October 2006

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Department of Economics Working Paper Series

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Working Paper 2005-28R

June 2005, revised October 2006

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Abstract

A standard finding in the political economy of trade policy literature is that we should expect export-oriented industries to attract more assistance than import-competing industries. In reality, however, trade policy is heavily biased toward supporting import industries. This paper shows within a standard protection for sale framework, how the costliness of raising revenue via taxation makes trade subsidies less desirable and trade taxes more desirable. The model is then estimated and its predictions tested using U.S. tariff data. An empirical estimate of the costliness of revenue-raising is also obtained.

Journal of Economic Literature Classification: F13, F16

Keywords: Protection for sale, tariffs, trade policy, costly taxation, political economy

I thank the co-editor Kala Krishna and two anonymous referees for comments that greatly improved this paper. Thanks also go to Kishore Gawande and Daniel Trefler for providing data and to Emily Blanchard, Dhammika Dharmapala, Josh Ederington, Kishore Gawande, Susumu Imai, Mary Lovely, Giovanni Maggi, Devashish Mitra, Paul Pecorino, Bob Staiger, Gautam Tripathi, and Christian Zimmermann for helpful comments on an earlier version of this paper. The hospitality of Hans-Werner Sinn and the CES-ifo Institute at the Ludwig-Maximilians University in Munich, where part of this research was conducted, is gratefully acknowledged.

1. Introduction

Trade policy is mainly import protection, whether we look at industrialized or developing countries. While economists have come up with many reasons to explain departures from free trade, most of these reasons, such as the optimal tariff argument or strategic trade policy arguments, cannot explain the occurrence of trade protection across a great variety of countries and industry structures. The only theoretical branch with a potential to explain why almost every country tries to influence trade flows in a vast array of different industries is the political economy of trade policy literature. The problem with this literature, however, is that it usually comes to the conclusion (Rodrik 1995) that export promotion should be more pronounced than import protection, a result very much at odds with empirical facts.

It has been argued that the costliness of tax collection compared to tariff collection (called costly revenue-raising henceforth) may explain why import tariffs are more prevalent than export subsidies; e.g., Riezman and Slemrod (1987) show that tariff rates are increasing in proxies of relative tax collection costs for a cross-section of countries in 1977. In this paper, I investigate this possibility in a protection for sale framework. The protection for sale model (Grossman and Helpman 1994) has by now become the new paradigm in the political economy of trade policy literature, and it is thus a natural choice to view the problem of costly revenue-raising in this setting. The protection for sale model has been tested for the United States and other countries (e.g., Mitra, Thomakos, and Ulubasoglu (2001) for Turkey; McCalman (2004) for Australia; Cadot, Grether, and Olarreaga (2003) for India) and has been found to fit the data well.[1] Whereas studies for other countries usually employ tariff data as protection measure, studies for the United States (e.g., Goldberg and Maggi (1999), Gawande and Bandyopadhyay (2000), and Eicher and Osang (2002) to name the most influential) typically use non-tariff barrier (NTB) coverage ratios as protection

[1] Although several papers in the literature find empirical evidence to support the protection for sale hypothesis, none of the tests these papers employ prove conclusively that the protection for sale model is the model generating the data; see, e.g., Goldberg and Maggi (1999) and Imai, Katayama, and Krishna (2005). The current literature's focus on the protection for sale model seems to be due to its solid micro foundations. Once other theoretically well-founded contending models emerge, tests between them may well lead to different conclusions.

measure,[2] despite the fact that the theoretical protection for sale model was developed for tariffs. The cited reason for this digression from theory is that tariff levels are set in multilateral negotiations, whereas the protection for sale model assumes that trade policy can be set unilaterally by the domestic government.

In this paper, I break with the tradition of using NTB coverage ratios, and instead use tariff data to investigate the importance of costly revenue-raising. The main reason for doing so is, of course, that many NTB measures do not create governmental revenue. Moreover, it is common knowledge that NTB coverage ratios, by the very manner in which they are constructed, can only provide very imperfect measures of how strongly protected an industry is. For example, compare two industries that both only produce one product. For one product, a technical standard applies which could be considered a trade impediment, but in practice may have very little influence on imports. For the other product, an import ban prevents the import of this good from abroad. Yet, when we compare trade policy restrictiveness based on NTB coverage ratios, we find that both industries are equally protected, with an NTB coverage ratio of 100%. Hence, we have to question whether using NTB coverage ratios in lieu of tariffs when testing the protection for sale model yields reliable results.

Yet, the problem remains that tariffs are set in multilateral negotiations. This problem may not be as big as it may seem at first glance, though. Trade liberalization negotiations start from the status quo of unilaterally-set tariffs and then seek to lower tariffs from this start level. Oftentimes, the goal of negotiations is to achieve a percentage tariff cut that applies equally to all industries; e.g., the proposed tariff cut in the GATT Kennedy Round was 50%. If such a tariff cut comes through, the structure of pre-negotiation tariffs will be preserved. Moreover, governments usually succeed in getting exemptions from tariff cuts for industries for which trade policy intervention is deemed especially important. This then further preserves or even deepens existing inter-industry tariff variations. On theoretical grounds, Grossman and Helpman (1995) have shown that the difference between the tariff rates of two large countries that negotiate over trade policy is the same as in the protection for sale model where tariffs are set unilaterally. An even stronger argument for the validity of the protection for sale predictions, even when countries are large and negotiate over

[2]Some recent exceptions include Gawande, Krishna, and Robbins (2004) who use tariff data and Lopez and Matschke (2006) who use implicit tariff data.

trade policy, comes from Bagwell and Staiger (1999). They show that when large symmetric countries start at the non-cooperative Nash tariff equilibrium and then gradually and reciprocally reduce tariffs, eventually they will end up at the politically optimal tariff level for a small country. This means that the protection for sale predictions for a small country that sets its tariff policy unilaterally may very well coincide with the tariff outcome for a large country that participates in multilateral trade negotiations.

In this paper, I show that the protection for sale model explains U.S. tariff data very well once costly revenue-raising is incorporated into the model. I obtain very precise estimates of how costly it is to raise revenue by means other than a tariff. It is further demonstrated that if costly revenue-raising is ignored, the protection for sale model performs poorly when confronted with U.S. tariff data. The conclusion is that costly revenue-raising is a major determinant of the observed bias toward supporting import-competing industries.

The remainder of the paper is organized as follows: In Section 2, I show how costly revenue-raising alters the equilibrium trade policy results of the protection for sale model. Section 3 uses data from U.S. manufacturing to test whether costly revenue-raising can account for part of the observed bias toward import protection. Section 4 concludes.

2. Theoretical Model

2.1. **Basic setup.**

In the following, I augment Grossman and Helpman's (1994) protection for sale model, from now on called GH model, to allow for costly revenue-raising.

As in the original GH model, I assume a small country with $n+1$ industries facing an exogenous vector of world prices. The country owns fixed amounts of industry-specific capital K_i, where $i = 1, \ldots, n$. Labor is supplied inelastically by the country's population. The population size is fixed at L. While labor cannot leave or enter the country, it is perfectly mobile between all domestic industries i, where $i = 0, \ldots, n$. Industries $i = 1, \ldots, n$ are the industries of interest; i.e., the industries which may be subject to trade policy. Each of them produces a single, tradable good using labor and sector-specific capital according to a linearly homogeneous and weakly concave production function F_i. Industry 0 produces a numeraire good from labor with a one-to-one technology, $F_0 = L_0$. Good 0 is traded freely; i.e., its trade is never subject to any trade policy intervention. Clearly, the world market price of good 0, which is normalized to 1, fixes the wage rate. Production in the numeraire industry thus provides a buffer for the other industries: Any labor set free in the non-numeraire industries can find employment in sector 0, and any additional labor needs in other sectors can be met by withdrawing labor from the numeraire sector without affecting wages.

On the consumption side, it is assumed that all individuals have identical quasilinear preferences. The utility function for any individual is the sum of his good 0 consumption and strictly concave and increasing transformations of the consumption of each of the non-numeraire goods 1 to n.[3] Quasilinearity of preferences implies that the indirect utility function of any individual is additively separable into an income and a price component. Specifically, indirect utility can be written as the sum of income and consumer surplus V_i from consumption of good i where i goes from 1 to n.

The domestic government raises revenue from a wage tax, import tariffs, and export taxes and uses these monies to pay for export and import subsidies as well as for a public service. Since the wage rate is fixed and labor supply is inelastic, the wage tax may also be viewed as a per-capita tax. Tariff revenue can be used as alternative source of income. Hence, if the government wants to levy a fixed amount of revenue, an increase in tariff revenue decreases the tax that has to be raised.[4]

Costly revenue-raising is modelled as follows: Raising the wage tax is costly; i.e., in order to have a certain amount X available from the tax, the government has to raise an amount $L_f(X)$ which exceeds X. Here, we can think of the difference $L_f(X) - X$ as some additional labor input requirement for raising the tax which the government formally pays, but whose cost is covered by raising the tax amount accordingly. In the end, the costliness of taxation reduces the labor input available in the numeraire sector 0. For simplicity, the function $L_f(X)$ is assumed to be linear in X, namely $L_f(X) = cX$, where $c > 1$. The government uses the tax revenue to finance export and import subsidies as well as provide a service to the population. Here, this service is treated as if it were a simple hand-out of a constant amount T, which is distributed evenly among the population.

[3]It is assumed that each individual has enough income to consume all goods; i.e., corner solutions are excluded.

[4]Instead of considering a wage tax, it is also theoretically possible to look at an income tax. Compared to the wage tax, this complicates the results because not only the tax rate, but also the tax base depends on the chosen trade policy. In the appendix, I solve for the equilibrium trade policy equation in the income tax case and show that this equation is, in general, not estimable with the data currently available.

In some of the industries, but not the numeraire industry 0, capital owners are active lobbyists that solicit trade protection from the domestic government. Each lobby offers the government a schedule that lists its contributions as a function of the domestic price vector p. The domestic price vector p may differ from the world price vector p^* if the domestic government imposes a vector t of specific import or export tariffs or subsidies. Hence, if p_i^* denotes the world market price of good i, then the domestic price is $p_i = p_i^* + t_i$. Suppose good i is an import good. Then $t_i > 0$ ($t_i < 0$) means that an import tariff (import subsidy) is imposed. In contrast, if good i is an export good, then $t_i > 0$ ($t_i < 0$) implies an export subsidy (export tax). The lobbies' goal is to maximize their members' income. The part of income that depends on the chosen price vector consists of profits, consumer surplus, and the wage income after taxes. Imposing an export tax or an import tariff reduces the necessary tax amount whose raising is costly, so the tax rate can be lowered following

$$c(T - \sum_{j=1}^{n} t_j M_j) = \tau L \qquad (2.1)$$

where τ stands for the wage tax rate and $M_j > 0$ ($M_j < 0$) denotes imports (exports) of good j. In (2.1), the money that has to be raised via domestic taxation appears on the left-hand side and the levied tax on the right-hand side. If the tariff revenue increases, the tax rate τ can be lowered.

The government maximizes the weighted sum of total contributions and aggregate welfare by choice of the trade policy vector. Here, the weight on aggregate welfare is denoted by a. Contributions C receive a weight of 1. I assume that contributions do not form part of the funds which the government uses for providing services to the citizens, so contributions cannot be used directly to decrease costly taxation.

The solution to the lobbying game follows the findings in GH. The equilibrium tariff vector is described by the following conditions: It maximizes the government's utility function, and it maximizes the sum of governmental utility and the utility of any lobby. The number of conditions is thus equal to the number of lobbies plus one. A corollary of this result, as pointed out by GH, is that the equilibrium tariff can alternatively be calculated by maximizing the weighted sum of domestic welfare and the welfare of the different active lobby groups.[5]

[5]The GH model thus provides micro foundations for the political support function approach where the welfares of different groups in society receive differing weights in the governmental objective function.

2.2. **Equilibrium trade policy.** Before investigating the case with lobbying, it seems worthwhile to look at the equilibrium trade policy which emerges when the domestic government simply maximizes domestic welfare. Given quasilinear utility, domestic welfare is the sum of consumer surplus V_j from consuming the non-numeraire goods $j = 1, \ldots, n$ and domestic income. Income consists of the value of production $p_j F_j$ in industries $j = 0, \ldots, n$ and trade policy revenue $t_j M_j$ for goods $j = 1, \ldots, n$; i.e., the government maximizes

$$\sum_{j=1}^{n} V_j + \sum_{j=0}^{n} p_j F_j + \sum_{j=1}^{n} t_j M_j.$$

To see that costly revenue-raising has an impact on domestic welfare, write out the production value in the numeraire industry 0, noting that this industry produces one unit of output from one unit of labor and that its price is normalized to 1, and further noting that costly revenue-raising reduces the amount of labor used in industry 0. Domestic welfare is hence given by

$$\sum_{j=1}^{n} V_j + \sum_{j=1}^{n} p_j F_j + [L - \sum_{j=1}^{n} L_j - (c-1)(T - \sum_{j=1}^{n} t_j M_j)] + \sum_{j=1}^{n} t_j M_j.$$

The term in brackets is the production value in the numeraire industry. Rearranging slightly, domestic welfare equals

$$\sum_{j=1}^{n} V_j + \sum_{j=1}^{n} \Pi_j + (1-c)T + c \sum_{j=1}^{n} t_j M_j,$$

where Π_j stands for profits in industry j. The above expression shows that the costliness of raising revenue via taxes puts an additional weight c on tariff revenue. The intuition for this higher weight is simple: Tariff revenue reduces the resources needed in the revenue-raising industry and increases the production value in the numeraire industry. Simplifying and omitting all components that do not depend on t_i, the government chooses t_i (where $i = 1, \ldots, n$) to maximize

$$W_G = V_i + \Pi_i + c t_i M_i.$$

The welfare maximizing trade policy for sector i is hence

$$t_i^G = -\frac{(c-1)M_i}{cM_i'}. \tag{2.2}$$

To sign this expression, I make use of the standard assumption $M_i' < 0$. If revenue-raising were not costly, then $c = 1$ and free trade would emerge, the usual result for small countries that free trade is optimal. However, since income from trade policy can be used to lower the levied tax and thus the cost from taxation, the government will impose an import tariff ($t_i^G > 0$) on import goods ($M_i > 0$), whereas for export goods ($M_i < 0$) an export tax ($t_i^G < 0$) is optimal. This means that even for the simple case of domestic welfare maximization, introducing costly revenue-raising induces incentives to favor import-competing industries and to hurt exporting industries.

To gain a better understanding of the outcome of the protection for sale lobbying game, it is reasonable to look at the trade policy measures that lobby groups would set if they could unilaterally do so. It has been shown elsewhere (Matschke 2004) that the equilibrium trade policy vector of the protection for sale model can be – roughly speaking – expressed as a weighted average of the unilaterally optimal tariffs of the players of the lobbying game. Viewing these tariffs separately provides a better understanding of the forces that ultimately determine the equilibrium trade policy.

If capital owners of industry k, where $k \neq i$, could set the trade policy instrument for sector i, they would do so to maximize[6]

$$W_k = \theta_k[V_i + (1-\tau)L],$$

where θ_k is the population share of capital owners in industry k and τ can be rewritten as $\frac{c}{L}(T - \sum_{j=1}^{n} t_j M_j)$ according to (2.1). The first-order condition for maximization of W_k is

$$t_i^k = -\frac{M_i}{M_i'} + \frac{D_i}{cM_i'}, \tag{2.3}$$

where D_i stands for demand of good i. When $c = 1$, we see that other industries desire an import subsidy or export tax for industry i depending on whether i is an import-competing or exporting industry. This changes, however, once the case of costly revenue-raising $c > 1$ is considered. It is easy to see that (2.3) is negative for $M_i < 0$; i.e., exporting industries would be left with an export tax if the other lobbies could decide trade policy for sector i. However, due to the additional costs of subsidies, it is no longer clear whether the outcome would be an import subsidy for import-competing industries.

Turning to the interests of capital owners in industry i itself, note that

$$W_i = \Pi_i + \theta_i[(1-\tau)L_i + V_i],$$

[6] Here and in the following, I leave out all welfare components that do not depend on t_i.

which is maximized by

$$t_i^i = -\frac{1-\theta_i}{\theta_i c}\frac{F_i}{M_i'} - \frac{c-1}{c}\frac{M_i}{M_i'}. \tag{2.4}$$

If revenue-raising were not costly, capital owners in i would want an import tariff (for $M_i > 0$) or export subsidy (for $M_i < 0$). Costly revenue-raising reinforces the case for an import tariff, whereas it is no longer clear whether industry i would want an export subsidy for its own good.

I now address the solution to the lobbying game itself. Denote by Θ the percentage of all lobbies in the population. I begin with the case that industry i lobbies. As was stated earlier, the equilibrium trade policy instrument t_i^* maximizes a times domestic welfare plus the sum of all lobby welfares, which, after substituting for the tax rate τ and omitting terms that do not depend on t_i, can be written as

$$a(V_i + \Pi_i + ct_iM_i) + \Pi_i + \theta_i[ct_iM_i + V_i] + (\Theta - \theta_i)[ct_iM_i + V_i]. \tag{2.5}$$

The equilibrium trade policy instrument when industry i lobbies is thus implicitly given by

$$t_i^* = -\frac{1-\Theta}{a+\Theta}\frac{F_i(t_i^*)}{M_i'(t_i^*)c} - \frac{c-1}{c}\frac{M_i(t_i^*)}{M_i'(t_i^*)} \tag{2.6}$$

or equivalently

$$t_i^* = -\frac{1-\Theta}{a+\Theta}\frac{F_i(t_i^*)}{M_i'(t_i^*)} + \frac{c-1}{c}\left[\frac{1+a}{a+\Theta}\frac{F_i(t_i^*)}{M_i'(t_i^*)} - \frac{D_i(t_i^*)}{M_i'(t_i^*)}\right].$$

If $c = 1$, import-competing lobbies would receive an import tariff and exporting industries would receive an export subsidy. But for $c > 1$, import-competing industries always receive an import tariff, whereas it is not clear whether exporting industries will end up with an export subsidy. It is also easy to show that the optimal trade policy is increasing in demand D_i if industry size (as measured by output F_i) and the slope of the import demand curve are held constant. Notice that the derivative with respect to D_i of the first-order maximization condition for (2.5), holding F_i and M_i' constant, is

$$(a+\Theta)(c-1) > 0$$

and has the same sign as dt_i^*/dD_i as long as the second-order condition of maximization holds.[7] In particular, this means that any potential export subsidy would not match the

[7]With costly revenue-raising, it is no longer clear that $dt_i^*/dF_i > 0$, holding D_i and M_i' constant; i.e., bigger industries in terms of output do not necessarily receive more protection.

import tariff in size for two otherwise equal industries, one import-competing and one exporting.[8]

It remains to analyze the case where capital owners of industry i do not lobby. In this case, the equilibrium trade policy instrument maximizes

$$a(V_i + \Pi_i + ct_iM_i) + \Theta[ct_iM_i + V_i]. \tag{2.7}$$

The equilibrium trade policy instrument for sector i when its capital owners do not lobby is thus given by

$$t_i^* = \frac{\Theta}{a+\Theta}\frac{F_i(t_i^*)}{cM_i'(t_i^*)} - \frac{c-1}{c}\frac{M_i(t_i^*)}{M_i'(t_i^*)}, \tag{2.8}$$

or, equivalently, by

$$t_i^* = \frac{\Theta}{a+\Theta}\frac{F_i(t_i^*)}{M_i'(t_i^*)} + \frac{c-1}{c}\left[\frac{a}{a+\Theta}\frac{F_i(t_i^*)}{M_i'(t_i^*)} - \frac{D_i(t_i^*)}{M_i'(t_i^*)}\right].$$

If $c = 1$, import-competing lobbies would receive an import subsidy and exporting industries would receive an export tax. For $c > 1$, the case for an export tax is reinforced, but it is no longer clear whether import-competing industries will have to bear an import subsidy. It is once again easy to show that the optimal trade policy is increasing in demand D_i, holding F_i and M_i' fixed; i.e., industries of the same size (as measured by their output F_i) receive higher t_i^* as demand increases.[9] In particular, any export tax put on goods of an exporting industry will exceed the corresponding import subsidy (if any) for an import-competing industry of equal size; i.e., import-competing industries will be favored over exporting industries. The intuition behind the positive relationship between D_i and t_i^*, after controlling for F_i and M_i', is straightforward: For an import-competing industry protected by an import tariff, higher demand increases the tariff base that can be tapped into by a higher import tariff (similarly, for an industry facing an import subsidy, higher demand leads to a higher subsidy base which then induces an incentive to lower the subsidy), so costly taxation can be reduced. A similar reasoning applies to exporting industries.

The positive relationship between equilibrium import tariff and demand is in contrast with the findings in Ederington and Minier (2005), henceforth EM, where the relationship

[8]Maggi and Rodriguez-Clare (2000) derive a similar import protection bias by assuming different weights on different welfare components in the governmental welfare function, in particular, they assume that tariff revenue receives a weight that exceeds one.

[9]Notice that for $t_i^* < 0$, an increase in D_i implies a smaller export tax or smaller import subsidy.

between equilibrium tariff and demand is negative. This difference in results arises from several distinct modelling differences between the two papers. For instance, EM allow for domestic production subsidies, but do not explicitly consider the revenue role of their policy instruments. In this case, the government would not choose trade policy at all in the standard GH model because domestic production subsidies can help producers just as well as trade policy instruments without distorting consumption. In order to reintroduce trade policy into their model, EM assume the existence of an unspecified benefit of trade policy. Their equilibrium tariff is hence a function of demand, demand elasticity and the marginal external benefit of trade policy (assumed constant across industries) only; in particular, t_i^* does not depend on output and is inversely related to demand because the marginal benefit of a tariff is constant for all industries, but the negative effects on consumers are higher for industries with higher demand. In the next section, I show that I find no evidence of any negative relationship between import tariffs and demand, and moreover, output and whether or not an industry lobbies seem to matter as well. However, the data set I use is for manufacturing industries where production subsidies are far less common than in agriculture, so it is not all that surprising that EM find empirical support for their model predictions in a cross-country sample of agricultural commodities.

In the following section, I test the implications of my model with import protection data. These data, at least with respect to import tariffs, are readily available, and import protection is without doubt the most prevalent form of trade policy intervention.[10]

3. Econometrics

To estimate the model and test its predictions, I use 1983 data for U.S. manufacturing industries described in Matschke and Sherlund (2006). The tariff rates and political action committee (PAC) contributions were provided by Kishore Gawande and are described in Gawande (1995). Data on imports and exports were taken from the NBER trade and immigration data base, shipments and value-added from the NBER productivity data base by Bartelsman and Gray (1996); elasticity estimates come from the study by Shiells, Stern,

[10]I do not consider export policy, but clearly, my model cannot solve the empirical puzzle of why export policy is much less pronounced than import policy. In particular, it cannot answer the question as to why we see so few export taxes, especially in industrialized nations.

and Deardorff (1986). Data on instruments[11] were provided by Daniel Trefler; see Trefler (1993) and Matschke and Sherlund (2006). After merging the data from different sources, 194 four-digit SIC manufacturing industries are left. Summary statistics for key variables are reported in Table 1.

The econometric model follows directly from (2.6) and (2.8). Letting I_i be the dummy variable indicating lobbying by capital owners in industry i, the protection equation can be rewritten in a unified form as

$$t_i^* = [1 - \frac{a}{(a+\Theta)c}]\frac{F_i}{M_i'} - \frac{1}{(a+\Theta)c} I_i \frac{F_i}{M_i'} - \frac{c-1}{c}\frac{D_i}{M_i'}. \tag{3.1}$$

To rewrite (3.1) in terms of observables, transform it as

$$t_i^* \tilde{M}_i' = [\frac{a}{(a+\Theta)c} - 1]\tilde{F}_i + \frac{1}{(a+\Theta)c} I_i \tilde{F}_i + \frac{c-1}{c}\tilde{D}_i, \tag{3.2}$$

where $\tilde{F}_i$ is the value of shipments minus exports[12] and $\tilde{D}_i$ the value of domestic consumption in industry i. The expression $t_i^* \tilde{M}_i'$ is calculated as $-t_i^* p_i M_i' = \tilde{t}_i^* e_i \tilde{M}_i/(1+\tilde{t}_i^*)$, where $\tilde{t}_i^*$ is the equilibrium ad valorem tariff rate, $e_i = -M_i' p_i / M_i$ the absolute price elasticity of import demand, and $\tilde{M}_i$ the value of imports. In the literature, the import demand elasticity is often included as part of the dependent variable to account for the fact that it is a generated (i.e. estimated) variable; see Goldberg and Maggi (1999) for a discussion. I follow a similar procedure here by including $\tilde{M}_i'$, which is calculated using the estimated import demand elasticity, on the left-hand side. The estimation equation thus becomes

$$t_i^* \tilde{M}_i' = \beta_1 \tilde{F}_i + \beta_2 I_i \tilde{F}_i + \beta_3 \tilde{D}_i + \epsilon_i, \tag{3.3}$$

[11] The instrumental variables include factor shares (defined as factor revenues divided by production value) for physical capital, inventories, engineers and scientists, skilled labor, semiskilled labor, and unskilled labor. Other instruments include seller concentration, seller number of firms, buyer concentration, buyer number of firms, capital-labor ratio, capital stock, unionization, geographic concentration, and tenure.

[12] Subtracting exports to calculate $\tilde{F}_i$ is necessary since exports are not sold at the domestic, tariff-inclusive price.

where, according to theory,

$$\beta_1 = \frac{a}{(a+\Theta)c} - 1 < 0,$$
$$\beta_2 = \frac{1}{(a+\Theta)c} > 0,$$
$$\beta_3 = \frac{c-1}{c} > 0,$$
$$\beta_1 + \beta_2 + \beta_3 = \frac{1-\Theta}{(a+\Theta)c} \geq 0.$$

The basic GH specification without costly revenue-raising results when $c = 1$, so that $\beta_3 = 0$. Notice that all coefficient signs can be predicted, and moreover, we know that $\beta_1 + \beta_2 + \beta_3$ should be positive. All structural parameters are exactly identified; namely, $c = 1/(1 - \beta_3)$, $\Theta = -(\beta_1 + \beta_3)/\beta_2$, and $a = (1 + \beta_1)/\beta_2$.

I estimate and compare the basic GH specification with the cost-of-funds specification derived in this paper. Several complications arise in estimating these models. First, components of the explanatory variables are endogenously determined; hence, instrumental variable techniques have to be used. A second complication arises because some of the explanatory variables are generated regressors; e.g., it is necessary to determine which of the industries are politically organized and lobby for trade policy. It is therefore important to explore the sensitivity of the results to different variable formulations.

Standard theory suggests that domestic production of good i for the home market is an increasing function of the tariff t_i and should therefore be treated as an endogenous explanatory variable in the econometric model. Moreover, domestic consumption is decreasing in the tariff, and the political organization variable is also potentially endogenous. Therefore, I estimate (3.3) by the two-step optimal Generalized Method of Moments (GMM) using moment conditions generated by the orthogonality of the structural error and the instruments. For overidentified models, optimal GMM is asymptotically better than two-stage least squares (2SLS), used in an earlier version of the paper, because it is more efficient; i.e., the standard errors are smaller.[13]

For the baseline case, the model is estimated without a constant because according to theory there should not be a constant term in the estimation equation, see, e.g., Goldberg

[13] 2SLS point estimates (not reported in this version) are very similar to the GMM estimates reported here.

and Maggi (1999) and Eicher and Osang (2002). In the sensitivity analysis, I also report results when a constant term is included in the estimation equation and show that the results are very similar to the case without a constant.

Although the protection for sale model does not provide much guidance on how to infer which industries are organized, this knowledge is important in estimating it. I use different approaches to categorize industries with and without organized lobbies to ensure that the uncertainty about the lobby indicator does not drive the results. In the first specification (labeled XM in Table 2), I regress PAC contributions (divided by value-added) on a constant and deadweight losses from protection (divided by value-added) interacted with 2-digit SIC dummy variables.[14] If the coefficient on an interaction is positive, I assume that all industries within this 2-digit SIC classification lobby. This is supported by theory since in the protection for sale model, lobby contributions are increasing in the deadweight loss from lobbying. For the second specification (labeled GB in Table 2), I follow Gawande and Bandyopadhyay (2000). To determine which industries are organized, I regress PAC contributions (divided by value-added) on a constant and import penetration ratios interacted with 2-digit SIC dummy variables. As before, if an interaction coefficient is positive, I assume that all industries within this classification lobby. The idea behind this specification is that in case of an active lobby, industries that are threatened more by imports (as evidenced by a higher import penetration ratio) will spend greater resources on lobbying. For the third specification (labeled GM in Table 2), I divide PAC contributions by value-added and then use a simple cutoff of 0.0001; industries where this variable exceeds the cutoff are considered to be organized lobbies. This is similar to Goldberg and Maggi (1999) except that they use gross contributions to determine the cutoff value. This specification is justified if industries contribute for a variety of reasons and only those with high contributions also contribute to influence trade policy.

To further account for the fact that the lobby indicator is a generated variable, I also consider variations of the regression-based XM and GB procedures by only considering industries as organized if the coefficient on the interaction term with the 2-digit SIC classification is positive and significant. Results for these indicator specifications appear as XMsig and GBsig, respectively, in Table 2. Finally, I also report bootstrapped standard errors as

[14] I use the formula $0.5\tilde{M}_i e_i \tilde{t}_i^* / (1 + \tilde{t}_i^*)^2$, given, e.g., in Vousden (1990), p. 49, for linear demand and supply to approximate the deadweight loss.

an alternative to the usual asymptotic standard errors. P-values based on the bootstrapped standard errors are given in brackets, whereas p-values from traditional standard errors are in parentheses.

Table 2 reports optimal GMM estimation results for the cost-of-funds specification and the simple GH specification. All explanatory variables are instrumented for, using instruments comparable to the ones in Goldberg and Maggi (1999), Gawande and Bandyopadhyay (2000), and Matschke and Sherlund (2006); namely, unionization percentage, factor shares, concentration ratios, scale, capital stock, tenure, capital-labor ratio, and geographic concentration. The instrumental variables are tested for validity, i.e., orthogonality to the structural error. The reported J-statistics show that the instruments are valid for the cost-of-funds specification with GBsig being a borderline case at the 10% level of significance. In contrast, for the basic GH specification, the J-test always rejects the validity of instruments at the 5% level. This indicates that the basic GH model leaves out important determinants of trade protection. The first-stage F-statistics, which are not reported in Table 2 to conserve space, show that the instruments are relevant. F-statistics for all specifications have a lower bound of 14 for $\tilde{F}_i$ and $\tilde{D}_i$. They are lower for $I_i\tilde{F}_i$, but the hypothesis that the instruments do not explain $I_i\tilde{F}_i$ is always rejected at least at the 0.1% level of significance.

Looking at the coefficient estimates in Table 2, the results are highly supportive of the cost-of-funds specification. All reduced-form parameter estimates have the right signs and are statistically significant at least at the 5% level when the asymptotic standard errors are used and at least at the 10% level when the bootstrapped standard errors are employed. The point estimates add up to a positive number, which is in line with $\beta_1 + \beta_2 + \beta_3 \geq 0$. The null of $\beta_3 = 0$ is strongly rejected in all specifications. Estimates of the structural parameters look very good as well.[15] As with other studies, I find that the estimate of the weight on domestic welfare in the governmental welfare function is high; i.e., the point estimates for a range between 34.72 in the XMsig case and 114.46 in the GB case and are quite close to the estimate reported in Goldberg and Maggi (1999), where NTB coverage ratios were used to measure trade protection. Point estimates for the percentage of the population represented by lobbies Θ lie between 5.93% for the XMsig case and 47.42%

[15]Standard errors for the structural parameters are calculated using the delta method.

for the GB case. They seem quite reasonable and are close to the estimates reported by Eicher and Osang (2002) and lower than those reported in Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000). The cost parameter c is very precisely estimated as lying between 1.03 and 1.05. This suggests that raising one dollar of governmental revenue via alternative taxes costs 3-5 cents more than the administrative costs of raising one dollar by means of a tariff, abstracting from the welfare costs of the tariff. Furthermore, the 99% confidence interval for c always excludes 1 when conventional standard errors are used. The results are very similar with bootstrapped standard errors. Interestingly, the XM specification, which is preferable on theoretical grounds, leads to less precise estimates with bootstrapped standard errors, but even in this case c is statistically different from 1 at the 10% significance level. In short, the results indeed suggest a positive cost of revenue-raising. That the estimate is quite close to 1 is not surprising, either. We would expect the marginal cost estimate of fund-raising to be substantially larger when looking at developing countries that heavily depend on income from trade restrictions (Kubota 2005). Yet, the results indicate that even in the U.S., the cost of raising funds still has a significant effect on trade protection.

Results for the simple GH specification show that the tariff data only offer weak support for the basic protection for sale model.[16] The estimate of β_1 has the wrong (positive) sign in all specifications, but is not statistically different from zero, with the exception of the GM and XMsig specifications where it is not only positive, but significant as well. As a consequence, the point estimate of Θ is always negative. The results for the simple GH specification, contrary to the cost-of-funds specification, thus do not provide strong support for the protection for sale model when tariff data are used as protection measure.

In the sensitivity analysis reported in Table 3, using the alternative lobby indicator specifications XM, GB, and GM,[17] I first consider an alternative protection measure: the tariff levels from the data set of Chris Magee, which was downloaded from `http://www.internationaldata.org`. The estimates obtained with these data (columns

[16]This is contrary to the results with NTB coverage ratio data for the U.S. in 1983 which support the basic protection for sale model, as shown by Goldberg and Maggi (1999), Gawande and Bandyopadhyay (2000), Eicher and Osang (2002), and Matschke and Sherlund (2006).

[17]The results for XMsig and GBsig are similar, but not reported to conserve space.

1–3 of Table 3) are also very similar to the original results and provide very strong support for the cost-of-funds specification. They also show the robustness of the cost estimates. Compared to the results obtained when using the Gawande tariff data, they increase slightly to 4–6 cents per dollar.

As a second robustness check, I consider all three capital lobby indicator specifications, but now estimate the model with a constant. The inclusion of a constant is a rudimentary way to allow factors outside the protection for sale model to matter for trade protection. The results are reported in columns 4 to 6 of Table 3. In two of the three specifications, the estimate of β_0 is significantly different from 0. The estimates of β_1, β_2, and β_3 all have the right signs and are statistically significant at the 5% level when conventional standard errors are used. With bootstrapped standard errors, the estimate of β_2 is not statistically different from zero at conventional levels of significance in two of the three specifications. Compared to the model without the constant, the estimates of Θ and a are somewhat higher, but remain well within the range of estimates reported previously in the literature. Most importantly, the estimate of c remains highly significant in all specifications, and the point estimates are almost identical to those obtained in the no-constant model.

Next, I introduce a labor market variable, which measures redistribution between workers and firms, into the estimation equation. A detailed description about how to introduce the labor market into the protection for sale model can be found in Matschke and Sherlund (2006) who use NTB coverage ratios to estimate the labor-augmented model. To infer which labor groups are organized, I use similar procedures as employed for the capital lobby indicator: In the XM case, I use an auxiliary regression where labor PAC contributions (divided by union wage sum) are regressed on a constant and deadweight losses from protection (divided by union wage sum) interacted with 2-digit SIC dummy variables. If the parameter estimate for an interaction variable is positive, I assume that labor in all industries within this classification lobbies. In the GB case, the same procedure is repeated, replacing deadweight loss by import penetration ratio. Finally in the GM case, the same cutoff value of 0.0001 to determine capital owner lobbying is also used for labor PAC contributions (divided by union wage sum). To classify industries into those with mobile and immobile labor, a cutoff of 10% for the industry unemployment rate is used as in Matschke and Sherlund (2006). In the tariff case, the labor variable is not significant in the "long specification" where $I_i\tilde{F}_i$ and the labor variable appear as separate explanatory variables. At the same time, the equality of their coefficients cannot be rejected so that the estimation of the "short specification", where $I_i\tilde{F}_i$ plus the labor variable appears as single explanatory variable, is feasible. Results for this short specification are reported in columns 7–9 of Table 3. A comparison with Table 2 shows that the conclusions are very similar to the case without an included labor variable. In particular, the estimates for the costly parameter c are almost identical.

Finally, I also redo the estimation after dividing both sides of the estimation equation by imports. The results obtained in this case are quite interesting. Looking at the parameter estimates, we see that the point estimates for β_1 and β_3 increase, whereas the point estimate for β_2 decreases dramatically and is no longer statistically different from 0 at usual significance levels (the only exception occurs in the GM case with conventional standard errors, where β_2 remains statistically significant at the 10% level). For the structural coefficient estimates, this means that the estimate of a shoots up to levels between 3000 and 12500, estimates quite comparable to those found in Gawande and Bandyopadhyay (2000). The estimates for c increase slightly, but at levels between 1.07 and 1.08, they are still quite similar to the previous results and statistically significant at the 1% level. However, it would be a mistake to consider this final part of the sensitivity analysis as supporting the costly-funds version of the protection for sale model. Rather, there are strong indications that the model specification with division by imports is problematic for the tariff case. To begin with, the parameter estimates for β_1 and β_3 are practically identical in absolute value which was not previously the case. Further, notice that once we divide by imports, it is no longer possible to have a constant in the regression because of perfect multicollinearity (since $D_i/M_i - F_i/M_i = 1$). In fact, since β_2 is not statistically different from 0, the results are very similar to a regression without the lobby variable for which $-\beta_1 = \beta_3 = E(ZY)/E(Z)$, where Z is the instrumental variable, Y the dependent variable, and E the expectation operator. Therefore, these coefficients should not be given a protection for sale interpretation. A look at the validity and relevance of instruments explains why the results after division by imports are not reliable: The F-statistics for the first stage drop to very low levels, and the associated p-values sometimes even rise above 0.1, meaning that the instruments have little relevance. Even worse, the J-statistics always indicate that the instruments are not valid; i.e., not uncorrelated with the structural error. The validity of instruments is rejected in all cases, with p-values always below 0.01. These findings indicate that when evaluating the protection for sale model empirically, the performance of the chosen instruments should be carefully examined.

4. Conclusion

This paper shows how introducing costly revenue-raising (i.e., the marginal cost of raising additional revenue exceeds unity) into a standard protection for sale model may explain why, in general, import-competing industries receive more trade policy support than exporting industries. This cost-of-funds specification of the protection for sale model, tested using 1983 U.S. tariff data, finds strong empirical support. In contrast, the basic Grossman-Helpman model is only weakly supported by the tariff data. The point estimate of the cost of raising one dollar in taxes lies between 3 and 6 cents, with the lower boundary of 99% confidence intervals for this cost usually exceeding 0. Costly revenue-raising thus seems to have a significant effect on tariff levels, all else being equal. The policy implication is that part of the bias toward import protection can be explained by the fact that import tariffs raise governmental revenue and as such reduce the need for costly revenue-raising via taxes.

Appendix A. Income tax and equilibrium trade policy

In the following, I consider an income tax as opposed to a wage tax. In this case, the governmental budget constraint (2.1), which equalizes tax needs and tax revenue, becomes

$$c(T-\sum_{j=1}^{n} t_j M_j) = \tau(L+\sum_{j=1}^{n}\Pi_j + T), \tag{A.1}$$

where τ is the income tax rate. The income tax complicates matters because tax rate and tax base now both depend on t_i.

As before, I start by discussing the unilaterally optimal tariffs for different participants in the lobbying game. Clearly, the domestic welfare-maximizing tariff is still given by (2.2), but the unilaterally optimal tariffs for the lobby groups have to be recalculated. If lobby $k \neq i$ could set the tariff t_i unilaterally, it would do so to maximize $W_k = \theta_k V_i + (1-\tau)(\theta_k(L+T)+\Pi_k)$. Defining β_k as the share of group k's income in total income, lobby k's unilaterally optimal tariff on good i is

$$t_i^k = \frac{\theta_k D_i - \tau\beta_k F_i - c\beta_k M_i}{c\beta_k M_i'}.$$

Similarly, lobby group i would set the tariff for its own product to maximize $W_i = \theta_i V_i + (1-\tau)(\theta_i(L+T)+\Pi_i)$. Lobby i's unilaterally optimal tariff on good i is thus

$$t_i^i = \frac{\theta_i D_i - \tau\beta_i F_i - c\beta_i M_i - (1-\tau)F_i}{c\beta_i M_i'}.$$

Notice that since the income share of a lobby group is not equal to its population share, these expressions cannot be simplified further. Aggregating the unilaterally optimal tariffs to the equilibrium tariff for good i, I find that

$$t_i^* = -\frac{a(c-1)+c\Theta-\sum_{j\in\Omega}\gamma_j\theta_j}{c(a+\Theta)}\frac{D_i}{M_i'} + \frac{a(c-1)+(c-\tau)\Theta}{c(a+\Theta)}\frac{F_i}{M_i'} - \frac{\gamma_i(1-\tau)}{c(a+\Theta)}\frac{I_i F_i}{M_i'} \tag{A.2}$$

where $\gamma_j = \theta_j/\beta_j$ and the summation over $j \in \Omega$ is over all industries with active lobbies. If we bring the absolute elasticity of import demand over to the left-hand side, the result resembles the one in the wage tax case in that the coefficient on demand D_i is positive (since the income shares of lobbies always exceed their population shares, we have $c\Theta > \sum_{j\in\Omega}\gamma_j\theta_j$), the coefficient on output F_i is negative, and the coefficient on I_iF_i is positive. In (A.2), D_i, F_i, I_i, τ, M_i' and t_i are observed. However, the γ_i are industry-specific and unobserved, so that (A.2) cannot be estimated.

TABLE 1. Summary Statistics

Variable	Unit	Mean	Median	Std. Dev.	Min.	Max.
import tariff Gawande	fraction	0.058	0.052	0.049	0.000	0.419
import tariff Magee	fraction	0.053	0.052	0.042	0.000	0.419
shipments	$ million	5258.1	14266.0	2414.3	73.1	182591.8
imports	$ million	557.1	1595.4	167.5	0.2	17482.5
exports	$ million	493.1	1534.1	141.5	0.0	18779.5
import demand elasticity	absolute value	1.590	1.421	1.053	0.042	8.028
PACCORP	$ million per contributing firm	0.0264	0.0135	0.0273	0.0032	0.1551

Table 2. Estimation Results – Basic GH Model vs. Costly-Funds Model

	XM		GB		GM		XMsig		GBsig	
Parameter	Basic	Costly	Basic	Costly	Basic	Costly	Basic	Costly	Basic	Costly
β_1	.0003	−.0294	.0001	−.0458	.0006	−.0499	.0027	−.0498	.0006	−.0354
	(.442)	(.002)	(.731)	(.000)	(.093)	(.000)	(.000)	(.001)	(.175)	(.000)
	[.770]	[.061]	[.967]	[.002]	[.792]	[.002]	[.068]	[.007]	[.624]	[.018]
β_2	.0111	.0113	.0067	.0083	.0145	.0148	.0221	.0274	.0165	.0132
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.047)	(.032)	(.000)	(.000)
	[.003]	[.012]	[.024]	[.005]	[.023]	[.012]	[.067]	[.011]	[.003]	[.029]
β_3	–	.0272	–	.0419	–	.0461	–	.0482	–	.0330
		(.001)		(.000)		(.000)		(.001)		(.000)
		[.078]		[.002]		[.002]		[.005]		[.020]
Θ	−.0307	.1944	−.0113	.4742	−.0441	.2615	−.1207	.0593	−.0379	.1840
	(.466)	(.020)	(.738)	(.000)	(.129)	(.006)	(.092)	(.312)	(.221)	(.029)
	[.785]	[.089]	[.968]	[.001]	[.811]	[.026]	[.268]	[.382]	[.662]	[.111]
a	90.17	86.18	149.45	114.46	69.07	64.32	45.36	34.72	60.75	73.23
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.047)	(.032)	(.000)	(.000)
	[.003]	[.011]	[.024]	[.005]	[.024]	[.012]	[.068]	[.011]	[.003]	[.028]
c	–	1.0280	–	1.0437	–	1.0483	–	1.0506	–	1.0341
		(.000)		(.000)		(.000)		(.000)		(.000)
		[.000]		[.000]		[.000]		[.000]		[.000]
J-stat.	23.08	17.60	27.04	14.89	23.34	7.66	28.99	18.51	25.35	18.53
	(.041)	(.128)	(.012)	(.248)	(.038)	(.812)	(.007)	(.101)	(.021)	(.100)

P-values using heteroscedasticity-robust standard errors in parentheses, p-values using bootstrapped standard errors in brackets.

TABLE 3. Sensitivity Analysis

	Magee tariff, no constant			Gawande tariff, constant			Gawande tariff, labor variable			Gawande tariff, division by imports		
parameter	XM	GB	GM	XM	GB	GM	XM	GB	GM	XM	GB	GM
β_0	–	–	–	8.93	7.17	2.39	–	–	–	–	–	–
				(.002)	(.006)	(.581)						
				[.042]	[.057]	[.668]						
β_1	−.0433	−.0563	−.0609	−.0359	−.0455	−.0495	−.0309	−.0469	−.0496	−.0704	−.0707	−.0653
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.001)	(.000)	(.000)	(.000)	(.000)	(.000)
	[.002]	[.000]	[.000]	[.009]	[.001]	[.001]	[.066]	[.002]	[.003]	[.000]	[.000]	[.000]
β_2	.0106	.0075	.0133	.0053	.0050	.0123	.0130	.0097	.0179	.0001	.0002	.0003
	(.000)	(.000)	(.000)	(.011)	(.001)	(.003)	(.000)	(.000)	(.000)	(.592)	(.212)	(.054)
	[.017]	[.009]	[.009]	[.197]	[.085]	[.101]	[.024]	[.014]	[.016]	[.820]	[.591]	[.619]
β_3	.0398	.0514	.0559	.0331	.0417	.0457	.0285	.0428	.0458	.0704	.0705	.0653
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
	[.004]	[.000]	[.000]	[.012]	[.001]	[.001]	[.089]	[.003]	[.003]	[.000]	[.000]	[.000]
Θ	.3330	.6569	.3722	.5256	.7652	.3123	.1840	.4199	.2132	.5236	.7530	.1228
	(.000)	(.000)	(.000)	(.054)	(.002)	(.009)	(.008)	(.000)	(.006)	(.370)	(.000)	(.350)
	[.009]	[.000]	[.000]	[.228]	[.030]	[.044]	[.061]	[.001]	[.029]	[.820]	[.296]	[.942]
a	89.93	125.98	70.82	180.60	191.77	77.06	74.62	97.88	52.96	12400.78	4827.65	3298.88
	(.000)	(.000)	(.000)	(.011)	(.001)	(.003)	(.000)	(.000)	(.000)	(.592)	(.212)	(.054)
	[.016]	[.010]	[.009]	[.194]	[.086]	[.104]	[.022]	[.015]	[.017]	[.820]	[.592]	[.620]
c	1.0414	1.0542	1.0592	1.0343	1.0435	1.0479	1.0293	1.0447	1.0480	1.0757	1.0759	1.0699
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
	[.000]	[.000]	[.000]	[.000]	[.000]	[.000]	[.000]	[.000]	[.000]	[.000]	[.000]	[.000]
J-stat.	20.25	16.55	6.83	12.87	10.75	8.89	17.20	14.38	8.701	31.58	30.08	27.60
	(.062)	(.168)	(.869)	(.378)	(.550)	(.712)	(.142)	(.277)	(.728)	(.002)	(.003)	(.006)

P-values using heteroscedasticity-robust standard errors in parentheses, p-values using bootstrapped standard errors in brackets.

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