NBER WORKING PAPER SERIES

PROTECTION FOR SALE WITH IMPERFECT RENT CAPTURING

Giovanni Facchini
Johannes Van Biesebroeck
Gerald Willmann

Working Paper 11269
http://www.nber.org/papers/w11269

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
April 2005

We are grateful to Rob Feenstra whose questions prompted this research, to Kishore Gawande for providing us with the data, and to Geert Dhaene for help with the estimation. The usual caveat applies: All remaining errors are ours. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

Protection for Sale with Imperfect Rent Capturing
Giovanni Facchini, Johannes Van Biesebroeck, and Gerald Willmann
NBER Working Paper No. 11269
April 2005
JEL No. F13

ABSTRACT

Structurally estimating the Grossman and Helpman (1994) model using coverage ratios that include non-tariff barriers leads to biased parameter estimates. We develop a ``protection for sale" theoretical framework consistent with the data, by explicitly allowing for non-tariff barriers. Introducing partial rent capturing we obtain a testable specification which finds support in the data. Our results suggest that average rent capturing is in the order of 72-75 percent.

Giovanni Facchini
University of Illinois
facchini@uiuc.edu

Johannes Van Biesebroeck
Department of Economics
University of Toronto
150 St. George Street
Toronto, ON M5S 3G7
CANADA
and NBER
vanbiesebroeck@utoronto.ca

Gerald Willmann
University of Kiel
gerald@email.uni-kiel.de

1 Introduction

Successive rounds of international trade negotiations have successfully reduced the use of tariffs. With a few exceptions, developed countries now face strict limitations, imposed by the GATT–WTO, on the magnitude of taxes that they can levy on imports. This does not imply that protectionist interests are no longer able to influence policymakers, but rather that protectionist policies now often take the form of non-tariff barriers (NTBs) which as shown by Bradford (2003b) are quantitatively very important. In light of this development, it is not surprising that the leading framework for the analysis of endogenous trade policy formation — Grossman and Helpman (1994)'s protection for sale model — has been tested using NTB coverage ratios as the dependent variable.[1] While their use seems justified by the institutional setting and the increased importance of non-tariff barriers, Grossman and Helpman (1994)'s original theory was meant to analyze the *tariff* formation process. Using NTB coverage ratios as the dependent variable to test this model is likely to lead to biased estimated coefficients.[2]

To overcome this discrepancy between the theory and the data, we modify the protection for sale model to allow for NTB's that do not necessarily generate revenue for the government. In this way, we obtain an empirical specification that can be consistently estimated using the same dataset as Goldberg and Maggi (1999), Eicher and Osang (2002), Gawande and Bandyopadhyay (2000) and Matschke and Sherlund (2003). Employing both a maximum likelihood and a minimum distance estimator, we find that only part of the rents associated with trade barriers are captured. Depending on the econometric methodology, our results show that the U.S. government appropriates only 72–75 percent of the rents associated with trade policy, thus rejecting the assumption of perfect rent capturing that is implicit in the existing literature.[3] Furthermore, introducing this

[1]See, for instance, Goldberg and Maggi (1999) and Eicher and Osang (2002) among others.

[2]This inconsistency has been pointed out by Mitra, Thomakos, and Ulubasoglu (2002) and McCalman (2004) who find support for the model using tariff data from Turkey and Australia respectively.

[3]Perfect rent capturing is rejected with a p-value of 1.9% if the model is estimated with maximum likelihood. Using a minimum distance estimator for the same model produces similar point estimates, but because of higher standard errors it provides only weak evidence against the perfect rent capturing hypothesis, with a p-value of 9.7%.

modification also affects the other structural parameters of the model. In particular, compared to Goldberg and Maggi (1999), we obtain lower and more realistic estimates of the implied share of the population involved in lobbying activities.

The remainder of this paper is organized as follows: Section 2 discusses the empirical importance of NTBs. In section 3, we present the augmented model before we characterize the equilibrium protection structure in section 4. Section 5 presents the empirical results and section 6 concludes.

2 Non-tariff Barriers

International trade negotiations have been quite successful in reducing tariffs. Yet protectionism is far from dead as is illustrated by the pervasive use of non-tariff barriers (NTBs) even by countries that profess a free–trade orientation. NTBs comprise a long list of measures that alter, however indirectly, the prices and quantities of trade flows. Examples include import quotas, health and safety standards, biased government procurement, lax antitrust enforcement, burdensome customs procedures, and the list could go on.[4] While the importance of NTBs has been widely recognized, measuring their quantitative effects presents considerable conceptual and practical difficulties (see Deardorff and Stern (1997)).

⇒ [Table 1 approximately here] ⇐

At a theoretical level, the most satisfactory approach involves the computation of producer price gaps. Directly calculating tariff-equivalent measures allows to capture the full impact of NTBs without relying on a specific modelling framework. Clearly, this approach poses demanding requirements on the availability of detailed price data for the goods considered. The data needs to be comparable across countries, that is, the goods

[4]UNCTAD uses 18 different categories: quantity, price, quality,threat, advance payment, antidumping duty, antidumping investigation, countervailing duty, countervailing duty investigation, authorization, health and safety, license, inspection, labelling/marketing/packaging, product characteristics/standards, single channel, testing, embargos/prohibitions. See also the discussion in Deardorff and Stern (1997).

must share similar qualitative characteristics etc. This approach has been pursued by Bradford (2003b) who uses the 1999 survey of highly disaggregate price data compiled by the OECD to compute purchasing power parity adjusted exchange rates. These data are likely to represent the best available measures for international comparisons, as OECD researchers made every effort to compare equivalent products from every country. The results obtained are striking and we report the numbers for the U.S. aggregated up to 26 GTAP sectors, in Table 1.[5]

The first column lists the nominal tariff rate and the second the NTB's tariff equivalent as estimated by Bradford (2003a). Note that the world price has been normalized to one, so that a value of, for example, 1.040 for the tariff rate on Food Products indicates a 4 percent tariff. In the third column, we have calculated the share of NTBs in total protection. As we can see, the extent of protection granted through NTBs is on average substantially higher than the tariff. On average, 60 percent of the tariff equivalent of total protection takes the form of NTBs. Among the highly protected sectors, crops as well as vegetable oils appear to be subjected to extensive NTBs, with tariff equivalents in the order of 52 and 45 percent respectively, representing 96 and 87 percent respectively of the total protection. In sectors such as live animals and petroleum, on the other hand, protection mostly takes the form of import tariffs. The main message that emerges from table 1 is that NTBs are quantitatively very important.

It is important for our purposes to note that NTBs often do not allow the government to completely capture the rents associated with the distortion. Product standards, for example, increase the domestic price without generating any rent. The use of coverage ratios as the dependent variable in the empirical tests of the Grossman and Helpman (1994) protection for sale model with its assumption that those rents are fully captured is thus likely to lead to a bias in the parameter estimates. To remedy this problem, we now turn to extending the basic model to accommodate partial rent capturing.

[5]For further details on the methodology see Bradford (2003a) and Bradford (2003b).

3 The Model

The specific factors model forms the economic foundation of Grossman and Helpman (1994)'s "protection for sale" approach. A small, open economy consists of $1+n$ sectors, indexed by $i = 0, ..., n$, that produce under constant returns to scale. Sectors $\{1, ..., n\}$ each use a sector specific factor plus a common mobile factor. The exogenously given world market price for the output of each of these sectors is denoted by p_i^*, while the corresponding domestic price is $p_i^* + t_i$ where t_i is the import tariff [6] imposed on this commodity or the shadow value of a quantity restriction.

Sector zero uses only the mobile factor and by appropriate choice of units, it turns the mobile factor into output one-to-one. Using its output as the numéraire, we normalize the price p_0 to one. Strictly positive production in this sector implies that the wage of the mobile factor (labor) will also equal one. The same holds for the world market price p_0^*, if we allow for free trade in this commodity. The production possibilities of the other n sectors are summarized by profit functions $\pi_i(p_i)$ that can be interpreted as rewards to the specific factors.

The economy is populated by N agents who might differ in their factor endowment. All of them supply one unit of labor, and at most one sector specific factor. Let α_i be the fraction of the population that owns the specific factor i. All agents share the same preferences represented by a quasi-linear, additively separable utility function $u = x_0 + \sum_{i=1}^{n} u_i(x_i)$, where x_i is the individual's consumption of good i and the $u_i(.)$ are differentiable, strictly concave subutility functions. Optimizing subject to a given income level I, every individual demands $x_i = d_i(p_i) \equiv (u_i')^{-1}(p_i)$ of goods $i = 1, ..., n$ and $x_0 = I - \sum_{i=1}^{n} p_i d_i(p_i)$ of the numéraire. Domestic demand for good i can be satisfied through domestic production and/or imports, defined as:

$$m_i = \phi_i(t_i) \equiv N d_i(p_i^* + t_i) - y_i(p_i^* + t_i),$$

[6] The original model allows also for import subsidies as well as export taxes/subsidies. The subsequent literature has largely disregarded these policies in line with the empirical facts or even explicitly excluded them, as in Levy (1999) and Maggi and Rodriguez-Clare (2000). In our context subsidies would be paradoxical because partial rent capturing translates into partial funding and therefore we follow suit.

where y_i is the domestic supply of commodity i derived from π_i via Hotelling's lemma. Note that since $m_i(t_i)$ is strictly decreasing, it can be inverted. This allows us to express the tariff equivalent of a quota q_i as:

$$t_i = \phi_i^{-1}(q_i)$$

Given that we allow trade policy to take the form of tariffs as well as quotas, let Q denote the subset of sectors that face quantity restrictions and T the remaining sectors that are subject to tariffs. Note that T could well be empty, in which case all sectors are subject to a quantity restriction. In what follows, we consider the general mixed case.

Note that the choice of policy instruments is exogenous in our framework. Maggi and Rodriguez-Clare (2000) propose a model where this choice is endogenous. In that context, quantitative restrictions emerge only if domestic importers (or foreign exporters) carry substantial political clout. However, were this really to be the case, the government would rather transfer taxpayer dollars directly to domestic importers by combining an import subsidy with a quota, a possibility that the authors themselves dismiss as pathological. As for an empirical implementation of the model, the distinction between importers and domestic producers that is driving Maggi and Rodriguez-Clare (2000) results seems rather problematic. Finally, Gawande, Krishna, and Robbins (2004) find that non-tariff barriers are *negatively* related with foreign lobbying activity, a results that runs against the Maggi and Rodriguez-Clare (2000) prediction for voluntary exports restraints. Forced to acknowledge the lack of a satisfactory explanation, we take the choice of instruments to be exogenous and rely on the data to inform us on the actual degree of rent capturing and the implied policy mix.

In line with this objective, we assume that in each sector $i \in Q$ a percentage $\gamma_i \in [0, 1]$ is captured domestically. Consider, for instance, a voluntary export restraint. In this case foreign agents obtain the quota rent, and domestic rent capturing is zero. Similarly, the introduction of certain product standards leads to higher domestic prices, without the rents being captured. At the other extreme, if an import license is auctioned off competitively, then the capturing is complete.

We can now define the trade policy game. The organized sectors, $L = \{1, ..., \ell\}$, submit contribution schedules $C_i(t, q)$ to the government, which depend on the policy vector chosen, where t is a vector of tariffs applied to all sectors $i \in T$ and, similarly, q is a vector of quantity restrictions for all sectors $i \in Q$. The government then chooses a policy vector (t, q) that maximizes its objective function:

$$G = \beta \sum_{i=1}^{n} W_i(t, q) + (1 - \beta) \sum_{i \in L} C_i(t, q)$$

where the gross pay-off functions of the sectors are defined as follows

$$\begin{aligned} W_i(t, q) &= l_i + \pi_i(p_i^* + t_i) \qquad + \alpha_i N(r + s) \quad \forall i \in T \\ W_i(t, q) &= l_i + \pi_i(p_i^* + \phi_i^{-1}(q_i)) + \alpha_i N(r + s) \quad \forall i \in Q, \end{aligned} \tag{1}$$

where, in turn, the per capita tariff revenue, $r(t, q; \gamma)$, and consumer surplus, $s(t, q)$, take the form

$$\begin{aligned} r(t, q; \gamma) = & \sum_{i \in T} t_i(d_i(p_i^* + t_i) - y_i(p_i^* + t_i)/N) + \\ & \sum_{i \in Q} \gamma_i \phi_i^{-1}(q_i)(d_i(p_i^* + \phi_i^{-1}(q_i)) - y_i(p_i^* + \phi_i^{-1}(q_i))/N) \\ s(t, q) = & \sum_{i \in T} (u_i(d_i(p_i^* + t_i)) - (p_i^* + t_i)d_i(p_i^* + t_i)) + \\ & \sum_{i \in Q} (u_i(d_i(p_i^* + \phi_i^{-1}(q_i))) - (p_i^* + \phi_i^{-1}(q_i))d_i(p_i^* + \phi_i^{-1}(q_i))) \end{aligned}$$

4 Equilibrium Protection Structure

In solving the game between organized sectors and lobbies we are look for the subgame perfect Nash equilibrium, defined as follows

Definition 1 *The collection $(\{C_i^0(t, q)\}_{i \in L}, (t^0, q^0))$ is a subgame perfect Nash equilibrium of the tariff and quota game if C_i^0 is feasible for all $i \in L$, $\beta \sum_{i=1}^{n} W_i(t, q)$, and,* *given* $\{C_j^0(t,q)\}_{j\in L\setminus i}$*, no lobby* i *has an alternative feasible strategy* $C_i(t,q)$ *that would yield a higher (net) payoff.*

Bernheim and Whinston (1986) derive a useful characterization of subgame perfect Nash equilibria in menu auctions. We restate their proposition here using our notation:

Proposition 1 $(\{C_i^0(t,q)\}_{i\in L},(t^0,q^0))$ *is a subgame perfect Nash equilibrium for the tariff and quota game if and only if:*

i) $C_i^0(t,q)$ *is feasible* $\forall i\in L$,

ii) $(t^0,q^0)\in \arg\max\ (1-\beta)\sum_{i\in L}C_i(t,q)+\beta\sum_{i=1}^n W_i(t,q)$,

iii) $(t^0,q^0)\in \arg\max\ (1-\beta)\sum_{i\in L}C_i(t,q)+\beta\sum_{i=1}^n W_i(t,q)+W_i(t,q)-C_i(t,q)\ \ \forall i\in L$,

iv) $\forall i\in L,\exists(t^i,q^i)\in\mathbb{R}^n$ *that maximizes* $(1-\beta)\sum_{i\in L}C_i(t,q)+\beta\sum_{i=1}^n W_i(t,q)$ *such that* $C_i^0(t^i,q^i)=0$.

Assuming differentiability of the contribution schedules and combining conditions *ii*) and *iii*) the optimal policy vector satisfies:

$$(1-\beta)\sum_{i\in L}\nabla W_i(\mathbf{t},\mathbf{q})+\beta\sum_{i=1}^{n}\nabla W_i(\mathbf{t},\mathbf{q})=0 \tag{2}$$

Calculating the gradient of the sectors' gross pay-off function, we obtain:

$$\begin{aligned}
\frac{\partial W_i}{\partial t_j} &= (\delta_{i,j}-\alpha_i)\,y_j(p_j^*+t_j)\ +\ \alpha_i t_j\phi_j'(p_j^*+t_j) && \forall j\in T\\
\frac{\partial W_i}{\partial q_j} &= (\delta_{i,j}-\alpha_i\gamma_j)\,\frac{y_j(p_j^*+\phi_j^{-1}(q_j))}{\phi_j'(p_j^*+\phi_j^{-1}(q_j))}\ +\ \alpha_i\gamma_j\phi_j^{-1}(q_j)\ -\\
&\qquad \alpha_i(1-\gamma_j)\,\frac{Nd_j(p_j^*+\phi_j^{-1}(q_j))}{\phi_j'(p_j^*+\phi_j^{-1}(q_j))} && \forall j\in Q
\end{aligned}$$

where $\delta_{i,j}=1$ if $i=j$ and zero otherwise.[7] Substituting these partial derivatives back into equation (2) we obtain the following result:

[7] Note that we do not need to distinguish sectors that face a tariff from sectors subject to a quota (that is, whether $i\in T$ or $i\in Q$) because only the direct profit term would differ; however, the indicator in front of this term does not switch on since i cannot equal j for cross derivatives.

Proposition 2 *The government chooses a policy vector that satisfies*

$$t_j = -\frac{I_j - \alpha_L}{\frac{\beta}{1-\beta} + \alpha_L} \times \frac{y_j(p_j^* + t_j)}{\phi_j'(p_j^* + t_j)} \qquad \forall j \in T$$

$$\phi_j^{-1}(q_j) = -\frac{1}{\gamma_j} \times \frac{I_j - \alpha_L}{\frac{\beta}{1-\beta} + \alpha_L} \times \frac{y_j(p_j^* + \phi_j^{-1}(q_j))}{\phi_j'(p_j^* + \phi_j^{-1}(q_j))} + \frac{1-\gamma_j}{\gamma_j}\frac{m_j(p_j^* + \phi_j^{-1}(q_j))}{\phi_j'(p_j^* + \phi_j^{-1}(q_j))} \qquad \forall j \in Q$$

where I_j is an indicator that takes a value of one if the sector is organized and zero otherwise, while $\alpha_L = \sum_{i \in L} \alpha_i$ describes the fraction of the population that is organized.

The equilibrium tariff matches the solution obtained by Grossman and Helpman (1994). The result for quotas, on the other hand, requires explanation. Consider the case where the quota rent is fully captured ($\gamma_j = 1$). The tariff equivalent of the quota then equals the solution for the tariff. The above proposition thus implies:

Corollary 1 *Assume perfectly competitive markets: Enacting a quantity restriction in a particular market is equivalent to setting the corresponding tariff as long as the quota rent is fully captured ($\gamma_j = 1$).*

That is, choosing a (binding) quota or a tariffs allows the government to determine an outcome in the market for a traded good, i.e. the combination of quantity demanded and domestic price. The lobbies' contributions then depend only on the market outcome, and not on the policy instrument used to achieve it.

Consider now the more general case in which rent is only partially captured. What we have in mind, for example, are product standards, which raise the domestic price of a commodity without creating rents that could be captured. How does partial capturing affect the level of protection resulting from the policy game? Consider the derivative

$$\frac{\partial \phi_j}{\partial \gamma_j} = -\frac{1}{\epsilon_j \gamma_j^2}\left[\left(\frac{I_j - \alpha_L}{\frac{\beta}{1-\beta} + \alpha_L}\right)\frac{y_j}{m_j} - 1\right] \tag{3}$$

where ϵ_j is the absolute value of the import demand elasticity. The sign of this derivative, and thus the effect of partial capturing on the protection level depends on the term in square brackets. Assuming that sector j is organized, lower rent capturing will tend to increase the equilibrium protection level the lower the import penetration ratio, the smaller the government's weight on aggregate welfare, and the more concentrated the ownership of the organized sectors.

5 Empirical Test

A number of studies have estimated the original Grossman and Helpman (1994) model for a cross section of U.S. manufacturing industries using coverage ratios as the measure of protection. As already pointed out, the reason for using coverage ratios is that successive rounds of GATT-WTO negotiations have imposed extensive constraints on the use of tariffs. Even though the theory was originally developed for tariffs, Goldberg and Maggi (1999) in their well known paper find that "*the theoretical model is not inconsistent with our data.*" Similar results have been obtained by Gawande and Bandyopadhyay (2000) and Eicher and Osang (2002).

To test the augmented model that allows for quotas or other instruments that imperfectly capture rents, we transform the equilibrium tariff and quota equations and include an additive error term as in Goldberg and Maggi (1999). The estimating equations for our model thus take the form

$$\frac{t_j}{1+t_j}e_j = \theta I_j \frac{X_j}{M_j} + \psi \frac{X_j}{M_j} + \epsilon_{1j} \qquad \forall j \in T \qquad (4)$$

$$\frac{\phi_j^{-1}(q_j)}{1+\phi_j^{-1}(q_j)}e_j = \theta' I_j \frac{X_j}{M_j} + \psi' \frac{X_j}{M_j} + \lambda + \epsilon_{2j} \qquad \forall j \in Q \qquad (5)$$

where $\theta = \frac{1-\beta}{\beta+\alpha_L(1-\beta)}$ and $\psi = -\frac{\alpha_L(1-\beta)}{\beta+\alpha_L(1-\beta)}$ and correspondingly $\theta' = \frac{1}{\gamma}\theta$, $\psi' = \frac{1}{\gamma}\psi$ and $\lambda = -\frac{1-\gamma}{\gamma}$. The sign restrictions implied by the model are that $\theta > 0$, $\psi, \lambda < 0$ and $(\theta + \psi) > 0$.

If product j is protected by a policy instrument which allows for complete rent capturing, protection will be set according to equation (4). This is the implicit assumption underlying previous empirical work. On the other hand, if only a share γ_j of the rents is captured domestically, the optimal level of protection is determined by equation (5). In the empirical implementation, the absence of time series data forces us to impose a uniform degree of rent capturing across industries.

Two econometric issues have to be addressed when estimating the model. Because coverage ratios lie between zero and one, the dependent variable is potentially censored on both sides.[8] Furthermore, there are good reasons to believe that import penetration and the binary political organization variable are not exogenous. Two different estimators are used on a sample of 107 three digit manufacturing industries. A description of the data can be found in Gawande and Bandyopadhyay (2000).

The maximum likelihood estimator from Goldberg and Maggi (1999) jointly estimates the equation of interest — (4) or (5) — together with two reduced form equations. Import penetration and the tendency for an industry to organize (a latent variable) are modelled as linear functions of the set of instruments taken from Trefler (1993). The three error terms are assumed to be jointly normally distributed and potentially correlated. The censoring of the dependent variable and the discrete nature of the organization status can be explicitly modelled in the maximum likelihood framework. We refer to Goldberg and Maggi (1999) for further details on the approach.

As a robustness check, the model is also estimated using the minimum distance estimator previously used by Eicher and Osang (2002). In a first stage, the reduced form equations for each of the three endogenous variables are estimated separately as a function of the same instruments as before. The organization status of an industry is estimated using a Probit regression and the import penetration equation by ordinary least squares. These two reduced form equations are also substituted in the estimation equation of interest, which is estimated using a Tobit regression. In a second stage, the structural coefficients of the model are estimated from the reduced form coefficients with a two-step

[8]In the data, only left-censoring actually occurs.

GMM procedure. The method is described in detail in Lee (1995).

The maximum likelihood estimates are reported in Table 2, where for comparison we have included the baseline estimates of Goldberg and Maggi (1999) in the first column. The second column presents our results for the special case that rent capturing is complete. Our estimates are similar, except for small differences in the reduced form coefficients, which lead to a lower implied share of the population involved in lobbying. These differences are likely due to residual differences in the dataset.[9]

⇒ [Table 2 approximately here] ⇐

In the more general case, where not all the rents from protection are captured domestically, equation (5) applies. The results for this case are reported in column (3). Most importantly, the negative constant term indicates that the U.S. government, realizing that the use of NTBs leads to an additional welfare loss, chooses — ceteris paribus — a uniformly lower level of protection. This interpretation is confirmed by the implied value for γ, the degree of rent capturing, which is significantly less than one. In particular, our estimates imply that only 72 percent of potential rents are actually appropriated by the U.S. government.

The minimum distance results are reported in Table 3 using the same format as before. As can be seen from the table, the results are very similar. We take this to be a sign of robustness. Especially the degree of rent capturing, which is estimated to be 75 percent, is hardly different from the 72 percent above. Because of this similarity, we focus our discussion on the maximum likelihood results.

⇒ [Table 3 approximately here] ⇐

Compared to the baseline case in columns 1 and 2, the difference between organized and unorganized sectors remains, as can be readily seen from the coefficient on the interaction term. Organized sectors receive significantly higher protection than their unorganized counterparts. It might seem surprising at first that import penetration

[9] We were not able to obtain the very same dataset used by Goldberg and Maggi (1999).

alone does not play a significant role. Notice, however, that we are essentially estimating two different coefficients for each subset of the sample, organized and unorganized sectors. In this view, the coefficient for the organized subsample is the sum of the two coefficients reported above. It is only information from the unorganized sectors that would allow us to separately identify the role of import penetration. The theoretical model, of course, predicts that unorganized sectors should receive negative protection. Since the coverage ratios are censored at zero, this implies that if the model were deterministic, we should not have any information to this effect coming from the unorganized subsample. In the stochastic context at hand, obtaining the predicted negative coefficient must be due to large errors, which in turn explain the insignificance of said coefficient.[10]

The third sign prediction of the model, namely that the sum of the two reduced form coefficients is larger than zero finds strong support in the data.[11] This is reflected in the lower implied share of the population that is organized. While Goldberg and Maggi (1999) estimate that over 80 percent of the population is involved in trade-related lobbying, we find a more reasonable estimate of 34 percent, which is closer to the share of the workforce employed in organized sectors (around 50 percent).

Similarly to the previous literature, the weight attached by the government to aggregate welfare is estimated to be very high. In contrast with previous results, though, we estimate the share of the population involved in lobbying much lower: between 11.7 and 33.8 percent. This suggests that the low average amount of protection granted by the U.S. government should be interpreted as resulting from the high weight associated to aggregate welfare, rather than to the strategic interaction between competing lobbies, which makes lobbying ineffective. Our specification allows a government that values aggregate welfare to implement little or no protection for the majority of industries, while selectively granting some protection to a few industries which are organized. Average protection will be low, but sectors that lobby will still benefit.[12]

[10]In the baseline specification the coefficient on inverse import penetration partially picks up the role of the constant, so that this effect is not as apparent.

[11]The t-statistic for this test is 4.646.

[12]The parameter estimates in Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000) are consistent with both alternative explanations for the low rates of observed protection. The weight of

The estimated degree of rent capturing γ could be given a more general interpretation. In practice protection is set at a much more disaggregate level than the three digit SIC industries for which we have data. No single three digit sector can be characterized as protected exclusively by either tariffs or quotas. Both tools will instead be employed for different products in every industry, so both equations are relevant.

In light of this argument, equation (5) can be understood as a weighted average of both original formulations. Suppose that a fraction δ of the products in industry j are protected by a tariff, whereas the remainder is covered by a quota. For the latter only a fraction γ' of the potential rents are captured. The linear combination of the two equations with the appropriate weights leads to a new relationship, where the dependent variable is the following weighted average

$$\Big(\delta\frac{t_j}{1+t_j} + (1-\delta)\frac{\phi_j^{-1}(q_j)}{1+\phi_j^{-1}(q_j)}\Big)e.$$

The right hand side takes the same form as in equation (5) only that now

$$\gamma = \frac{\gamma'}{1-\delta(1-\gamma')},$$

which is a function of the structural coefficients δ and γ' that cannot be identified separately. The impact of the rent capturing coefficient in the equation is scaled up if a large fraction of products is protected by tariffs. An estimated γ of 0.72, as in Table 2, is compatible both with an industry protected by a quota of which 72 percent is captured, as well as with an industry, where half of the products are protected by tariffs and the other half by a quota, of which 56 percent is captured, etc. The estimation remains unchanged, only the interpretation of the results in the third columns is affected. In light of this, the estimates of γ seem even more plausible.

Finally, we perform a specification test of the augmented model (column 3) versus

aggregate welfare in the government's objective function (β) and the share of the population involved in lobbying (α_L) are both estimated very high. The sizeable cross-sectoral variation in rates of protection in the data points towards β over α_L as an explanation for low average protection rates.

the standard specification (column 2). This corresponds to testing whether γ is equal to one, versus the alternative that γ is less than one. The p-value associated with the test statistic is 0.019, that is, the one-sided test rejects that γ is equal to one at a significance level of 2 percent.[13] Given the small number of observations, only 107 sectors, this is relatively strong evidence against perfect rent capturing. The same test using the minimum distance results also rejects equality of γ to one, albeit only at a 10 percent significance level. This confirms the importance of explicitly accounting for partial rent capturing when estimating the Grossman and Helpman (1994) model.

6 Conclusion

In this paper we have addressed the existing discrepancy between Grossman and Helpman (1994) theoretical model explaining tariff protection, and its empirical implementations that have for the most part used NTB coverage ratios as the measure of protection. Extending the model by allowing for partial rent capturing, a salient feature of NTBs, we have derived an augmented specification which we have empirically implemented employing both a maximum likelihood as well as a minimum distance estimator. Our augmented specification finds support in the data, and the average degree of rent capturing turns out to be 72-75 percent.

Furthermore, we obtain lower and more reasonable estimates than the previous literature for the share of the population involved in lobbying activity, while the weight on aggregate welfare in the government's objective function continues to be very high, as in previous implementations. Allowing for partial rent capturing suggests then that the low average amount of protection granted by the U.S. government should be interpreted as the result of the high weight associated to aggregate welfare, rather than to the strategic interaction between competing lobbies. While our results show the importance of taking the structural approach seriously, i.e. of having a theoretical model that is consistent with the data, they offer additional support for the protection for sale framework.

[13] A likelihood ratio test gives the same conclusion.

References

Bernheim, B. D. and M. D. Whinston (1986). Menu auctions, Resource allocation, and Economic Influence. *Quarterly Journal of Economics 101*, 1–31.

Bradford, S. C. (2003a). Non tariff barriers in rich economies: Quantifying them, identifying them and assessing their impacts. mimeo, Brigham Young University.

Bradford, S. C. (2003b). Paying the price: Final good protection in OECD countries. *Review of Economics and Statistics 85*, 24–37.

Deardorff, A. V. and R. M. Stern (1997). Measurement of non tariff barriers. Working paper 179, OECD.

Eicher, T. and T. Osang (2002). Protection for sale: An empirical investigation: Comment. *American Economics Review 92*, 1702–1710.

Gawande, K. and U. Bandyopadhyay (2000). Is protection for sale? Evidence on the Grossman–Helpman theory of endogenous protection. *Review of Economics and Statistics 82*, 139–152.

Gawande, K., P. Krishna, and M. J. Robbins (2004). Foreign Lobbies and US Trade Policy. Wp 10205, NBER.

Goldberg, P. K. and G. Maggi (1999). Protection for Sale: An Empirical Investigation. *American Economic Review 89*(5), 1135–55.

Grossman, G. M. and E. Helpman (1994). Protection for Sale. *American Economic Review 84*, 833–850.

Lee, M.-J. (1995). Semiparametric estimation of simultaneous equations with limited dependent variables: A case study of female labor supply. *Journal of Applied Econometrics 15*, 187–200.

Levy, P. (1999). Lobbying and international cooperation in tariff setting. *Journal of International Economics 47*, 345–370.

Maggi, G. and A. Rodriguez-Clare (2000). Import penetration and the politics of trade protection. *Journal of International Economics 51*, 287–304.

Matschke, X. and S. Sherlund (2003). Do labor issues matter in the determination of US trade policy? An empirical reevaluation. mimeo, University of Connecticut.

McCalman, P. (2004). Protection for sale and trade liberalization: An empirical investigation. *Review of International Economics 12*, 81–94.

Mitra, D., D. D. Thomakos, and M. A. Ulubasoglu (2002). Protection for Sale in a developing country: Democracy versus Dictatorship. *Review of Economics and Statistics 84*, 497–508.

Trefler, D. (1993). Trade Liberalization and the Theory of Endogenous Protection: an Econometric Study of U.S. Import Policy. *Journal of Political Economy 101*, 138–160.

Table 1: Tariffs and NTBs (Source: Bradford (2003) and own calculations)

GTAP sector	Tariff	NTB	NTB share
Vegetables, fruit, nuts	1.064	1.203	0.760
Crops: Garden products	1.020	1.524	0.963
Live Animals: Pets	1.043	1.000	0
Other Ag. Products: Eggs	1.092	1.000	0
Fishing	1.005	1.301	0.984
Bovine cattle, sheep and goat, horse meat products	1.108	1.001	0.001
Meat product n.e.c.: Poultry, pork	1.060	1.004	0.063
Vegetable oils and fats	1.065	1.447	0.873
Dairy products	1.082	1.145	0.639
Processed rice	1.054	1.119	0.688
Sugar	1.278	1.000	0
Food products n.e.c.	1.040	1.071	0.640
Beverages and tobacco products	1.126	1.063	0.333
Textiles	1.072	1.271	0.790
Wearing apparel	1.142	1.000	0
Leather products: Footwear	1.143	1.000	0
Wood products	1.045	1.000	0
Paper products, publishing	1.008	1.066	0.892
Petroleum, coal products	1.008	1.000	0
Chemical, rubber, plastic products	1.049	1.287	0.854
Mineral products n.e.c.: Glassware and Tableware	1.087	1.096	0.525
Metal products	1.047	1.192	0.803
Motor vehicles and parts	1.034	1.157	0.822
Electronic equipment	1.042	1.061	0.592
Machinery and equipment n.e.c.	1.040	1.085	0.68
Manufactures n.e.c.	1.065	1.016	0.198
Weighted geometric means	1.058	1.087	0.602

Table 2: Estimation of the augmented Grossman-Helpman model by MLE

	GM99[a]	(2)	(3)
inverse import penetration (X/M)	-0.0093**	-0.0081**	-0.0053
	(0.0040)	(0.0043)	(0.0055)
(X/M) $\times$ organization dummy	0.0106**	0.0166***	0.0157***
	(0.0053)	(0.0045)	(0.0054)
constant term			-0.3937*
			(0.2626)
$\hat{\beta}$	0.986	0.983	0.988
	(0.005)	(0.004)	(0.004)
$\hat{\alpha}_L$	0.883	0.489	0.338
	(0.223)	(0.134)	(0.244)
$\hat{\gamma}$	1.000	1.000	0.718
			(0.135)
Log-likelihood		-308.2	-305.4

[a] Goldberg and Maggi (1999), Table 1

Note: Standard errors in parenthesis

* significant at the 10% level, ** at the 5% level, and *** at the 1% level

Table 3: Estimation of the augmented Grossman-Helpman model by MDE

	EO02[a]	(2)	(3)
inverse import penetration (X/M)	-0.0098***	-0.0026**	-0.0022
	(0.0023)	(0.0013)	(0.0027)
(X/M) $\times$ organization dummy	0.0374***	0.0173***	0.0190***
	(0.0051)	(0.0008)	(0.0017)
constant term			-0.3255*
			(0.2330)
$\hat{\beta}$	0.96	0.982	0.985
		(0.002)	(0.003)
$\hat{\alpha}_L$	0.26	0.149	0.117
		(0.086)	(0.152)
$\hat{\gamma}$	1.000	1.000	0.754
			(0.189)

[a] Eicher and Osang (2002), Table 1 and results in text.

Note: Standard errors in parenthesis

* significant at the 10% level, ** at the 5% level, and *** at the 1% level