RENTS, VOTES, AND PROTECTION: EXPLAINING THE STRUCTURE OF TRADE BARRIERS ACROSS INDUSTRIES

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Abstract: This paper develops a model of the structure of protection across industries. We model five types of agents: policy makers, producers, importers, workers, and consumers. The model implies that protection increases with workforce size and decreases with lobbying costs. The effects of both output and imports are ambiguous. We test the model with US data, including new measures of protection, and confirm most of its implications. We do not find evidence that protection increases with output. The empirical results also suggest that policy makers weight campaign contributions about 12 per cent more heavily than national income. (*JEL* D72,F13)

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1 INTRODUCTION

Pervasive protection continues to impose great economic losses on all countries, despite decades of postwar liberalization.[1] Protection's prevalence has justifiably generated numerous inquiries into its causes. One important question that remains unresolved is: How do we account for the pattern of protection across industries? In other words, why do some sectors receive lots of protection and thus extract lots of rents from the rest of society, while other sectors do not?

Shedding light on this topic should be useful for both theory and policy. As for theory, work in the political economy of protection has shown that political forces can significantly alter standard trade theory results.[2] As for policy, knowing what causes protection can guide policy makers in their efforts to remove barriers. Richardson 1993, for instance, shows that free trade agreements may be preferred to customs unions because the former are more likely to lead to a further decline in protection once the agreement is signed.

Researchers have conducted numerous econometric analyses of the structure of protection across industries, but this work yields no clear conclusions because of the failure to combine explicit modeling with well-specified empirical tests.[3] Another

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[1] Hufbaur and Elliott 1994 estimate that the annual deadweight losses from protection in the US are at least $10 billion. For Japan, Sazanami et al 1995 estimate the losses at $17 billion annually.

[2] For instance, Brainard and Verdier 1993 shows that the connection between price changes and output may not be as simple as is implied by the standard trade models. They develop a model in which industries that have greater political influence receive greater protection from price shocks and thus maintain higher long run outputs. Thus, this work implies that the standard results from the specific factors model and the Stolper-Samuelson Theorem need to be modified to take account of the varying ability of industries to win insulation from price declines. This is but one example of how a clearer understanding of what induces protection makes it possible to model trade more accurately.

[3] See, for example, Cheh 1974, Caves 1976, Helleiner 1977, Ray 1981, Marvel and Ray 1983, Baldwin 1985, Godek 1985, Goldstein 1988, Hansen 1990, Trefler 1993, Finger and Harrison 1996, and Gawande 1998. Magee, Brock and Young 1989 and Rodrik 1995 survey this large literature. Trefler's 1993 article

problem with these empirical analyses concerns data: one wonders how accurately the amount of protection has been measured. Using just tariff rates would be misleading, since governments use a wide range of hard-to-measure, under-the-table methods to protect domestic industries. Also, since tariffs have been negotiated to very low levels through the World Trade Organization, the relative importance of under-the-table methods has increased. Given all this, it is quite difficult to know just how much protection an industry enjoys. A number of researchers have estimated protection levels across industries in advanced countries, but these estimates suffer from flaws that render the data suspect. This study will use new measures of protection that we believe are more trustworthy than previous ones (see Bradford 1998).

Grossman and Helpman broke new theoretical ground with their 1994 article by developing a model in which they derived an expression for the structure of protection across industries. Their model (the GH model) implies that the amount of protection depends positively on the ratio of output to imports, negatively on the elasticity of import demand, and negatively on the weight that the government places on social welfare. Goldberg and Maggi 1997 confirms empirically the main GH prediction—that protection is increasing in the ratio of output to imports. Goldberg and Maggi include variables outside of the GH framework and find that none of several possible augmented

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is probably the best among those that are not guided by modeling. He is careful to correct for endogeneity and submits his results to a number of sensitivity tests. He also has an excellent data set, upon which we have relied. Another intriguing piece is Gawande 1998. This article is the only one of which we are aware that conducts tests of several political economy of trade models against each other, instead of the usual approach of testing one's favorite model against the easily rejected null of no model. She does not, however, correct for endogeneity, since incorporating it into her Bayesian framework is too unwieldy. She finds that the two most likely determinants of protection are special interest lobbying and voting, two prominent features of our model.

regressions leads to a significant improvement in fit. They do not, however, test the GH model against an alternative.

This paper develops a new model of the structure of protection across industries. We model five types of agents: policy makers choose protection levels so as to maximize votes, producers and importers seek to maximize rents through lobbying, and workers and consumers vote according to protection's effect on their economic well-being. Our model generalizes the GH model and captures formally, the connection between protection and jobs and the role of importers in the protection game.[4] With importers, the model can also accommodate all kinds of trade barriers, not just tariffs. The model implies that protection increases with workforce size and decreases with lobbying costs and the elasticity of import demand. The effects of both output and imports are shown to be ambiguous.

We test the model with US data, including our new measures of protection, and confirm its predictions. Thus, we show that our theoretical generalization of the GH framework is empirically meaningful. The empirical results also imply that policy makers place about 12% more weight on campaign contributions than on national income and that about one million votes are lost for each $1 billion reduction in national income.

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[4] For another paper that models the role of importers in protection, see Maggi and Rodriquez-Clare 1997.

THE MODEL

2.1 Consumer Preferences[5]

Assume that the economy is too small to affect world prices, so that we may always take these to be exogenously given. All consumers have the same preferences given by the following quasilinear utility function:

$$u = x_0 + \sum_{i=1}^{n} u_i(x_i). \qquad (1)$$

The first good is the numeraire, and its domestic and world prices are always 1. It is assumed that total spending by all consumers is high enough such that the numeraire will absorb all income effects. Each of the subutility functions is well behaved: differentiable, increasing, and strictly concave.

Consumer surplus generated from consumption of each of the non-numeraire goods is given by:

$$s_i(p_i) = \overline{u}_i[d_i(p_i)] - p_i d_i(p_i), \qquad (2)$$

$s_i(p_i)$: total consumer surplus derived from consumption of good *i*,
p_i: the price of good *i*,
$\overline{u}_i[d_i(p_i)]$: sum of utilities over all consumers of good *i*,
$d_i(p_i)$: the total demand for good *i*.

There is, of course, no surplus derived from consumption of the numeraire.

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[5] This section follows GH.

2.2 The Production Structure, Capitalists, and Workers

For the production side of the market, consider a modified version of the specific factors model. As with the standard model, assume that all goods are produced under constant returns to scale and that goods markets are competitive. Also, each good requires the use of both specific capital, which is completely immobile, and mobile labor. Unlike the standard model, however, the wage in each sector is fixed at some level above that which would clear the market. This could result, for instance, from union bargaining or from efficiency wage considerations. Such a wage structure creates unemployment and thus a connection between jobs and protection.

With the wage set artificially high, the amount of labor employed depends strictly on labor demand and thus, with technology fixed, only on the price. We have, therefore, that $L_i = L_i^d(\frac{\overline{w}_i}{p_i})$, where L_i is the amount of labor employed in industry *i*, and $\overline{w}_i$ is the fixed wage. Price decreases cause the real wage to increase, and workers get laid off. Price hikes cause the real wage to decrease, and unemployed workers get hired.[6]

With wages fixed, the total reward to specific capital depends only on the price of the good produced: $p_i = p_i(p_i)$. Here, p_i is the total returns to specific capital in industry *i*. This profit function, which is increasing in the price of the good, creates the incentive for specific capital owners to lobby for protection.

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[6] One might think it more reasonable to allow wages to move, as well as employment. Wages are assumed to be fixed because it makes the model cleaner and because there is evidence to indicate that employment is quite a bit more flexible than wages in the short run. Revenga 1992 shows that the import price elasticity of wages in the early 80s—the same time period from which our data is drawn—is significant but small, only .06 to .09. The corresponding elasticities for employment are .24 to .39. Also, since any one industry is small relative to the rest of the economy, price changes within a single industry will probably have a small impact on overall wages.

2.3 The Government's Objective and the Imposition of Protection

The government is modeled as a single agent that has the power to impose trade barriers as it pleases in each industry. The government chooses for each industry a domestic price between the world price and the price that results in no imports.[7]

The key consideration for any elected government as it chooses policies must be popular support. Assume, therefore, that the government sets trade policy so as to maximize votes. One may wonder why, in a democratic system, a government would need any more than half the votes. There are two reasons why it makes sense to assume that the government maximizes votes when setting trade policy. First, trade policy is only one piece of the broader policy realm that determines total popular support. Thus, if one assumes that the number of votes won or lost through trade policy is small relative to the total required to maintain office, then it makes sense to assume that the government wants to maximize votes when setting trade policy. In effect, we assume that national elections and the make-up of Congress do not turn on trade policy.

Second, even if trade policy is crucial to national electoral outcomes, governments have good reason to maximize votes beyond the majority level. A larger majority in the legislature makes it more likely that the government's overall agenda will be implemented. Also, super-majorities increase the scope for retaining the support of key people through the dispensing of patronage jobs and other perks. Thus,

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[7] We rule out subsidies since they differ fundamentally from trade barriers in requiring appropriations of funds. See Rodrik 1986 and Wilson 1990 for models in which trade barriers are chosen even when subsidies are available. The basic idea is that, in political economic equilibrium, using the less efficient trade barriers may result in less deadweight loss, since more efficient policies, such as subsidies, may be used to a greater degree.

maximizing total votes can increase the government's ability to retain power over time.

The government's objective function therefore has the following form:

$$V(\mathbf{p}) = V^{T}(\mathbf{p}) + cC(\mathbf{p}), \qquad (3)$$

p: the vector of prices of all non-numeriare goods,
$V(\mathbf{p})$: the total votes received by the government,
$V^{T}(\mathbf{p})$: votes received directly as a result of trade policy, and not as a result of campaigning,
$C(\mathbf{p})$: total contributions received from lobbyists,
c: the fraction of a vote that $1 of contributions will buy.

When setting trade policy, the government generates votes through two channels. First, the policy wins or loses votes directly as a result of its impact on people's well being. Protection wins the votes of workers who gain or retain jobs as a result of that industry's production being propped up and may lose the votes of some consumers of that product. Second, lobbyists make contributions to the government in an effort to influence policy: imposing protection presumably wins the monetary support of organized beneficiaries. Politicians can then spend these funds on campaigning in order to "buy" those votes which have not been won, or have been lost, directly through trade policy. Let us turn to a discussion of what kinds of instruments governments use to restrict imports.

2.4 Types of Trade Barriers and Their Political Economy Impacts

Different kinds of trade barriers may have different political and economic effects. There are two broad classes of barriers: trade taxes, such as tariffs and other duties, and “non-revenue barriers” (NRBs), which restrict the quantity of imports without generating tax revenues. There are a variety of such barriers, including quotas, VERs, heavy-handed government regulation, biased government procurement, lax antitrust enforcement, unduly restrictive health and safety standards, burdensome customs procedures, and threats. All such NRBs create rents: any entity that has the privilege of selling the imported good collects, on each unit sold, a rent equal to the gap between the domestic price of the good and its world price.

A crucial question for any model of trade or protection is: What happens to those revenues or rents? In the case of trade taxes, economists usually assume that the revenue gets rebated lump sum to the populace, so that this revenue can be grouped with consumer surplus in the analysis. This is what GH assume. With NRBs, though, it appears less palatable to assume that rents get rebated lump-sum, since it seems likely that people will compete for the rents. In addition, even with trade taxes, lump-sum rebating rarely occurs in practice. Thus, it makes sense to explore what happens if we do not invoke this assumption.

We assume, therefore, that the revenues or rents that trade barriers generate become the object of political competition. In the case of NRBs, importers will vie for the right to import restricted goods. They will make contributions and otherwise curry policy makers’ favor in efforts to win the right to import, just as producers seek trade protection. As for trade taxes, assume similarly that those revenues become the object of lobbying. Thus, no matter what the trade barrier used, the import rents generated produce contributions from those seeking to capture those rents.[8] Importers will seek import rents, while those seeking revenues may not necessarily be importers. Nevertheless, to simplify the exposition, in what follows, all who seek for rents or revenues will be referred to as importers.[9]

2.5 Votes and Protection

As described above, protection creates jobs for unemployed workers (or prevents the layoff of employed workers). Assume that each worker hired as a result of protection will switch her or his vote from opposing the government (because he or she was unemployed) to supporting the government. Thus, if $L_i^d(p_i)$ represents labor demand in industry *i,* then protection in that industry will directly generate $L_i^d(p_i) - L_i^*$ votes, where L_i^* is the amount of labor demanded when trade is free.[10,11]

Aside from the direct impact of protection on votes via job creation, protection can also be expected to cause a loss of votes from among consumers who have to pay

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8 It is perhaps more accurate to allow for both lump-sum rebating of trade taxes and the seeking of import rents. Treating trade tax revenue and other import rents differently, however, complicates the analysis without a commensurate gain in insight. Bhagwati 1982 discusses the very real possibility of revenue seeking, as well as rent seeking. Also, the greater use of NRBs compared to trade taxes implies that import rents significantly outweigh trade tax revenues.

9 This framework encompasses VERs, if we assume that foreign producers lobby the importing country's government. Recent events show that such foreign lobbying occurs frequently.

10 The results do not depend on having each worker who gets hired or fired switch her or his vote. As long as some fraction of these workers switch, the results go through. Also, an extension of this framework would be to model more explicitly who will switch votes as a result of being hired or fired. For instance, higher skilled workers may be better able to absorb the blow of job loss and thus may be less likely to switch from support to opposition if fired (and from opposition to support if hired).

11 We abstract from any job impacts on importers. Restricting imports, while creating rents for those who are allowed to continue to import under the tightened regime, can be expected to lead to job loss in the importing sector. Importing, however, is not very labor intensive, so the total jobs lost through reducing imports will be relatively small. To account for this effect would complicate the algebra without significantly affecting the results.

higher prices and thus suffer a loss of wealth. In many cases, the loss of consumer surplus resulting from protection is small enough to be ignored by consumers. The great majority of US citizens, for instance, simply accept without complaint (or are unaware of) the extra $5 per year that they pay because of the sugar quota. Nevertheless, many citizens groups have lobbied against protection in the US (see Destler and Odell 1987) and presumably in other countries.[12] Thus, with 100 million voters in the US and large numbers in other OECD countries, we can expect protection to result in the loss of a fair number of votes, because of the large amount of wealth which is extracted from consumers through trade barriers. It is assumed that the number of votes lost is directly proportional to the loss of consumer surplus. In particular, let the number of votes lost through protection be given by $a[s_i(p_i) - s_i^*]$. The parameter a represents the votes lost per dollar of lost consumer surplus, and s_i* is the free trade level of consumer surplus. a is constant across all industries.[13]

2.6 Lobbying and Protection

We do not model the choice of whether to form a lobby. Instead, following GH, we appeal to Olson's 1965 work on collective action to make the following assumptions: 1) All owners of specific capital within an industry have trade policy stakes that are high enough to justify incurring the costs required to form lobbies. 2) Importers, too, find it worthwhile to form lobbies. 3) Individual consumers' stakes are low enough so that

[12] Also, retailers often end up representing consumer interests by lobbying for free trade. See Feenstra 1998.
[13] Another possible extension to this model would be to allow a to vary across industries. For instance, consumers may be more forgiving of protection for industries in which wages are low.

there are no consumer lobbies. Nevertheless, the total stakes for consumers are so high that the effect of protection on them as a group will not be ignored.[14]

We now specify the lobbies' welfare functions. Assume that the membership of each lobby is small enough such that it represents a negligible fraction of the total population. This assumption allows us to ignore the total consumer surplus derived by any one lobby. In general, then, the total welfare of any producer lobby simply equals total profits accruing to the specific factor owners in that industry:

$$w_i^P(p_i) = p_i(p_i)\,. \tag{4}$$

Similarly, assume that the total welfare of importers is equal to the total rents from importing in that sector. This implies that free trade profits for importers are 0. The total welfare of importers is thus given by:

$$w_i^M(p_i) = (p_i - p_i^*)\,m_i(p_i)\,, \tag{5}$$

m_i : imports in sector *i.*

Producers and importers make contributions to the government in an effort to win

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[14] There are no intermediate goods in this model. With intermediate goods, we might expect to see industries lobbying against protection on those goods, just as US laptop makers lobbied hard against protection on Japanese flat-panel display screens. While there are examples such as these, such lobbying is rare compared to lobbying for protection for one's own product. See Nelson 1996 on the principle of "reciprocal noninterference".

rents. Assume that both groups engage in efficient bargaining with the government. Thus, contributions for producers and importers are given respectively by:

$$C_i^P(p_i) = p_i(p_i) - K_i^P\,, \tag{6}$$

$$C_i^{IM}(p_i) = (p_i - p_i^*)\, m_i(p_i) - K_i^{IM}\,, \tag{7}$$

K_i^P, K_i^{IM}: the amount of rents that producers and importers retain in the bargain.

We assume that amassing contributions and transferring them to the government is not costless. There will be, as with most any trade, marginal transactions costs that dissipate some fraction of the contributions before they can be put to use by policy makers. Raising money from members of the lobby will require resources, with the amount of resources used increasing with the amount of funds to be raised per time period. Also, some portion of lobbying contributions consists of in-kind payments, rather than simple transfers of money. Lobbyists may wine and dine policy makers, invite them to ski retreats, or bestow gifts. Such in-kind payments will certainly incur transactions costs—resources spent which do not benefit the policy maker. Because of these fund-raising and in-kind payment costs, we assume that the costs of contributions increase with the amount contributed.[15]

Let b_i^P and b^{IM} represent the fraction of contributions that actually makes it into the hands of policy makers. Call these fractions the “transfer ratios”. Thus, the costs of

[15] The transactions costs are not necessarily large, but the model allows for the likelihood that they will be non-zero. It is quite possible within the model to set these costs equal to 0, but the approach outlined here will allow the data to determine whether such a simplification is justified.

lobbying, as a percentage of total contributions, are given by $1-b_i^P$ for producers and $1-b^{IM}$ for importers. Since importers are relatively homogeneous, we take b^{IM} to be constant for all sectors. Producing industries, on the other hand, differ widely in their characteristics, so the transfer ratio for producers, b_i^P, is allowed to vary by sector. We expect more diffuse industries to have more difficulty coordinating their lobbying efforts because of larger incentives to free ride, since protection granted to any one firm is granted to all. For instance, if an industry's output is concentrated in a fairly small number of firms, then that industry should find it relatively easy to raise funds from members and transfer the funds to politicians. On the other hand, industries with lots of firms will need to spend more for each dollar contributed. Thus, it is reasonable to hypothesize that b_i^P, and thus protection, will be increasing in such variables as the 4-firm concentration ratio and the Herfindahl index and decreasing in the number of firms in an industry.[16] Also, industries that have strong unions can be expected to have greater lobbying clout and fewer free rider problems, which leads to the hypothesis that b_i^P, and thus protection, will be increasing in an industry's unionization rate. Many empirical papers have analyzed such variables, but the modeling here allows us to test for the impact of such characteristics within a coherent theoretical framework.

Assume that politicians value contributions because they can be used to buy votes through campaign spending. Also, assume that campaign funds can win votes

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[16] See Chapter 6 of Magee, Brock, and Young 1989 for an interesting discussion and a formal model of contributions made by lobbies seeking trade protection. They pay particular attention to free riding problems, and, in one formulation, they show that total contributions are given by the Herfindahl index times total sales in the industry.

more effectively than does the direct bestowal of rents. Put another way, $1 million spent on campaigning wins back more votes than are lost through extracting $1 million in surplus from consumers. Thus, each campaign dollar is assumed to buy back *c* votes, where $c > a$.

3 OPTIMAL PROTECTION IN POLITICAL ECONOMIC EQUILIBRIUM

The above discussion implies that the government's objective function can be written as:

$$V(\mathbf{p}) = \sum_{i=1}^{n} [(L_i^d(p_i) - L_i^*) + c[b_i^P C_i^P(p_i) + b^{IM} C_i^{IM}(p_i)] + a(s_i(p_i) - s_i^*)]\,. \qquad (8)$$

Actual contributions received have been scaled back with the *b* terms, to account for the transactions costs associated with lobbying.

The government will choose the price in each sector so as to maximize votes, taking account of the jobs gained, the contributions induced, and the consumer votes lost by such a choice. Taking the derivative of *V* with respect to a representative price, p_i, and suppressing the dependence of labor demand, output, and imports on the price, we find:

$$\tilde{P}_i = \frac{p_i - p_i^*}{p_i} = \frac{e_{L,p}L_i + c(b_i^P \bar{y}_i + b^{IM}\overline{m}_i) - a(\bar{y}_i + \overline{m}_i)}{e_{L,p}L_i + cb^{IM}e_{(m,p),i}\overline{m}_i}, \tag{9}$$

$e_{L,p}$: the elasticity of labor demand,
$e_{(m,p),i}$: the elasticity of import demand in sector *i* (defined to be > 0),
$\bar{y}_i = y_i p^*$: the **value** of output at free trade prices,
$\overline{m}_i = m_i p^*$: the **value** of imports at free trade prices.[17]

This expression is our prediction for protection levels in import-competing industries in industrialized democracies.[18] (See Appendix 1 for a derivation of the result.)

4 IMPLICATIONS OF THE MODEL

The above modeling provides theoretical backing for a number of results:

Result 1: Protection is increasing in the number of workers in a given sector. Since $\tilde{P}_i$ is bounded by 0 and 1 and L_i enters additively into the numerator and the denominator, $\tilde{P}_i$ is monotonically increasing in L_i. In short, jobs matter. The GH model and its variants abstract from jobs and voting. It is a robust empirical finding, however, that jobs do matter. This model provides theoretical backing for this

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[17] $\tilde{P}_i$ maps protection onto the [0,1) interval. This formulation follows GH and Goldberg and Maggi. Also, the two elasticities can theoretically depend on the price, but we have suppressed this dependence as well.

[18] We assume no negative protection, so that $\tilde{P}_i$ is bounded below by 0. Negative values of $\tilde{P}_i$ would imply import subsidies, which we rule out because they hurt producers. Such subsidies go against our assumption that producers are organized and consumers are not. This assumption appears to be innocuous since it turns out that all the industries in our sample get positive protection. Manipulation of equation 9 shows that $\tilde{P}_i < 0$ if $e_{L,p}L < (a - cb^P)\bar{y} + (a - cb^{IM})\overline{m}$. This means that a necessary (but not sufficient) condition for there to be a corner solution at the lower bound is to have $a > cb^P$ or $a > cb^{IM}$. If one of these inequalities holds, then that sector **may** get no protection, with the chances of it getting no protection increasing as *a* increases and as *L*, $e_{L,p}$, *c*, b^P, and b^{IM} decrease.

proposition which has not, to our knowledge, been captured formally.

Result 2: The higher the elasticity of labor demand, the greater the protection. The same reasoning for Result 1 leads to the conclusion that $\tilde{P}_i$ is increasing in $e_{L,p}$. Industries that will hire lots of workers in response to a price increase will also provide lots of votes if granted protection.

Result 3: Industries with lower transactions costs associated with lobbying receive more protection. It is clear from equation 9 that protection is increasing in b_i^P. Recall that a higher b_i^P implies lower transactions costs. As discussed above, transactions costs are probably closely connected to the extent of free riding, which, it is reasonable to suppose, decreases as industry concentration or unionization or both increase. Thus, we would expect protection to increase with these, or related, variables.

Result 4: Importers want neither free trade nor autarky but some intermediate level of protection that maximizes their rents. To see this, note what would happen to the price if all other special interests were removed from the game, ie, if a, b_i^P, and $e_{L,p}$ were all set equal to 0. We would then have $\tilde{P}_i = \dfrac{1}{e_{(m,p),i}}$, which is the expression for the maximum revenue tariff, or, more generally, the maximum rent trade barrier. Importers want the price that maximizes rents, which means choosing a protection level such that $\tilde{P}_i = \dfrac{1}{e_{(m,p),i}}$.[19]

[19] This implies that $e_{(m,p),i} > 1$. Even if $e_{(m,p),i}$ is less than or equal to 1 at world prices, as the price rises, $e_{(m,p),i}$ will exceed 1 at some point, as long as we assume that there is some upper limit on the price that consumers are willing to pay for imports.

Result 5: Protection is increasing in output if $cb_i^P > a$. This results from the fact that larger industries will receive a larger increase in rents for any given price change. Holding all else equal, including the number of workers, large industries will have more resources to contribute to politicians in order to acquire more rents. If, however, c or b_i^P is quite low, meaning either that contributions are not valued enough or that lobbying costs are high, then larger industries may get less protection. In this case, large industries cannot muster enough contributions to counteract the large amount of consumer surplus that they would wipe out.

Result 6: Protection is decreasing in imports if $cb^{IM} \leq a$. Otherwise, the connection between protection and imports is ambiguous. See the appendix for a proof. If the clout of importers is small enough, so that $cb^{IM} \leq a$, then, holding everything else equal, industries with more imports should get less protection, because more imports means that protection for such an industry will result in a larger loss of consumer surplus. If, on the other hand, importers have enough clout relative to consumers ($cb^{IM} > a$), then the fact that importers want an intermediate level of imports creates an ambiguous connection between imports and the protection level.

Result 7: Protection is decreasing in the elasticity of import demand. (This is clear by inspection of Equation 9.) As with GH, we find that, since more elastic demand leads to greater deadweight loss when prices are propped up, more elastic import demand leads to less protection.

We now turn to the task of empirically testing the model's predictions.

5 EMPIRICS

First, we develop an empirical model based on the theoretical model. Then, we briefly describe the data. Finally, we present and analyze the regression results.

5.1 An Econometric Model

In equation 9, imports, production, and labor demand are all endogenous with respect to the level of protection.[20] To see how we can tackle endogeneity, first divide the top and bottom of the equation by $\bar{y}_i$:

$$\tilde{P}_i = \frac{p_i - p_i^*}{p_i} = \frac{e_{L,p}\frac{L_i}{\bar{y}_i} + c(b_i^P + b^{IM}\frac{m_i}{y_i}) - a(1+\frac{m_i}{y_i})}{e_{L,p}\frac{L_i}{\bar{y}_i} + cb^{IM}\, e_{(m,p),i}\frac{m_i}{y_i}}. \tag{10}$$

The number of endogenous variables has been reduced from 3 to 2: import penetration, $\frac{m_i}{y_i}$, and labor intensity, $\frac{L_i}{\bar{y}_i}$ (where we have divided the number of workers by the **value** of output at world prices). We can instrument for both of these by using factor shares. Goldberg and Maggi 1997 and Trefler 1993 have done so for import penetration. As with the Heckscher-Ohlin model, for the specific factors model, import penetration will be some function of endowments. It is reasonable to instrument for

[20] As mentioned in note 15, both elasticities can be thought of as endogenous, but we assume that they are constant around equilibrium. This is a standard assumption for import demand elasticities. Accounting for possible endogeneity would greatly complicate the analysis.

labor intensity in the same way, since this, too, will depend on factor endowments. Since we are not interested in the details of that dependence, we write each equation in reduced form, as a simple linear function of factor shares.[21]

As mentioned above, we expect b^P to be some function of variables that reflect the extent of transactions costs in lobbying. The Trefler data set upon which we rely has four such industry-level variables: 4-firm concentration ratio, geographical concentration, number of firms, and the unionization rate. Trefler scales the number of firms by industry sales. Thus, we will call his variable "scaled number of firms". We add a fifth variable for which the number of firms is not scaled by industry sales and call it "number of firms".[22] We do not develop a full-blown model of the relation between these variables and lobbying transactions costs. Instead, for the empirical analysis below, we specify a simple linear relation between b^P and each of the variables, so that we have $b^P = b_0^P + b_1^P x_i$, where x_i is a lobbying cost variable and i indexes the five variables. We will then let the data tell us whether, within the theoretical framework developed, there is any relation between these proxies for lobbying costs and protection.

Thus, our econometric model can be written as:

[21] We do not use labor variables as instruments, since labor is one of the endogenous variables. The instruments are: physical capital, inventories, cropland, pasture, forest, coal, petroleum, and minerals. The data is that used in Trefler 1993. The main results are robust to the choice of instruments, although using a longer list of instruments increases the standard errors (as one would expect).

[22] It turns out, though, that we cannot use simply the number of firms, because this has a huge range--from 13 to nearly 10,000—and the estimation does not work. So, we normalize number of firms to the [0,1] interval by dividing the number of firms by the maximum number of firms.

$$\tilde{P}_i = \frac{eLAB_i + c([b_0^P + b_1^P LOB_i] + b^{IM} IMP_i) - a(1 + IMP_i)}{eLAB_i + cb^{IM}(ELAS_i)(IMP_i)} + u_i , \qquad (11)$$

$$IMP_i = \mathbf{ß_{IM}}'\mathbf{Z} + u_{IM\,i} , \qquad (12)$$

$$LAB_i = \mathbf{ß_L}'\mathbf{Z} + u_{L\,i} , \qquad (13)$$

LAB_i :	labor intensity, $\frac{L_i}{\bar{y}_i}$,
IMP_i :	import penetration, $\frac{m_i}{y_i}$,
LOB_i :	one of the lobbying costs variables,
$\mathbf{b_{IM}}, \mathbf{b_L}$:	vectors of coefficients,
Z:	a vector of factor shares,
$a, b_0^P, b_1^P, b^{IM}, c$, and e :	parameters to be estimated or fixed, corresponding to $a, b_0^P, b_1^P, b^{IM}, c$, and $e_{L,p}$, respectively.

We assume that the error terms are jointly normally distributed and estimate the system using limited information maximum likelihood (LIML).[23]

5.2 The Data

We test the model using mid-80's US data for 125 SIC 4-digit industries. This choice of country and time period stems from the fact that the endowments data needed for the instruments is only readily available for the US in 1983 (Trefler 1993).

As mentioned above, we have developed new, industry-level measures of protection. The details of how these data were constructed are in Appendix 2. In a

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[23] The dependent variable is constrained to be greater than or equal to 0 and less than 1, but it is neither truncated nor censored. There are no 0's in our data, indicating no truncation. Also, we have included all final goods industries, except for prepared fish, for which the Feenstra data had no production data. Thus, no industries were dropped because their protection level was below 0, indicating no censoring. We also estimated the system using non-linear 2-stage least squares and got very similar point estimates, with larger standard errors.

nutshell, we have used detailed price data from the OECD to construct tariff equivalent price gaps that capture any and all barriers to international arbitrage for a sample of 6 OECD countries. These protection measures are from 1985.

The employment data also comes from Trefler and is 1983 US data. For each industry, the total number of workers was calculated by dividing the number of employees by one minus the unemployment rate for that industry. This employment data was then adjusted to account for intra-industry trade. Since some output from each industry (with a couple of exceptions) gets exported, the number of workers was multiplied by the ratio of non-exported production to total production, to arrive at an estimate of the number of import-competing workers for that sector.

The data on production and exports comes from the Feenstra data set at the NBER website. This was also the source of the import data needed to calculate import penetration. Output, too, is adjusted downward so that it only reflects import competing production. The lobbying cost variables--4-firm concentration ratio, geographical concentration, number of firms, and unionization rates--all come from Trefler.

Like Goldberg and Maggi 1997, we take the elasticities data from Shiells, Stern, and Deardorff 1986. These estimates are considered to be the best available at the level of disaggregation used in this empirical analysis. Many other studies have used these estimates.

Summary statistics for the key variables are shown in Table 1.[24]

[24] Our protection measures are nominal, even though specific capital owners care about effective protection, which could, theoretically, differ substantially from nominal protection. Unfortunately, it is most difficult to calculate effective protection. The standard measures of effective protection assume that there is no substitutability among inputs and thus overstate true effective protection. There have been attempts to overcome this problem (see Bureau and Lakaitzandonakes 1995 for one example), but to do so is

5.3 Empirics

5.3.1 Estimating the Model

The equation for protection is homogeneous of degree 0 in a, c, and e and in b_0^P, b_1^P, b^{IM}, and c. In the first case, doubling $a, c,$ and $e_{L,p}$ would not affect $\tilde{P}$. In effect, changing the units of dollars in which we measure votes does not affect protection (just as changing the units in which we measure prices and income does not affect demand). In the second case, doubling the transactions costs for both lobby groups while cutting in half the weight that policy makers place on contributions also would not affect $\tilde{P}$. Thus, one of a, c, and e must be pegged, and one of b_0^P, b_1^P, b^{IM}, and c must be pegged.

We peg a and b^{IM}. The significance of each of the estimated parameters is invariant to the choice of a and b^{IM}. Thus, the substantive results do not depend on the calibration. We peg a because we are most interested in what the data say about the sign and significance of e and c. These two parameters indicate whether jobs and contributions, respectively, play important roles in the protection game. What value should be chosen for a? Given that e, the elasticity of labor demand, is a parameter that others have estimated in other contexts, it seems reasonable to choose a such that the estimate for e comes out in a reasonable range. Hammermash 1986, Table 8.3, presents estimates of labor demand elasticities at the industry level, and they range

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expensive and very few such estimates exist. There are, as a result, no reliable estimates of effective protection for the 125 sectors. In the end, it appears to make little difference empirically. Using data from Deardorff and Stern 1984, the correlation between nominal and effective protection for 18 2-digit sectors in the US was .99. (It was .93 for the EU and .87 for Japan.)

from .20 to 1.03. It turns out that setting a at .001 generates point estimates for e that range from .18 to .51.[25] This value of a implies that each $1000 drop in consumer surplus results in the loss of one vote. Thus, a $25 billion drop in consumer surplus, or about $100 per capita in the US, would result in the loss of 25 million votes nationwide.

We peg b^{IM} because, in addition to wanting to estimate c, as mentioned above, we want to investigate the connection between lobbying costs and protection by actually estimating b_0^P and b_1^P. Unlike with a, however, there is no empirical work that might shed light on reasonable values for b^{IM}. Thus, the equation was estimated 10 times, with b^{IM} set equal to all multiples of .1 ranging up to 1, since b^{IM} is bounded by 0 and 1. The sign and significance of all three estimated parameters are robust to all choices of b^{IM}. We will focus our discussion on the results for b^{IM} = .9. This value is chosen because it seems likely that there are some transactions costs associated with importer lobbying but that the majority of contributions from importers will not be dissipated. Picking lower values for b^{IM}, meaning higher transactions costs, would unequivocally strengthen all the conclusions below. We discuss the implications of assuming no transactions costs ($b^{IM} = 1$) in footnote 24.

5.3.2 The Empirical Results

The results of estimating equations 11, 12, and 13 using LIML are shown in

[25] Increasing a by a factor of 10 **reduces** e by a factor of 10. Thus, setting a equal to .01 would lead to an estimate for e of less than .1. Similarly, 10-fold reductions in a would **increase** e by a factor of 10. Again, the significance of e does not depend on the choice of a.

Table 2. In each case, the point estimate for e is significantly positive at the 5% level. Overall, it appears that industries with a greater number of workers do receive more protection, holding the other key variables in the model constant. This result confirms the findings of Cheh 1974, Baldwin 1985, Hansen 1990, Finger and Harrison 1996, and Goldberg and Maggi 1997.

The results for c provide unambiguous evidence that lobbying contributions influence protection, just as votes do. The point estimate is significantly greater than 0 in all cases. Also, the estimate for c is significantly greater than the pegged value of a in each case. This implies that contribution dollars are more valuable to policy makers than consumer surplus dollars.[26] The point estimate of c indicates that politicians find contributions to be about 12% more valuable in terms of how many votes they can buy than is consumer surplus. In other words, $1 million dollars of contributions can overcome about $1.12 million of lost consumer surplus. This estimate seems a bit low but also a bit more reasonable than that of Goldberg and Maggi, which implied that producer contributions only receive about 2% more weight than does consumer surplus.

The results for the lobbying costs variables, b_0^P and b_1^P, show that there are significant transactions costs associated with lobbying (b_0^P is significantly less than 1)

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[26] This is the only conclusion that does not hold for all calibrations of b^{IM}. In particular, if $b^{IM} = 1$, then c is significantly greater than a at only the 10% level for each of the lobbying variables except scaled number of firms, for which c is not significantly greater than a at any reasonable significance level (t-stat of .71). The reason that the result weakens when we set b^{IM} at a higher level is that imputing more influence to importers for a given amount of protection means that producers' contributions may need to receive less weight in order to best estimate the model with the given data. If, however, we ignore the lobbying costs variables, producer contributions do get a significantly (at the 5% level) higher weight than consumer surplus for all values of b^{IM}.

but that there is a weak connection at best between the variables used and the extent of those costs. We find no evidence that geographical concentration or the number of firms affect the ability of industries to lobby. For the scaled number of firms and unionization, b_1^P is significant at the 10% level with the expected sign. The 4-firm concentration ratio is not significant at the 10% level, but, in a likelihood ratio test of the column 1 model versus the model in column 6 (discussed below), we reject the latter in favor of the former at the 5% level. Thus, we have some evidence that fewer firms, higher unionization rates, and higher concentration ratios do make it easier for industries to lobby and win more protection.[27] The point estimates are so low, however, that the estimated impact of these variables on lobbying transactions costs is quite small. For instance, halving the scaled number of firms from its mean of 20 per $100 million and doubling the unionization rate from its mean of 34% would, in each case, only reduce lobbying transactions costs by about 1%.[28] In short, these variables are weakly statistically significant and have little economic significance.

Given this weak connection between the lobbying cost variables and the

[27] There are conflicting empirical results in the literature on the connection between concentration and protection. Helleiner 1977 and Trefler 1993 find a positive relation. Caves 1976 and Ray 1981 find a negative relation. Marvel and Ray 1983 find both, depending on the set of independent variables used. Our results here clearly do not resolve this question, but it appears that a positive relation is more likely than a negative one, especially given that, among previous studies, Trefler's inspires the most confidence.

[28] Scaled number of firms is measured in firms per one million dollars, and the mean for this variable is .20. Since the estimate for the producer transfer ratio is given by $\hat{b}^P = b_0^P + b_1^P LOB_4$, the estimate for b^P evaluated at the mean value of .20 is .891+(-.0123)(.20)=.88854. Starting from the mean and cutting LOB_4 in half increases the estimate for b^P to .891 + (-.0123)(.10) = .88977. Thus, the estimate for transactions costs, which equals $1- b^P$, is reduced from .1115 to .1102, only a 1% reduction. A similar calculation for unionization, LOB_5, shows that increasing unionization from its mean of .34 to .68, increases the estimate for LOB_5 from .886+(.00364)(.34)=.88724 to .88848. Thus, the estimate for transactions costs decreases from .1128 to .1115, which is also a 1% reduction.

producer transfer ratio, we re-estimated the equation without a lobbying cost variable. Thus, we assumed that b^P simply equals a constant, b_0^P. The result of this restricted model is reported in the sixth column of Table 2. As with all the other regressions, $e, c,$ and b_0^P are significantly positive. Notice also that b_0^P is significantly less than b^{IM}, which has been set at .9. This implies that transactions costs for producer lobbies are significantly higher than for importers. The estimate of .886 implies that the transactions costs for producers are 14% higher than for importers. (.114 is 14% greater than .1.)

Is protection increasing in output? The GH model says unequivocally that it is, while Goldberg and Maggi 1997 and Godek 1985 have found empirical evidence for this proposition. Recall from Result 5 above that, in our framework, protection increases in output if $cb^P > a$. This means that we have empirical evidence that protection increases in output if $c(b_0^P + b_1^P LOB_i)$ is significantly greater than a. Using the mean of each lobbying cost variable, we find that, for all six columns in Table 2, $c(b_0^P + b_1^P LOB_i)$ is not significantly greater than a. Thus, we have no evidence that protection is increasing in output. While policy makers do value contributions more than consumer surplus, the presence of transactions costs apparently diminishes producer influence to the point where the contributions from large producers cannot outweigh the large consumer costs inflicted by protecting those large producers.

5.3.3 Comparison with the GH Model

While we have confirmed most of our model's theoretical predictions, it will be useful to check the sturdiness of these results by comparing our framework with GH's.

The GH framework allows for cross-industry lobbying and for the possibility that some industries will not be organized for lobbying. Neither of these applies to our analysis because our data only covers final goods industries (against which no industries will lobby) and because all industries in our data set receive some protection (implying that they are all organized).

Assuming, then, that all import competing industries are organized for lobbying and that there is no cross-industry lobbying, the GH result is:

$$\tilde{P}_i = \frac{p_i - p_i^*}{p_i} = \frac{y_i}{a^{GH} e_{(m,p),i} m_i}. \tag{14}$$

Here a^{GH} is a parameter that measures how much weight the government places on overall welfare relative to contributions.

Equation (14) is a constrained version of our model, with three restrictions: $e_{L,p} = 0$, $b_1^P = 0$ (or $b^P = b_0^P$), and $cb^{IM} = a$. The first restriction comes from not accounting for the role of jobs and voting in the politics of protection. The second comes from not allowing lobbying strength to vary by industry. The third constraint comes from assuming that import rents and revenues get rebated lump-sum to the populace. Thus, those rents get a weight of a instead of cb^{IM}. As shown in Table 2, e is significant in all 6 specifications. As discussed above, Table 2 also shows that, for 3 of the 5 politics variables, including a measure of lobbying costs does significantly improve the fit. As for the third restriction, in 3 of the specifications—number of firms, unionization rate, and no lobbying costs—we have $cb^{IM} > a$ at the 5% level. These facts imply that our more general model adds significant explanatory power to the GH model that applies to final goods. Indeed, the log-likelihood for this modified GH model is –49.9, far less than the log-likelihoods shown in Table 4.

Thus, we cannot justify all the restrictions required by the GH model. This raises the question: Can we get away with imposing just one or two of them, and thus have a somewhat more elegant model? We have already seen that imposing the second restriction **is** justified for 2 of the 5 lobbying cost variables. Imposing the first restriction, $e_{L,p} = 0$, which says that jobs and votes do not matter, is not justified. Doing so drops the log-likelihood down to the --31 to –33 range, depending on which lobbying cost variable is used.[29] Imposing the third restriction ($cb^{IM} = a$), however, which assumes that all imports rents are rebated lump-sum, does turn out to be justified. The theoretical result when we assume lump-sum rebating ($cb^{IM} = a$) is given by:

$$\tilde{P}_i = \frac{p_i - p_i^*}{p_i} = \frac{e_{L,p}\dfrac{L_i}{\bar{y}_i} + cb_i^P - a}{e_{L,p}\dfrac{L_i}{\bar{y}_i} + a\, e_{(m,p),i}\dfrac{m_i}{y_i}}. \tag{15}$$

Thus, the main econometric equation becomes:

[29] The results are not reported here. With this restriction, only scaled number of firms and unionization rate add significant explanatory power to the model.

$$\widetilde{P}_i = \frac{eLAB_i + c(b_0^P + b_1^P LOB_i) - a}{eLAB_i + a(ELAS_i)(IMP_i)} + u_i \tag{16}$$

Once again, we need to peg either c or one of the b's, as well as a. So, we set b_0^P equal to the point estimates from the previous results shown in Table 2.[30]

We report the results for this restricted model in Table 3. The logs of the likelihood functions are only slightly less than the values for the general model. In fact, likelihood ratio tests show that we cannot reject this model in favor of the more general one, even at the 10% level. The estimate for e is, once again, significantly positive in all cases, confirming that jobs matter. e is significantly positive at the 1% level for 4 of the specifications: 4-firm concentration, scaled number of firms, unionization rate, and no lobbying cost variable. As before, the estimate for c is significantly positive and is significantly greater than the calibrated value of a, confirming that politicians do indeed value contributions more than wealth spread across the populace. The results for the lobbying cost variables are similar to the previous results, except that the unionization rate is now significantly positive at the 5% level, rather than the 10% level. For the same 3 variables--4-firm concentration, scaled number of firms, and unionization rate--including them does lead one to reject the model with no lobbying cost variable. As before, though, these variables have limited economic significance.

Thus, the econometric analysis shows that our model does extend the GH model

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[30] The log-likelihood does not depend on the choice of b_0^P. Also, the point estimates change very little as we vary b_0^P.

in empirically meaningful ways. We have strong evidence that jobs and voting influence protection levels and limited evidence that lobbying cost variables are important. We also find, however, that adding importer lobbying to the protection game does not add significant explanatory power. While importer lobbying does occur, it appears that the age-old assumption of lump-sum rebating need not be abandoned, at least according to the framework and data used in this analysis.[31]

6 CONCLUSION

We have developed a protection model that takes account of the fact that politicians win support through creating or preserving jobs, as well as through campaign spending. In fact, we may think of job preservation as a direct way, and campaign spending as an indirect way, of winning votes. The modeling implies that protection for an industry will be increasing in: 1) The number of workers in that industry, 2) The elasticity of labor demand, and 3) The industry transfer ratio. The result also implies that protection is decreasing in the elasticity of import demand. We have confirmed these results empirically using new measures of protection. The regressions also provide evidence that politicians place about 12% more weight on campaign contributions than on wealth for the average citizen.

The modeling also shows that there is no necessary connection between protection levels and either output or imports. In particular, if industries cannot organize

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[31] When we impose the restriction $e_{L,p} = 0$, then the lump-sum rebating assumption **is** too restrictive. These results are not reported, since we know that $e_{L,p} = 0$ is too restrictive.

well enough, protection may be decreasing in output. Also, the impacts of both imports and output on protection are conditioned by workers' ability to influence policy makers through voting. For example, a larger sector will not necessarily receive more protection than a smaller one if the latter is more labor-intensive than the former. In fact, our empirical analysis revealed no significant relation between industry size and protection.

GH say in their 1994 article, footnote 11, that "our formula suggests that only two variables (the elasticity of import demand and the ratio of domestic output to imports) should explain the cross-industry variation in protection levels." The results in this paper provide solid evidence that an additional variable, number of workers, matters for determining why some sectors get lots of protection. We have also provided some evidence that unionization rates, the scaled number of firms, and the 4-firm concentration ratio affect protection levels. We did not find, however, any evidence that one needs to replace the lump-sum rebating assumption with a formal specification of the role that importers play in the protection game.

Our framework can accommodate modifications in order to test other hypotheses. For instance, to test whether there is a sympathy motive for protection, we could let c depend on wages, skill levels, or industry growth, just as we have let b^P depend on lobbying cost variables. It would also be useful to see whether we can verify this papers' conclusions with more recent data or data from other countries or both. While much work remains to be done, we hope that the modeling and empirics in this paper have shed light, and will stimulate further research, on the complex connections among rents, votes, and protection.

APPENDIX 1: DERIVATION AND PROOF

Derivation of Equation 9

The objective function is

$$V(\mathbf{p}) = \sum_{i=1}^{n} [(L_i^d(p_i) - L_i^*) + c[b_i^P\, C_i^P(p_i) + b^{IM}\, C_i^{IM}(p_i)] + a(s_i(p_i) - s_i^*)]$$

$$= \sum_{i=1}^{n} [(L_i^d(p_i) - L_i^*) + c(b_i^P[\pi_i(p_i) - K_P] + b_i^{IM}[(p_i - p_i^*)m_i(p_i) - K_{IM}]) + a(s_i(p_i) - s_i^*)],$$

where Equations 6 and 7 have been used to substitute for $C_i^P(p_i)$ and $C_i^{IM}(p_i)$.

Taking the derivative with respect to a representative price, p_i, and setting it equal to 0, we get:

$$\frac{\partial V}{\partial p_i} = \frac{\partial L_i^d(p_i)}{\partial p_i} + c(b_i^P y_i(p_i) + b_i^{IM}[(p_i - p_i^*)m_i'(p_i) + m_i(p_i)]) - a[y_i(p_i) + m_i(p_i)] = 0 .$$

Note that $\pi_i' = y_i$, by Hotelling's Lemma, and $s_i' = d_i = y_i + m_i$.

Dropping the *i* subscripts and not writing out the explicit dependence of *y*, *m*, and *d* on p_i, we have the following:

$$cb^{IM} m'(p - p^*) = a(y + m) - c(b^P y + b^{IM} m) - \frac{\partial L^d}{\partial p}$$

$$\Rightarrow\ cb^{IM} m' \frac{p}{m}\frac{m}{p}(p - p^*) = a(y + m) - c(b^P y + b^{IM} m) - \frac{\partial L^d}{\partial p}\frac{p}{L}\frac{L}{p}$$

$$\Rightarrow\ cb^{IM} e_{m,p}\frac{m}{p}(p - p^*) = e_{L,p}\frac{L}{p} + c(b^P y + b_{IM} m) - a(y + m)\text{, where } e_{L,p} = \frac{\partial L^d}{\partial p}\frac{p}{L} \text{ and}$$

$$e_{m,p} = -m'\frac{p}{m}.$$

$$\Rightarrow\ cb^{IM} e_{m,p} m(p - p^*) = e_{L,p} L + [c(b^P y + b^{IM} m) - a(y + m)]p$$

$$\Rightarrow\ [c(b^{IM} e_{m,p} m - b^P y - b^{IM} m) + a(y + m)]p = e_{L,p} L + cb^{IM} e_{m,p} m p^*$$

$$\Rightarrow\ p = \frac{e_{L,p} L + cb^{IM} e_{m,p} m p^*}{c(b^{IM} m(e_{m,p} - 1) - b^P y) + a(y + m)}$$

$$\Rightarrow \frac{p}{p^*} = \frac{e_{L,p} L + cb^{IM} e_{m,p} m p^*}{[c(b^{IM} m(e_{m,p} - 1) - b^P y) + a(y + m)]p^*}$$

$$= \frac{e_{L,p} L + cb^{IM} e_{m,p} \overline{m}}{c(b^{IM} \overline{m}(e_{m,p} - 1) - b^P \overline{y}) + a(\overline{y} + \overline{m})}$$

$$\Rightarrow \frac{p^*}{p} = \frac{c(b^{IM} \overline{m}(e_{m,p} - 1) - b^P \overline{y}) + a(\overline{y} + \overline{m})}{e_{L,p} L + cb^{IM} e_{m,p} \overline{m}}$$

$$\Rightarrow 1-\frac{p^*}{p}=\frac{p-p^*}{p}=\frac{e_{L,p}L+cb^{IM}e_{m,p}\overline{m}-c(b^{IM}\overline{m}(e_{m,p}-1)-b^{P}\overline{y})-a(\overline{y}+\overline{m})}{e_{L,p}L+cb^{IM}e_{m,p}\overline{m}}$$

$$=\frac{e_{L,p}L+c(b^{P}\overline{y}+b^{IM}\overline{m})-a(\overline{y}+\overline{m})}{e_{L,p}L+cb^{IM}e_{m,p}\overline{m}}.$$

Proof of Result 6

Differentiating Equation 9 with respect to imports, we get:

$\frac{\partial\tilde{P}}{\partial\overline{m}}=\frac{(e_{L,p}L+cb^{IM}e_{m,p}\overline{m})(cb^{IM}-a)-[e_{L,p}L+c(b^{P}\overline{y}+b^{IM}\overline{m})-a(\overline{y}+\overline{m})]cb^{IM}e_{m,p}}{D^2}$, where D^2 is the square of the denominator in Equation 9. (We invoke the usual assumption that the elasticities are constant, at least around equilibrium.) The first term in parentheses is positive, since all variables in the model are positive. The term in square brackets, which is the numerator of the equilibrium expression for $\tilde{P}$, is non-negative, since we have ruled out negative protection. Thus, the sign of $\frac{\partial\tilde{P}}{\partial\overline{m}}$ depends only on $cb^{IM}-a$. If this is nonpositive, then $\frac{\partial\tilde{P}}{\partial\overline{m}}$ is unambiguously negative. Otherwise, the connection between the level of imports and the equilibrium protection level is unclear.

APPENDIX 2: NEW PROTECTION MEASURES

Many researchers have attempted to measure the extent of protection at a fairly detailed level of aggregation, but most such efforts are unreliable for a variety of reasons. Also, most of these studies are not comprehensive analyses of barriers to trade because they focus only on explicit trade barriers and ignore the possible protective effects of other types of regulations. We have developed for six OECD countries disaggregated measures of protection that, we believe, are more reliable than others. We will first provide an overview of other efforts to measure protection and then briefly discuss how we developed ours.[32]

A1 OTHER ATTEMPTS TO MEASURE PROTECTION

The greatest obstacle to accurately measuring the openness of markets is the fact that nations can protect their industries in any of many different ways, as discussed above. Accounting for **all** possible barriers, not just visible ones, clearly is not straightforward. There are 3 main approaches to this thorny problem in the literature.[33] We discuss each approach and its shortcomings and then describe a new approach.

Method 1: Estimate a trade model and use the gap between predicted and actual trade flows to infer the extent of protection. (See Leamer 1988 and Saxonhouse and Stern 1989.)

This approach requires having a model that can accurately account for all determinants of trade, besides barriers. This is an overly ambitious requirement for any trade model. One can use the residuals to infer the extent of trade barriers, but who is to say how much of any residual results from barriers and how much results from model misspecification or data mismeasurement or both?

Method 2: Count NTBs. (See Laird and Yeats 1990 for a description of various NTBs and a survey of other relevant references.)

The United Nations maintains extensive data on NTB incidence. These data are calculated by computing what percentage of products within a sector has any kind of NTB.[34] These measures are flawed because they do not take account of how restrictive each barrier is. One sector may have a lot of products that are subject to minor NTB's. Another sector may have just a few products with very restrictive NTB's. The first sector would have a much higher NTB incidence measure, while we would expect the second sector to actually be more restricted by trade barriers. It is also unclear whether all NTB's have been accounted for in the UN's accounting. Finally, these measures are incomplete in that they ignore all trade taxes.

Method 3: Infer price gaps by using unit values derived from detailed trade data. (See Sazanami et al 1995, Knetter 1994, and Swagel 1995.)

Unit values are notoriously inexact measures of prices because of large quality differences in products. For instance, Sazanami et al derive tariff equivalents by

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[32] For a more thorough discussion of these new measures, see Bradford 1998.
[33] See Baldwin 1989, Deardorff and Stern 1985, Laird and Yeats 1990, and USITC 1995 for overviews of some of the issues.
[34] These are the measures used by Goldberg and Maggi and by Trefler in their empirical analyses.

comparing the unit values of domestically produced goods and imported goods in the same product category. It turns out that the unit values of radios and televisions produced in Japan are six times higher than the unit values of radios and TV's imported into Japan. The actual level of protection, though, is probably much less than this because Japanese radios and TV's are generally of much higher quality than those that the Japanese import.

A2 A NEW APPROACH

We develop a fourth approach. It is similar to that in Roningen and Yeats 1976 in that we rely on retail prices. With so many possible barriers to trade, the only way to account for all of them is to exploit the information which prices concisely convey. If a gap in price exists for equivalent goods in two different markets, after correcting for unavoidable distribution and transport costs, then we can conclude that those markets are protected, and, moreover, we can use the gap in price as a measure of the extent of protection. Thus, a single number, a price gap, if measured correctly, can tell us the total effect of all possible barriers to integration.[35]

A2.1 The Underlying Price Data

The protection measures are generated by exploiting data on carefully matched retail prices that the Organization of Economic Cooperation and Development (OECD) collects for over 3000 final goods in order to calculate Purchasing Power Parity (PPP) estimates. The researchers make every effort to ensure that products of the same quality are compared across countries. For most manufactured goods, the same make and model are compared. For other manufactured goods and food items, researchers rely on an exact description of the items to be priced. When it is difficult to find appropriate matches based on model or on descriptions, researchers from the countries involved travel to the other countries in order to examine which items would be most appropriate matches for the items in their country. The researchers have also called upon the expertise of manufacturers, trade associations, and buyers for large stores in order to determine matches.

Prices are collected at the level of the "basic heading". A basic heading cannot be too broad or too narrow. It cannot be so broad that very different products are compared. It cannot be so narrow that each product is only purchased in one country. For instance, seaweed is too narrow, and food is too broad. To be included in the survey, each product must be accepted for pricing by at least one other country. In the end, not every product is priced in each country, but, as long as countries price their own nominated products and a share of all other products nominated, relative prices for each product and country can be calculated indirectly as well as directly.[36] This method does not completely resolve the problem of comparing items of different qualities, but

[35] Sazanami et al had the right idea, but they did not implement it properly because they used unit values and thus were not able to compare equivalent goods. A price gap does not provide useful information to the extent that the goods compared are not equivalent.

[36] For details on how the prices are combined into one average price for each country see Eurostat-OECD PPP Programme 1996.

the scale of resources expended on accurate matching clearly indicates that these are excellent measures of price differences for equivalent products. There are about 200 product categories, and the sample has been trimmed to 125 traded goods. Data is available for 1985, 1990, and 1993, and protection measures have been derived for each of those years. See Table A1 for a list of the products.

A2.2 The Derivation of Protection Measures

The OECD data consists of consumer prices, not the producer prices that one needs to measure how much an industry is protected from world markets.[37] We convert the OECD prices, however, to producer prices using data on margins: wholesale trade, retail trade, transportation, and taxes.[38] Estimates of producer prices were generated by peeling off the relevant margins. Thus,

$$p_{ij}^{p} = \frac{p_{ij}^{c}}{1 + m_{ij}}, \tag{A1}$$

p_{ij}^{p}: the producer price of good i in country j,
p_{ij}^{c}: the consumer price of good i in country j, as taken from the OECD data,
m_{ij}: the margin for good i in country j.

Producer prices alone do not indicate the extent of protection. We must also take account of transport costs from one nation's market to another and compare each producer price to the landed price of the foreign good. We infer the landed price by using data on export margins and data on international transport costs, as follows.[39] By adding the export margins to the producer prices, the export price is found for each product in each country. Thus, the export price is given by:

$$p_{ij}^{e} = p_{ij}^{p}(1 + em_{ij}) \tag{A2}$$

p_{ij}^{e}: the export price of good i for country j,
em_{ij}: the export margin of good i for country j.

The landed price, which is a proxy for the unobserved world price, is then found by adding the international transport cost to the lowest export price in the sample:

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[37] The Japanese Ministry of International Trade and Industry (MITI)-US Department of Commerce retail price survey (MITI 1992) has been used by some as evidence of protection in Japan. But retail prices do not reflect protection for producers to the extent that domestic trade margins differ by country. Since, as discussed below, margins can vary widely, a simple comparison of retail prices probably cannot provide reliable information on protection. See Yager 1991 and Noland 1995, however, for interesting analyses of the MITI data.

[38] Roningen and Yeats 1976 also use retail prices and adjust for taxes and transport costs, but they do not adjust for wholesale and retail trade margins, which, in general, significantly outweigh taxes and transport costs.

[39] For details on the margins and international transport costs data, see Bradford 1998.

$$p_{ij}^{\ell} = p_{iM}(1 + tr_i)\,, \tag{A3}$$

p_{ij}^{ℓ}: the landed price of good i into country j,
tr_i: the international transport margin for good i,
$p_{iM} = min(p_{1j}^{e}, p_{2j}^{e}, \ldots, p_{6j}^{e})$, the minimum of the 6 export prices.

The ratio of each country's producer price to the common landed price was then used as a preliminary measure of protection. Thus, preliminary protection, ppr_{ij}, is given by:

$$ppr_{ij} = \frac{p_{ij}^{p}}{p_{ij}^{\ell}}\,. \tag{A4}$$

These measures will differ from true protection measures if each of the six countries has substantial barriers to imports. For such goods, the calculated landed price will be higher than the true world price to the extent that the low cost producer in the sample has barriers against imports. This will bias the protection measures downward. By the same token, if just one of the six has no barriers to imports in that good, then these measures will not be biased downward, because, in this case, prices in the free trading country will approximate world prices. Since the sample includes Canada and the US, which are considered to be generally free traders, we can safely conclude that the low price in the sample will approximate the world price a majority of the time. Nevertheless, we use data on trade taxes to correct, at least partially, for the possible downward bias. The final measure of protection is given by:

$$pr_{ij} = max(ppr_{ij}, 1 + t_{ij})\,, \tag{A5}$$

t_{ij}: the tariff rate for good i in country j.

We simply use the fact that trade taxes provide a lower bound on protection. If our preliminary measures do not exceed the overall tariff rate, then that tariff rate is used as the measure of protection. After this correction, the only time that these protection measures will be biased downward is when all six countries in the sample have non-tariff barriers against the rest of the world.

The correlation between our new measures and the NTB incidence indices is only .22. So, these two data sets tell different stories and the choice of which to use must be based on their methodologies.

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TABLE 1
SUMMARY STATISTICS

	MEAN	MEDIAN	MIN	MAX
Regression Variables				
Protection: $\tilde{P}$	.196	.146	.000999	.661
Labor Intensity (workers/$ million): $\frac{L}{\bar{y}}$ or *LAB*	27.6	17.2	0.659	513
Import Penetration: $\frac{m}{y}$ or *IMP*	.198	.0782	2.33×10^{-6}	3.92
Elasticity of Import Demand: $e_{m,p}$ or *ELAS*	2.15	1.07	.0420	23.9
Lobbying Cost Variables:				
4-firm Concentration Ratio: LOB_1	.405	.382	.0700	.940
Geographical Concentration: LOB_2	.704	.708	.300	.996
Number of Firms: LOB_3	.0617	.0284	.00135	1.00
Scaled Number of Firms: LOB_4	.204	.121	.00155	1.54
Unionization Rate: LOB_5	.346	.326	.0660	.754
Underlying Data				
Tariff Equivalent: $\frac{p}{p*}$	1.31	1.17	1.001	2.95
Employment (thousands): *L*	57.3	26.0	2.20	1000
Production ($ million): *y*	6420	2820	73.1	183,000
Imports ($ million): *m*	579	212	.0167	17,500
Exports ($ million)	493	128	0	7540

TABLE 2
LIML ESTIMATION OF THE GENERAL MODEL

Dependent Variable: $\tilde{P} = \frac{p - p^*}{p}$.

Number of Observations: 125

a is set equal to .001.

b^{IM} is set equal to .9.

LOBBYING COST VARIABLE USED

Para-meter	*4-Firm Concen-tration* Estimate (St. Err.)	*Geograph-ical Concen-tration* Estimate (St. Err.)	*Number of Firms* Estimate (St. Err.)	*Scaled Number of Firms* Estimate (St. Err.)	*Union-ization Rate* Estimate (St. Err.)	*None* Estimate (St. Err.)
e	.251**	.244**	.215**	.505**	.251**	.182**
	(.134)	(.141)	(.122)	(.219)	(.124)	(.105)
c	.00112***	.00112***	.00113***	.00112***	.00113***	.00113***
	(1.08×10^{-5})	(1.04×10^{-5})	(9.30×10^{-6})	(1.49×10^{-5})	(9.71×10^{-6})	(8.50×10^{-6})
b_0^P	.888***	.888***	.888***	.891***	.886***	.886***
	(.00804)	(.00773)	(.00715)	(.0115)	(.00707)	(.00648)
b_1^P	.00141	.00075	-.00160	-.0123*	.00364*	
	(.00243)	(.00199)	(.00785)	(.00838)	(.00279)	
Log-Likelihood	1021.60	1019.87	1019.28	1025.84	1022.22	1019.19

*,**,*** Significant at the 10%,5%, or 1% level, respectively. All are 1-tailed tests.

TABLE 3
LIML ESTIMATION OF THE MODEL WITHOUT IMPORTER LOBBY

Dependent Variable: $\tilde{P} = \frac{p - p^*}{p}$.
Number of Observations: 125
a is set equal to .001.
b_0^p is set equal to the point estimates shown in Table 7.

	LOBBYING COST VARIABLE USED					
	4-Firm Concen-tration	*Geograph-ical Concen-tration*	*Number of Firms*	*Scaled Number of Firms*	*Union-ization Rate*	*None*
Para-meter	**Estimate (St. Err.)**	**Estimate (St. Err.)**	**Estimate (St. Err.)**	**Estimate (St. Err.)**	**Estimate (St. Err.)**	**Estimate (St. Err.)**
e	.341***	.342**	.322**	.568***	.333***	.258***
	(.145)	(.163)	(.141)	(.226)	(.138)	(.104)
c	.00111***	.00112***	.00113***	.00113***	.00113***	.00113***
	(1.91×10^{-6})	(2.42×10^{-6})	(1.01×10^{-6})	(1.58×10^{-6})	(2.35×10^{-6})	(8.18×10^{-7})
b_1^P	.00235	.00147	-.00426	-.0134*	.00486**	
	(.00262)	(.00227)	(.0117)	(.00914)	(.00287)	
Log-Likelihood	1021.06	1019.33	1018.72	1025.52	1021.52	1018.21

*,**,*** Significant at the 10%,5%, or 1% level, respectively. All are 1-tailed tests.