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Protection for Sale with Imperfect Rent Capturing

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Protection for Sale with Imperfect Rent Capturing*

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Abstract

We extend the protection for sale framework by modelling non tariff barriers. Explicitly introducing partial rent capturing leads to a testable specification that bridges the gap between the theoretical Grossman and Helpman (1994) model and its empirical implementation, where coverage ratios have been used to measure protection. Our econometric analysis supports the augmented specification and leads to more realistic estimates for the structural parameters of the model.
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1 Introduction

Due to the elegance of its theoretical argument and the encouraging empirical evidence, the "protection for sale" approach of Grossman and Helpman (1994) has quickly become one of the leading explanations of trade policy determination. However, whereas the original model is meant to analyze the tariff formation process, recent empirical work[1] uses US data on coverage ratios as the measure of protection. This discrepancy is pointed out, among others, by Mitra, Thomakos, and Ulubasoglu (2002) and McCalman (2000), who find supporting evidence for the model using tariff data from Turkey and Australia respectively. On the other hand, there is good reason to use NTB data: successive rounds of GATT-WTO negotiations have substantially constrained the use of tariffs, and non tariff barriers have come to replace them as the instrument of choice used by protectionist governments.[2]

To overcome this discrepancy we explicitly model, in a protection for sale framework, restrictions that do not necessarily generate revenues for the government. We characterize the equilibrium protection structure that emerges when they are implemented. We show that if rent capturing is complete, quantitative restrictions are strategically equivalent to tariffs in the lobbying game we consider. For the more relevant case of partial rent capturing, we derive an augmented specification that depends on the degree of rent capturing. Using the same dataset as in Gawande and Bandyopadhyay (2000), Eicher and Osang (2002), and Goldberg and Maggi (1999), we estimate the augmented specification by maximum likelihood and find that only part of

[1] Empirical studies include Goldberg and Maggi (1999), Gawande and Bandyopadhyay (2000), Eicher and Osang (2002) and Esfahani (2001) — for a survey see Gawande and Krishna (2003).

[2] Notice that in this paper we take the use of NTB as the result of an institutional constraint – in particular multilateral GATT negotiations – rather than trying to explicitly model the *unilateral* choice of alternative policy instruments by a government like in Maggi and Rodriguez-Clare (2000). The fact that the choice of protectionist instruments is constrained by multilateral negotiations is highlighted among others, by Rodrik (1995): "As for the shift towards NTBs, this is usually explained by reference to successive rounds of agreements under GATT, which by cutting and binding tariffs have left governments little discretion over their tariff levels." (page 1485).

the rent from trade barriers is captured. Furthermore, the results imply that the US government expects to forego 28% of the rents. In addition, the estimates of the structural parameters of the original specification are affected. In particular, compared to Goldberg and Maggi (1999), the implied share of the population involved in lobbying is significantly lower (34 instead of 88 percent). Finally, a formal test of the original specification against our augmented model rejects the case of perfect rent capturing.

The remainder of this note is organized as follows: In section 2 we develop the augmented model, section 3 characterizes the equilibrium protection structure, and section 4 presents the empirical results.

2 The model

Recall the specific factors model that 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 [3] imposed on this commodity or the shadow value of a quantity restriction.

Sector zero is special in that it only uses the mobile factor. By appropriate choice of units, sector zero 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 hold for the world market price p_0^*, if we allow for free trade in this commodity. The production possibilities of

[3]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 **?**) 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.

the other n sectors are summarized by profit functions $\pi_i(p_i)$ that can be interpreted as the rewards of 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:

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

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. However, in what follows, we consider the general mixed case.

Whereas for tariffs it seems natural to assume that the revenue is captured by the domestic government, this is less clear in the case of quantity restrictions. In the case of a voluntary export restraint, for example, foreign agents obtain the quota rent. We account for this possibility by assuming that for each sector $i \in Q$ a percentage $\gamma_i \in [0, 1]$ is captured domestically.[4]

[4]We do not explicitly consider the possibility that the quota rent is captured by a

We can now define the trade policy game. The organized sectors, $L\{1, ..., n\}$, 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

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

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

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

3 Equilibrium Protection Structure

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

separate domestic interest group or by foreign lobbies. Those cases are discussed by Maggi and Rodriguez-Clare (2000), who also allow the government to choose among policy instruments. We abstract from these possibilities here as our objective is to check the robustness of the empirical tests of the Grossman and Helpman (1994) model which have not included such extensions.

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* $i \in L$, (t^0, q^0) *maximizes* $(1-\beta)\sum_{i\in L} C_i(t,q) + \beta \sum_{i=1}^n W_i(t,q)$, *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*) in the standard way, we find that the optimal policy vector will satisfy:

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

Taking a closer look at the gradient of the sectors' gross pay-off function, we see that:

$$\frac{\partial W_i}{\partial t_j} = (\delta_{i,j} - \alpha_i)\, y_j(p_j^* + t_j) \; + \; \alpha_i t_j \phi_j'(p_j^* + t_j) \qquad \forall j \in T$$

$$\frac{\partial W_i}{\partial q_j} = (\delta_{i,j} - \alpha_i\gamma_j)\, \frac{y_j(p_j^* + \phi_j^{-1}(q_j))}{\phi_j'(p_j^* + \phi_j^{-1}(q_j))} \; + \; \alpha_i\gamma_j\phi_j^{-1}(q_j) - \alpha_i(1-\gamma_j)\, \frac{Nd_j(p_j^* + \phi_j^{-1}(q_j))}{\phi_j'(p_j^* + \phi_j^{-1}(q_j))} \qquad \forall j \in Q$$

where $\delta_{i,j} = 1$ if $i = j$ and zero otherwise.[5] Substituting these partial derivatives back into equation (2) we obtain the following result:

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 is exactly the solution obtained by Grossman and Helpman (1994). Our result for the quota, 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:

[5]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.

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

The intuition for this result is appealing. 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 capturing is only partial. What we have in mind are for example 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 import demand elasticity (positively defined). 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.

4 Empirical test

A number of studies have estimated the original Grossman and Helpman (1994) theory for a cross section of US manufacturing industries using coverage ratios as the measure of protection. As we already pointed out the reason for this choice is that successive rounds of GATT-WTO negotiations have imposed extensive constraints on the use of tariffs. In their well known paper, Goldberg and Maggi (1999) use a maximum likelihood methodology and conclude 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).

We transform the equilibrium tariff and quota equations as in Goldberg and Maggi (1999) and include an additive error term. The estimating equations for our augmented 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 $(\theta + \psi) > 0$. Two issues have to be considered when estimating the model. Because coverage ratios lie between zero and one, the dependent variable is censored on both sides. Furthermore, there are good reasons to believe that import penetration and the binary political organization variable are not exogenous. We control for both, following the approach taken by Goldberg and Maggi (1999).

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 (5).[6] We estimate both equations using maximum likelihood, and refer to Goldberg and Maggi (1999) for further details on the approach.[7] A description of the data we use can be found

[6]The cross–sectional nature of the dataset forces us to focus on a uniform degree of rent capturing across industries when it comes to the estimation .

[7]The maximum likelihood estimator from Goldberg and Maggi (1999) jointly estimates the equation of interest—(4) or (5)—with two reduced form equations. Import penetration and the organizational status are explained by the set of instruments from **?**). The three error terms are assumed to be jointly normally distributed and potentially correlated. The

Table 1: 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

in Gawande and Bandyopadhyay (2000). 107 industries are included in the sample.

The results of our estimation are reported in Table 1, 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 hypothetical case in which rent capturing is complete. Our estimates are similar to theirs, 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.[8]

In the more realistic 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 indi-

censoring of the dependent variable and the discrete nature of the organization dummy are explicitly accounted for.

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

cates that the US 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 % of potential rents are actually appropriated by the US government.

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 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.[9]

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.[10] 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%). In line with previous results,

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

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

the weight attached by the government to aggregate welfare is estimated to be very high.

Note that 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.[11] 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, while 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

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

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.

[11] OECD data for the U.S. at the 2-digit ISIC industry classification reveals that, at this crude level of disaggregation, the *level* of nontariff trade barriers is positively correlated with the amount of tariff protection, in 1988, 1993, and 1996. The correlation between the *change* in use of the two instruments was positive between 1988 and 1993, but turned negative between 1993 and 1996, after the Uruguay round. From the cross-sectional correlation we learn that industries with a higher than average level of tariff protection also receive a higher than average level of protection by nontariff barriers. This is not inconsistent with the observation in the introduction that in industries were tariffs are lowered, nontariff barriers are erected. In response to the WTO rules, countries substitute tariffs by nontariff barriers, but this only applies to changes over time.

An estimated γ of 0.72, as in Table 1, is compatible both with an industry protected by a quota of which 72% 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% is captured, etc. The estimation remains unchanged, only the interpretation of the results in the third columns is affected. In light of this, the relatively high estimates of γ seem even more plausible.

Finally, we performed a specification test of the augmented model (in column 3) versus the standard model (in column 2). This corresponds to testing whether γ is equal to 1, versus the alternative of γ smaller than 1. The p-value associated with the test statistic is 0.019. A one-sided test, rejects that γ is equal to one at a significance level of 2%.[12] This confirms the importance of explicitly accounting for partial rent capturing when estimating the Grossman and Helpman (1994) model.

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