3}$$

$$\max_{\{q_1,q_2\}} \Pi = \Pi_1(q_1, p_1, e_1) + \delta \Pi_2(q_2, p_2, e_2). \tag{4}$$

The first order conditions can be written as

$$\frac{\partial \pi_t}{\partial p_t} = x(q_1, p_1) + p_t \frac{\partial x}{\partial p_t} - \phi'(\cdot) \frac{\partial x}{\partial p_t} = 0, \tag{5}$$

$$\frac{\partial \Pi_t}{\partial q_t} = e_t y(q_1, p_1) + e_t q_t \frac{\partial y}{\partial q_t} - \varphi'(\cdot) \frac{\partial y}{\partial q_t} = 0. \tag{6}$$

We will assume that the second order conditions are satisfied and that there exists a unique, stable Nash equilibrium in this benchmark scenario and that in

8

equilibrium both firms' prices and output are strictly positive.[7] Let $(\tilde{q}_t(e_t), \tilde{p}_t(e_t))$ denote the Nash equilibrium prices and let the domestic and foreign best response functions be denoted as $\beta(q_t)$ and $\beta^*(p_t, e_t)$, respectively.

Totally differentiating the first order conditions we can derive the effect of the first period exchange rate on the firms' first period prices:

$$\begin{bmatrix} \frac{dp_1}{de_1} \\ \frac{dq_1}{de_1} \end{bmatrix} = \frac{1}{D} \begin{bmatrix} -\frac{\partial^2 \Pi_1}{\partial q_1^2} & \frac{\partial^2 \pi_1}{\partial p_1 \partial q_1} \\ \frac{\partial^2 \Pi_1}{\partial q_1 \partial p_1} & -\frac{\partial^2 \pi_1}{\partial p_1^2} \end{bmatrix} \begin{bmatrix} \frac{\partial^2 \pi_1}{\partial p_1 \partial e_1} \\ \frac{\partial^2 \Pi_1}{\partial q_1 \partial e_1} \end{bmatrix},$$

where $D > 0$ denotes the determinant of the Hessian matrix.

Of most interest is the elasticity of the foreign firm's price with respect to the exchange rate:

$$\frac{dq_1}{de_1}\frac{e_1}{q_1} = \frac{1}{D}\left[\frac{-\partial^2 \pi_1}{\partial p_1^2}\right]\left[\frac{q_1 e_1^2(1+\eta)^2}{\varphi'(\cdot)\eta}\right] < 0, \tag{7}$$

where $\eta = q_t/y(\cdot)\partial y/\partial q_t$ is the foreign firm's own price elasticity of demand.

The latter is the typical pass-through result found in the literature (Feenstra, 1989; Knetter, 1989) and it implies that when the domestic currency appreciates, the foreign firm lowers its domestic currency price. Feenstra established conditions where the pass-through is less than one-for-one, which implies that that the foreign firm's price *rises* in terms of foreign currency.

We should point out this result does not depend on the assumption about which currency the foreign firm sets its price. If we suppose instead that the

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[7]Friedman [1983] discusses the sufficient conditions for these conditions to hold. In particular, assume that profit functions are twice-continuously differentiable and strictly concave in their own price, and that the best response functions are contractions.

foreign firm set its price in its home currency, then the above result implies that the an appreciation of the domestic currency will raise its foreign currency price. And, if Feenstra's conditions hold (i.e., less than full pass-through) then the price of the foreign good in terms of the domestic currency *falls*.

Equilibrium Pricing and Pricing-to-Market with Antidumping Law

In general, the threat of an AD action implies that the strategy of simply maximizing profit on a period-by-period basis will not be optimal. Rather, first period pricing decisions influence second period profit.

We therefore need to solve the model recursively. At the beginning of period two, firms know whether duties have been levied. If duties have not been levied, the firms' simply maximize second period profits, just as they did without AD law. Denote this equilibrium as $\{\tilde{q}_2, \tilde{p}_2\}$. In this case, the firms will earn $\pi_2(\tilde{q}_2, \tilde{p}_2)$ and $\Pi_2(\tilde{q}_2, \tilde{p}_2, e_2)$, respectively.

If, on the other hand, dumping has been found, the domestic government requires the foreign firm's price equal q_D. In this case, the domestic firm sets a price $p_D = \beta(q_D)$ and will earn profits $\pi_2(q_D, p_D)$.

The domestic firm's gain when AD duties are imposed can be expressed as

$$\Delta(q_D) \equiv \pi_2(q_D, p_D) - \pi_2(\tilde{q}_2, \tilde{p}_2) > 0. \tag{8}$$

Recall that when dumping duties are levied the foreign firm collects only q_1

10

per unit. Thus, the foreign firm's expected loss is

$$\Gamma(q_D, e_2) \equiv \Pi_2(q_D, p_D, e_2) - e_2(q_D - q_1)y_2(q_D, p_D) - \Pi_2(\tilde{q}_2, \tilde{p}_2, e_2) < 0. \qquad (9)$$

For the moment, we will assume that the domestic firm finds it profitable to file an AD petition. In this case, we can write the AD law-distorted two-period expected profit functions as

$$\pi(q_1, p_1) = \pi_1(q_1, p_1, e_1) + \delta \left\{ \pi_2(\tilde{q}_2, \tilde{p}_2) + \rho^I(\cdot)\rho^L(\cdot)\Delta(q_D) - C \right\}, \qquad (10)$$

$$\Pi(q_1, p_1, e_1, e_2) = \Pi_1(q_1, p_1, e_1) + \delta \left\{ \Pi_2(\tilde{q}_2, \tilde{p}_2, e_2) + \rho^I(\cdot)\rho^L(\cdot)\Gamma(q_D, e_2) \right\}. \qquad (11)$$

The first order conditions are

$$\frac{\partial \pi(\cdot)}{\partial p_1} = \frac{\partial \pi_1(\cdot)}{\partial p_1} \left[1 + \delta \rho_1^I(\cdot)\rho^L(\cdot)\Delta(q_D) \right] = 0 \qquad (12)$$

$$\frac{\partial \Pi(\cdot)}{\partial q_1} = \frac{\partial \Pi_1(\cdot)}{\partial q_1} + \delta \left[\Gamma(q_D, e_2) \left(\rho^L(\cdot)\frac{\partial \rho^I(\cdot)}{\partial \pi_1}\frac{\partial \pi_1(\cdot)}{\partial q_1} + \rho^I(\cdot)\frac{\partial \rho^L(\cdot)}{\partial q_1}e_1 \right) \right]$$

$$+ \delta \rho^I(\cdot)\rho^L(\cdot)e_2 y_2(q_D, p_D) = 0 \qquad (13)$$

The conditions can be interpreted as follows. In both equations the first term is the marginal change to first period profit while the bracketed expression is the net effect of a price change on second period profit. When the firms myopically maximize their first period profits, as they do without AD law, the prices are chosen so that the first term (in each equation) equals zero, as seen in (5)–(6).

For the domestic firm, simply maximizing first period profit (i.e., setting $p_1 =$

$\beta(q_1))$ is always a solution to (12). Since our focus in this paper is the effect of AD on pricing-to-market behavior, we will assume that this is indeed the unique outcome.[8]

By contrast, simply maximizing first period profits cannot be a solution for the foreign firm. Altering its first period price directly impacts both the LTFV and injury determination. In particular, an increase in the first period price decreases both the probability of injury and LTFV sales. An increase in the first period price also reduces the second period loss if duties are imposed. All three effects lead the foreign firm to announce a higher first period price than it would without AD law. In other words, letting $\beta_d^*(p_1, e_1)$ denote the foreign firm's best response function with AD law, we know that $\beta_d^*(p_1, e_1) \geq \beta^*(p_1, e_1)$.

We will once again assume that the second order conditions are satisfied, that there exists a unique, stable Nash equilibrium in this AD-distorted scenario and that in equilibrium both firms' prices and output are strictly positive. Let $(\hat{q}_1(e_1), \hat{p}_1(e_1))$ denote the Nash equilibrium prices.

Totally differentiating (13) and (12) we can derive the effect of the first period exchange rate on pricing:

$$
\begin{bmatrix} \frac{dp_1}{de_1} \\ \frac{dq_1}{de_1} \end{bmatrix} = \frac{1}{H} \begin{bmatrix} -\frac{\partial^2 \Pi}{\partial q_1^2} & \frac{\partial^2 \pi}{\partial p_1 \partial q_1} \\ \frac{\partial^2 \Pi}{\partial q_1 \partial p_1} & -\frac{\partial^2 \pi}{\partial p_1^2} \end{bmatrix} \begin{bmatrix} \frac{\partial^2 \pi}{\partial p_1 \partial e_1} \\ \frac{\partial^2 \Pi}{\partial q_1 \partial e_1} \end{bmatrix},
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where $H > 0$ denotes the determinant of the Hessian matrix.

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[8]In a related paper, Prusa (1994) establishes conditions when $p_1 = \beta(q_1)$ is the unique equilibrium response. The unusual outcome is when the domestic firm deliberately lowers first period profit in order to increase the probability of an affirmative injury determination.

Now, solving for the effect of the exchange rate on first period pricing:

$$
\frac{dq_1}{de_1} = \frac{1}{H}\left(\frac{-\partial^2\pi}{\partial p_1^2}\right)\left(\frac{\partial^2\Pi_1}{\partial q_1\partial e_1} + \delta\left[\rho^I(\cdot)\frac{\partial\rho^L(\cdot)}{\partial e_1}q_1 e_2 y(q_D, p_D)\right]\right.
$$
$$
\left. + \delta\Gamma(\cdot)\left[\left\{\frac{\partial\rho^L(\cdot)}{\partial e_1}\frac{\partial\rho^I(\cdot)}{\partial\pi_1}\frac{\partial\pi_1(\cdot)}{\partial q_1}q_1\right\} + \rho^I(\cdot)e_1\frac{\partial^2\rho^L(\cdot)}{\partial q_1\partial e_1} + \left\{\rho^I(\cdot)\frac{\partial\rho^L(\cdot)}{\partial q_1}\right\}\right]\right)
$$

$$(14)$$

From (7) we know that $\frac{\partial^2\Pi_1}{\partial q_1\partial e_1} < 0$. The first square bracketed term measures the impact that *if duties are levied* a higher first period price generates higher second period revenue (because the firm pays lower duties). This term is negative, reflecting that the higher exchange rate lowers the probability of a LTFV determination and thus allows more pass through.

The second square bracketed term is where the ambiguity appears. It can be either positive or negative. Recall that $\Gamma(\cdot) < 0$ so the second bracketed term is the change in the probability of the foreign firm loss. The first curly bracketed term captures that the foreign firm's incentive to raise its price in order to reduce the chance of injury ($\frac{\partial\rho^I(\cdot)}{\partial\pi_1}\frac{\partial\pi_1(\cdot)}{\partial q_1} < 0$) is attenuated by the fact that the exchange rate appreciation reduces the chance of LTFV ($\frac{\partial\rho^L(\cdot)}{\partial e_1} < 0$). In effect, in terms of the LTFV determination the exchange rate appreciation allows the foreign firm to lower its price. The second curly bracketed captures the direct effect of a higher price on the LTFV determination. In general, either effect can dominate.

The domestic firm may not, of course, choose to file an AD petition. It will

file a petition if

$$\rho^I(\cdot)\rho^L(\cdot)\Delta(q_D) - C.$$

For some industries the expected payoff from filing will not exceed the costs.

An increase in either $\rho^I(\cdot)$ or $\rho^L(\cdot)$ will increase the return to filing. In the case of incomplete pass-through, an appreciation of the exchange rate increases the chance of injury and lowers the chance of LTFV. If the outcome of AD cases tend to hinge on the injury test then we would expect filings to be associated with strong domestic currency. If, on the other hand, the the LTFV test tends to be the crucial determination, then we would expect filings to be associated with weak domestic currency. We now proceed to empirically investigate the issue.

3. Data

To investigate the relationship between antidumping filings and macroeconomic conditions, we collected data on AD filings by the four largest users: Australia, Canada, the United States, and the European Union. The filing data is available from the GATT/WTO annual reports.

These four users accounted for more than two-thirds of all AD actions filed worldwide since 1980. For each of these four reporting regions (henceforth referred to as "reporting" or "filing" countries), we have aggregate filing data on an annual basis from 1980-98.[9] For each filing, we know the filing country, the industry, the country named in the filing (i.e., the defendant), and the ultimate determination

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[9]Changes in antidumping law in 1979 preclude us from using filing data prior to 1980.

(injury or no injury).

Figures 1 and 2 display the number of filings by filing country for our 1980-98 sample period. Figure 1 is total filings, while Figure 2 excludes filings made by the steel industry, which is generally viewed to be unique in terms of its proclivity to file a large number of cases. The figures show there is considerable variation in the number of filings from year-to-year. Furthermore, it is clear that filings are related to the business cycle, especially for the United States and Australia. The recessions that began in the early 1980s and early 1990s (the only two in our sample) are associated with large spikes in the number of filings.

The level and variation of filings across filers is also summarized in Table 1. Adjusting for the fact that Australia did not file cases early in the sample, it is the heaviest filer of the four regions. This is surprising given that it is the smallest of the four countries by a fairly large margin (e.g., Canada has a population about 50% greater than Australia, while the U.S. and EU are about 10 times the size of Canada.)

The International Monetary Fund *International Financial Statistics* CD-ROM provided real GDP data for both the filing countries and the named countries. In our empirical testing we perform tests using both aggregate filings and also the number of filings against individual countries. For the aggregate filing behavior, we use the real effective exchange rate index (based on labor costs) for the filing country as reported by the IMF. In our examination of filings against individual foreign countries (i.e., "bilateral filings"), we used bilateral real exchange rates between each of the four filing countries and each country named in at least

one anti-dumping case since 1980. The Economic Research Service of the U.S. Department of Agriculture was a convenient source for bilateral real exchange rates since they report exchange rates in a consistent fashion for virtually all countries in the world.

4. Empirical Specification and Results

The theoretical model motivates how filings might be affected by real exchange rates, filing country GDP, and rest of world GDP. The dependent variable in our econometric work will be the number of filings (and for robustness, sometimes number of filings excluding steel-an industry with an unusually large amount of filing activity) occurring in a year.

Since the number of filings is a non-negative count variable, we will estimate the relationship between number of filings and macroeconomic factors using Poisson and Negative Binomial regression as well as OLS, with the belief that the Poisson or Negative Binomial regression is probably more appropriate given the nature of the data.

The Poisson regression model assumes that the incidence rate v (the rate per unit time at which happenings occur) is a function of some underlying variables as follows:

$$v_j = e^{\beta_0 + \beta_1 x_{1j} + \beta_2 x_{2j} + \cdots + \beta_k x_{kj}}$$

The expected number of occurrences is equal to this incidence rate multiplied by the exposure (the number of units of time over which observations are mea-

sured). The exposure is uninteresting in our case since each observation in the data set is the number of AD filings in a one year interval. We believe that the incidence rate is a function of GDP growth in the home and foreign countries, the real exchange rate, and possibly other factors. This Poisson regression is estimated by maximum likelihood.

One feature of the Poisson model that is frequently violated in potential applications is the equivalence of the expected value and variance of a Poisson random variable. Often, count data exhibit overdispersion with respect to the Poisson model—i.e., the variance of the observed counts exceeds their mean. This is certainly true regarding the data reported in Table 1. In such cases, an alternative is to assume that the data are generated by a negative binomial random variable, which allows for a variance that is greater than the expected value of the distribution. While we will base most of our conclusions on the negative binomial (NB) regression model, all models yield similar results in terms of the statistical and economic significance of the macroeconomics factors on AD filings.

In addition to method of estimation, another important specification issue is the lag structure of the regressors. The legal framework for determining LTFV and material injury offers some guidance here. Pricing behavior is analyzed over the year prior to the filing of the case in order to assess LTFV. Injury is determined over the three years preceding the filing. Given these features of the law, it seems plausible to consider lags from one to three years for our variables. Because we suspect filing country real GDP growth is likely to be most important for the material injury criterion, we will use the growth of real GDP over the three years

17

prior to filing in our initial estimates. We will begin with a one-year lag on the real exchange rate in initial specifications (since we conjecture that exchange rates may be more important for LTFV which is assessed over the one year period), but will experiment with other lag structures as well.

Our empirical findings are presented for several different data sets: annual data on aggregate filings, quarterly data on aggregate filings, and annual data on U.S. filings against individual foreign countries. We present and discuss the findings for each data set separately.

Annual Data on Aggregate Filings

Our first set of results is based on the annual number of filings for each of our four reporting units (Australia, Canada, EC, and US). We estimate the number of filings as a function of the real exchange rate, domestic real GDP growth, and rest of world real GDP growth using OLS, Poisson, and NB regression.

Table 2 reports the results of OLS estimation when the data from all four countries are pooled in a single regression. We experiment in different specifications with the set of independent variables and the lag structure used for the real exchange rate and the real GDP variables. In all specifications, the real exchange rate is statistically significant at the 1% level. The positive sign implies that filings increase as the currency of the filing country strengthens against its trading partners. The range of values of the point estimates for the exchange rate response across these specifications is from 45-55. This implies that a 100% real appreciation (a unit increase in the log of the real exchange rate) of the filing

country's currency would be expected to generate an additional 45-55 AD filings in the following year.

Our other macro factors, growth in filing country real GDP and growth in rest of world GDP, have a more ambiguous relationship with AD filings. When filing country real GDP is added to a model with real exchange rates and filing country dummy variables, we find a statistically significant negative relationship, which is what we would expect. For each percentage point decline in real GDP growth between $(t-3)$ and (t), we expect slightly more than three additional filings in year t. However, when we add world real GDP growth (defined over the same interval) to this regression, neither GDP variable is statistically significant, although both have a negative sign. Other regressions experiment with changing the window over which the exchange rate variable and GDP variables are defined, but these modifications do not alter the basic finding about the impact of real exchange rates. When we use only the most recent year's growth in real GDP, world GDP growth is negative and significant at the 5% level, suggesting that weak economic conditions outside of the filing country may precipitate more alleged dumping.

As noted earlier, OLS is not the appropriate method for analyzing the count data on AD filings. Table 3 reports the results of the Poisson regression. In these tables, we report "incidence rate ratios" associated with the parameter estimates. The incidence rate ratio (IRR) is the ratio of the number of counts predicted by the model when the variable of interest is one unit above its mean value and all other variables are at their means to the counts predicted when all variables are at their means. Thus, ((IRR-1)*100) gives the percentage increase in counts for

19

a one unit increase in the variable of interest around the mean of all variables in the model. If the IRR for the real exchange rate is 1.50, then a one unit increase in the real exchange rate (a 100% real appreciation given that we use the log of the real rate) would increase counts by 50%.

Our findings regarding the impact of real exchange rates on AD filings are qualitatively the same using the Poisson regression as they were using OLS. In every specification, the real exchange rate is statistically significant at the 1% level. The range of IRR values associated with the exchange rate coefficients suggest that the count of AD filings increase anywhere from 240% to 355% in response to a 100% real appreciation of the currency of the filing country. Given a mean number of annual filings around 32, this implies between 77 and 114 additional filings due to a 100% real appreciation. This is a greater quantitative impact than we found using OLS.

The ambiguity we witnessed regarding the impact of real GDP growth on filings is less apparent in the Poisson model. Filing country real GDP growth over the three-year interval corresponding to the period over which material injury is assessed is negatively and significantly (at the 1% level) related to filings, whether or not world real GDP growth is included.[10] A one percentage-point decline in the three-year real GDP growth of the filing country leads to a 7-10% increase in the number of filings. A one percentage-point decline in the three-year world real GDP growth leads to an 8-11% increase in the number of filings (both estimates

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[10]Note that IRR values less than 1.0 imply a negative relationship between a variable and filing counts.

are significant at the 5% level). When we examine one-year real GDP growth variables, we note that filing country real GDP growth has no significant effect, but that world growth is negatively related to filings and is significant at the 1% level.

Although the Poisson model seems more intuitively appealing than OLS as a way to analyze the count data on filings, the goodness of fit statistics show that we can reject that the data obey the Poisson distribution at the 1% level for each model. Usually this is a result of "overdispersion" of the data—i.e., the variance of the counts exceeds the mean. This seems to be the case for the AD filings. Consequently, we consider an alternative count data model, the negative binomial (NB), that is similar to Poisson but does not constrain the relationship between mean and variance.

The results of estimating the NB model are presented in Table 4. Once again, rather than report the coefficient estimates themselves, we report the IRR associated with each estimate. The first point to note is that IRR associated with the real exchange rate estimates using the NB model are very similar to those obtained using Poisson. They are all statistically significant at the 1% level and have magnitudes that are very close to those obtained using the corresponding Poisson model. Clearly, the aggregate filing data suggest that AD filings increase substantially when the filing country currency strengthens in real terms, which contrasts with Feinberg's (1989) result that U.S. filings rise with a weakening currency.[11]

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[11]Feinberg uses quarterly data from 1982-87 for U.S. filings against Korea, Mexico, Brazil,

Since our findings in Tables 2–4 are based on pooling all data on AD filings across our four filing countries, it is of interest to see how these effects hold up for various subsets of the universe of cases. In particular, we are interested in whether our findings hold for filings outside the steel industry (the steel industry files a large fraction of U.S. and Canadian cases). When we exclude steel cases from the data, we find that the statistical significance of the real exchange rate effects is similar and the economic significance (given by the magnitude of the IRR in NB regression) is much greater. The results are reported in Table 5. The real GDP growth effects become insignificant (although the point estimates are still negative) when steel cases are excluded from the data. The impact on exchange rates and GDP from excluding steel suggests that AD filings in steel are heavily influenced by the business cycle, but not so much by exchange rates.

In Table 6 we report results on aggregate filings, both including and excluding steel cases, in regressions that include a filing-country specific real exchange rate effect. This allows us only 19 annual observations with which to detect a relationship, and more importantly, only a few big swings in the real exchange rate series for each filing country. Here we find that Australia has by far the most pronounced exchange rate effect. The IRR values exceed 50 in some cases and the coefficients are significant at the 1% level. The U.S. results depend on whether steel cases are included or not. With steel included, the IRR is between 2 and 2.5, but the marginal significance level is never below 11%. When steel cases are

excluded, the U.S. IRR exceeds 10 and the estimates are significant at the 1% level. Canada and the EU are never close to being statistically significant and the IRRs tend to be quite small. Part of the problem may be the limited number of observations, which we can rectify by examining filings by "affected country" (i.e., those countries of firms named in a suit as "defendants") for each of our filing countries.

Annual Data on Bilateral Filings

In constructing the database with filings broken down by affected country, we lost a very small number of observations due to the inability to construct real exchange rates over the sample period. Most of the cases involved countries that were part of the former Soviet Union. Once these observations were eliminated, we had a panel dataset with 4 filing countries, 48 affected countries (each was named in at least one case by at least one of our filing countries), and 19 years. We model the number of cases against an affected country by a filing country in each year as a function of the bilateral real exchange rate, filing country real GDP growth, and affected country real GDP growth. Following the findings with aggregate filing data, we apply the negative binomial regression model to the data.

The main results are presented in Table 7. When we estimate a common response to exchange rates across all filing countries, we find the real exchange rate variable is significant at the 1% level in all models, with an IRR ranging from 2.78 to 3.34. When we allow for a filing-country specific response to the real exchange rate (all country dummies and real GDP growth are included), we find that the

real exchange rate impact is significant at the 10% level for Canada (with an IRR of 1.87) and at the 1% level for the U.S. (IRR equal to 1.94), the EU (IRR equal to 5.03) and Australia (IRR equal to 6.49). The increased detail of the observations has the greatest impact on our results for the EU, which with the aggregate data showed no sign of increased filings when the trade weighted real exchange rate appreciated. In the bilateral data, it is clear that filings rise systematically against countries whose real exchange rates have depreciated against the countries of the EU.

In the bilateral filings database, it is also apparent that filing country real GDP growth is negatively and significantly related to the number of filings. In the model with a full set of country dummies and a common real exchange rate response, we find that a one percentage-point decrease in filing country three-year real GDP growth leads to a 3% increase in the number of filings. Adding real GDP growth of the affected countries does nothing to alter this estimate. Affected country real GDP growth itself has an insignificant effect on the number of filings. Using one-year real GDP growth rates yields a similar result.

If we exclude the steel cases, once again the real exchange rate impacts increase in importance while filing country real GDP growth remains negatively and significantly related to the number of filings. Adding filing-country specific real exchange rate responses and including the real GDP growth variables in the data without steel cases, we find that the real exchange rate effect becomes insignificant for Canada, but remains significant at the 1% level for each of the other three countries (IRR values of 2.4 for the U.S., 4.4 for the EU, and 7.2 for

Australia). As with the whole data set, filing country real GDP growth is negatively and significantly related to filings, while affected country real GDP growth is insignificant.

The more robust link between filings and macro factors (especially for filing-country specific responses to exchange rates) is no doubt attributable to the increased number of observations in the bilateral data and the reduction in noise associated with the real exchange rate. The latter results from the fact that the real exchange rate is matched to a specific affected country, rather than being a trade-weighted average rate as it was for the aggregate filings regressions.

5. Conclusion

Anti-dumping suits have become an increasingly popular form of protection for firms engaged in international markets. This paper has shown how macroeconomic factors, such as fluctuations in real exchanges, can influence the probability of affirmative findings for the LTFV and material injury criteria. With regard to real exchange rates, in theory the effect is ambiguous. A currency change that increases the likelihood of injury will typically reduce the likelihood of LTFV. Which effect dominates is an empirical matter.

Our empirical work using data on AD filings from Australia, Canada, the European Union, and the United States shows that a real appreciation of the filing country's currency will lead to a significant increase in AD filings. This result is at odds with existing research on the subject, but is robust to the method of

estimation, to the inclusion of other macroeconomic variables such as real GDP growth, and to the elimination of steel cases in the filing data. The result is strongest when we examine bilateral filings. The magnitude of the effect is roughly that a 100% appreciation of the filing country currency will lead to a 200% increase in filings. We also find in most specifications that filing country and foreign country GDP growth are negatively related to filings.

Overall, the empirical link between macroeconomic factors and filings suggests that AD filings are driven to a significant degree by factors that are beyond the control of foreign firms. This casts doubt on the fairness of AD law.

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Table 1. Mean and Standard Deviation of Filings by Source Country, 1980-98

	Avg. Filings Per Year	Std. Dev.
Australia*	41	24
Canada	23	15
EC	30	9
USA	39	19

*1982-98

Table 2. OLS Estimation of Aggregate Filings

Model	(1)	(2)	(3)	(4)	(5)	(6)
Constant	33.10	41.00	54.70	59.30	56.90	50.60
	(16.20)	(10.40)	(9.34)	(8.71)	(7.87)	(8.43)
rxr (-1)	52.50	54.70	45.60	47.10		52.70
	(3.09)	(3.48)	(3.01)	(3.11)		(3.41)
rxr (avg)					46.40	
					(2.77)	
GDP (avg)			-3.26	-1.76	-2.63	
			(-3.03)	(-1.12)	(-1.68)	
GDP (-1)						0.48
						(0.54)
WGDP (avg)				-4.05	-2.34	
				(-1.31)	(-0.74)	
WGDP (-1)						-4.24
						(-2.11)
Country effects	NO	YES	YES	YES	YES	YES
R-squared	0.11	0.24	0.32	0.32	0.28	0.27

Notes: rxr is the log of the real exchange rate, GDP (WGDP) is percentage growth in real GDP of filing country (rest of world) over prior three years (avg) or previous year (-1). T-statistics in parenthesis beneath coefficients.

Table 3. Poisson Estimation of Aggregate Filings

Model	(1)	(2)	(3)	(4)	(5)	(6)
rxr (-1)	4.57	4.15	3.38	3.49		4.16
	(9.45)	(9.26)	(7.69)	(7.91)		(9.13)
rxr (avg)					3.67	
					(7.33)	
GDP (avg)			0.90	0.95	0.93	
			(-8.05)	(-2.91)	(-4.10)	
GDP (-1)						1.02
						(1.85)
WGDP (avg)				0.89	0.92	
				(-3.30)	(-2.25)	
WGDP (-1)						0.87
						(-6.25)
Country effects	NO	YES	YES	YES	YES	YES

Notes: All variables defined as in Table 2. Estimates are reported as "incidence rate ratios".
T-statistics reported for a test of no effect on filings (which corresponds to an IRR value of 1.0).

Table 4. Negative Binomial Estimation of Aggregate Filings

Model	(1)	(2)	(3)	(4)	(5)	(6)
rxr (-1)	4.18 (2.75)	4.23 (2.85)	3.50 (2.61)	3.67 (2.73)		4.45 (3.11)
rxr (avg)					3.82 (2.50)	
GDP (avg)			0.92 (-2.69)	0.97 (-0.71)	0.94 (-1.17)	
GDP (-1)						1.02 (0.83)
WGDP (avg)				0.87 (-1.45)	0.90 (-1.00)	
WGDP (-1)						0.86 (-2.38)
Country effects	NO	YES	YES	YES	YES	YES

Table 5. Negative Binomial Estimation of Aggregate Filings Excluding Steel

Model	(1)	(2)	(3)	(4)
rxr (-1)	9.26	8.32	8.56	8.37
	(3.71)	(3.60)	(3.64)	(3.62)
GDP (avg)		0.94		0.97
		(-1.54)		(-0.45)
WGDP (avg)			0.87	0.91
			(-1.64)	(-0.77)
Country effects	YES	YES	YES	YES

Table 6. Negative Binomial Estimation of Aggregate Filings--Country Specific Exchange Rate Response

Model	(1)	(2)	(3) excl steel	(4) excl steel	(5) excl steel
rxr (AUS)	59.70	29.30	70.80	33.40	43.00
	(3.72)	(3.06)	(3.37)	(2.75)	(2.90)
rxr (CAN)	2.26	0.69	0.09	0.03	0.03
	(0.56)	(-0.25)	(-1.37)	(-1.90)	(-1.90)
rxr (EU)	2.58	2.39	1.36	1.30	1.19
	(0.63)	(0.59)	(0.19)	(0.16)	(0.11)
rxr (US)	2.12	2.53	12.90	14.80	14.40
	(1.24)	(1.59)	(3.47)	(3.81)	(3.77)
GDP (avg)		0.93		0.92	0.97
		(-2.31)		(-2.10)	(-0.62)
GDP (avg)					0.88
					(-1.10)
Country effects	YES	YES	YES	YES	YES

Table 7. Negative Binomial Estimation of Bilateral Filings

| Model	(1)	(2)	(3)	(4)	(5)	(6) excl steel	(7)	(8) excl steel
rxr (-1)	2.78	2.83	3.16	3.15	3.14	3.34		
	(5.51)	(5.59)	(7.08)	(7.14)	(6.97)	(6.55)		
rxr (AUS)							6.49	7.17
							(5.68)	(2.54)
rxr (CAN)							1.87	1.60
							(1.81)	(1.21)
rxr (EU)							5.03	4.37
							(4.34)	(3.55)
rxr (US)							1.94	2.41
							(2.34)	(2.69)
GDP (avg)				0.97	0.97	0.97	0.97	0.97
				(-6.16)	(-5.85)	(-4.56)	(-5.29)	(-4.07)
AGDP (avg)					1.00	1.00	1.00	1.00
					(-0.57)	(0.23)	(-0.57)	(0.23)
Filing country effects	NO	YES	YES	YES	YES	YES	YES	YES
Affected country effects	NO	NO	YES	YES	YES	YES	YES	YES

Figure 1. Total AD Filings
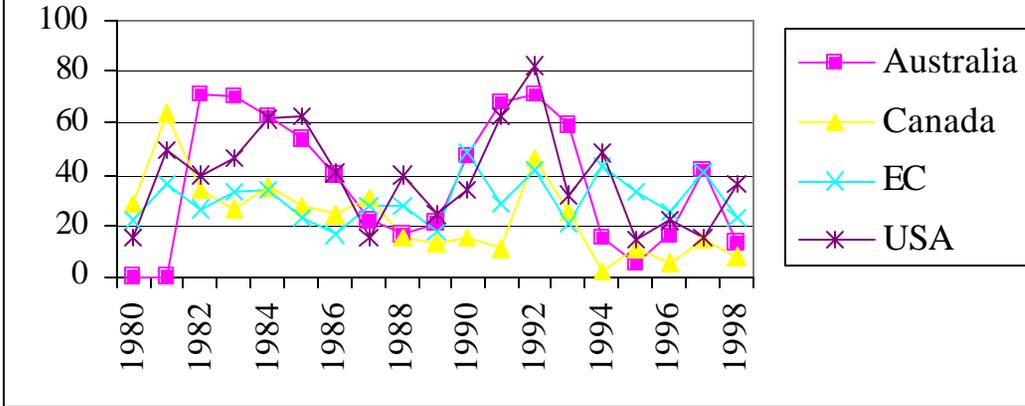
Figure 2. Total AD Filings, excl. steel