The Effects of Loss Aversion on Trade Policy and the Anti-Trade Bias Puzzle*

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Abstract

We study the implications of loss aversion for trade policy determination and show how it allows us to explain a number of important and puzzling features of trade policy. In particular, we show that if individual preferences exhibit loss aversion and the coefficient of loss aversion is large enough, there will be an anti-trade bias in trade policy. We also show that, for a sufficiently high coefficient of loss aversion, more import-competing lobbies will form than under the current leading political economy model of trade protection due to Grossman and Helpman (1994), and import-competing sectors will be more likely to form a lobby than export sectors, reinforcing the anti-trade bias result. The predictions for protection that we obtain also imply that, everything else equal, higher protection will be given to those sectors in which profitability is declining. We use a nonlinear regression procedure to directly estimate the parameters of the model and test the empirical validity of its predictions. We find empirical support for the model and, very importantly, we obtain estimates of the parameters that are very close to those estimated by Kahneman and Tversky (1992) using experimental data. In order to test some predictions on the lobbying side, we estimate a Probit equation on political organization using the two-stage conditional maximum likelihood estimator proposed by Rivers and Vuong (1988), and find evidence of loss aversion in lobby formation. Finally but importantly, we find that the data favors our model over the Grossman and Helpman model.

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1. Introduction

Although economists are usually opposed to protectionism, governments continue to use trade policy on a widespread basis. The importance of the use of trade policy has led to a significant development of the literature on the political economy of protection, with an increasing interest in estimating the determinants of protection as directly derived from models that have micro-foundations. In that context, the Grossman and Helpman (1994) (henceforth GH) model has become the leading political economy model because, by explicitly modeling government-industry interactions, it derives from first principles a set of predictions about the determinants of protection. Furthermore, its predictions are directly testable, which has led to several empirical evaluations of the model.[2] However, despite the fact that the GH model has the advantage of being very parsimonious and yielding clear-cut empirical predictions, it fails to explain some basic features of trade policy, and thus a number of puzzles remain. For instance, it cannot explain the anti-trade bias in trade policy (which we describe below) and, in fact, as Levy (1999) shows, under some neutrality assumptions it predicts a pro-trade bias.[3] Similarly, it does not explain why protection is usually given to industries in which profits and employment are declining.

In this paper we study the effects of loss aversion on trade policy determination and show how it allows us to explain a number of important features of trade policy. In particular, we show that if individual preferences exhibit loss aversion and the coefficient of loss aversion is large enough, there will be an anti-trade bias in trade policy. In addition, we obtain lobby formation predictions that reinforce the anti-trade bias result. We also show that, if there is loss aversion, higher protection will be given to those sectors in which profitability is declining, everything else equal. The concept of loss aversion is due to Kahneman and Tversky (1979), who show empirical evidence that indicates that individuals place a larger welfare weight on the loss of a given amount of

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[2] Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000) were the first to test its predictions.

[3] We should point out that it is possible to obtain an anti-trade bias in the Grossman and Helpman model if, for instance, there is only one non-numeraire good and it is imported or if we introduce some artificial asymmetries.

income than on a gain of the same amount. Empirical estimates of loss aversion are typically close to 2, implying that the disutility of giving something up is twice as large as the utility of acquiring it[4]. Accounting for loss aversion seems particularly worthy given that the concept is gaining increased recognition in the economics literature as an important explanation for several patterns of human behavior. Its popularity is due mainly to the fact that it can explain many phenomena that remain paradoxes in traditional choice theory, such as the endowment effect (Thaler [1980]) and the equity premium puzzle (Benartzi and Thaler [1995]).

Since the introduction of loss aversion to individual preferences in a model of endogenous protection leads to predictions for protection that allow us to explain some important and puzzling features of trade policy, we use a nonlinear regression procedure to test the empirical validity of those predictions as well as to directly estimate the parameters of the model. We find empirical support for the model. Very importantly, we obtain estimates of the parameters that are very close to those estimated by Kahneman and Tversky (1992) using experimental data. In particular, we find that losses have a larger impact on protection than gains, and we obtain estimates of the coefficient of loss aversion that are about 2, consistent with the findings of the previous literature. To our knowledge, this is the first paper that provides econometric estimates from data not generated by experiments of *all* the parameters of the value function proposed by Kahneman and Tversky (1992).[5] Given that our predictions for protection differ from those of GH (1994), we compare the empirical performance of both models and find that the standard information criteria favor our model over the GH model. These results contrast with those of Gawande and Bandyopadhyay (2000) and Goldberg and Maggi (1999), who find that introducing additional variables in the estimation of the GH model does not significantly improve its explanatory power. Our approach differs from theirs, however, in that we have a well-specified alternative hypothesis.

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[4] See, for instance, Kahneman, Knetsch and Thaler (1990), and Kahneman and Tversky (1992).
[5] Besides the estimations that use data from experiments, we know of two papers that estimate the loss aversion coefficient. Putler (1992) estimated separate demand elasticities for increases and decreases in the retail price of shell eggs relative to a reference price and obtains a ratio of 2.4. Hardie, Johnson and Fader (1993) estimate coefficients of loss aversion for quality in the case of orange juice that are also about 2; however, they assume that the value functions are linear and thus do not test for diminishing sensitivity and do not estimate the corresponding parameter.

Finally, given that in the model the influence that special interest groups exert on policy makers by means of political contributions is a crucial determinant of protection, we estimate a Probit equation on political organization using the two-stage conditional maximum likelihood estimator proposed by Rivers and Vuong (1988) and we find evidence of loss aversion in lobby formation. The fact that we test some predictions obtained by endogenizing lobby formation also differs from the empirical work of Gawande and Bandyopadhyay (2000) and Goldberg and Maggi (1999), who estimate a version of the GH model which takes lobby formation as exogenous.[6]

Since an important objective of the paper is to explain the anti-trade bias puzzle, we proceed to say more about it. A common answer to the question of why free trade is so rarely practiced relies on the government's use of trade policy to redistribute income toward specific groups. However, as Rodrik (1995) says, an equally important puzzle remains: Why is trade policy typically biased in favor of import-competing sectors, being therefore trade restricting rather than trade promoting? This puzzle is particularly relevant for small economies, given that they cannot use tariffs to improve their terms of trade. Nonetheless, some of the political economy models of endogenous protection get rid of the puzzle by introducing some artificial assumptions.[7] Moreover, as we already mentioned, the current leading political economy model, due to Grossman and Helpman (1994), not only cannot explain the anti-trade bias in trade policy but also, as Levy (1999) shows, under some symmetry assumptions it predicts a pro-trade bias.

In a model of endogenous protection, we show that if individual preferences exhibit loss aversion and the coefficient of loss aversion is large enough, there will be an anti-trade bias in trade policy. The intuition is as follows. Consider two non-numeraire goods, good 1 and good 2, and start with complete symmetry between sectors in both consumption and production, and assume that under autarky their domestic prices are equal to the world price, which in turn equals unity by the choice of units. Then, introduce a shock that causes the economy to import good 2 and export good 1, for

[6] They allow for the political organization variable to be potentially endogenous in the estimation of the protection equation but they do not test any predictions on political organization obtained from endogenizing lobby formation.

[7] For instance, the tariff-formation function approach, first used by Findlay and Wellisz (1982), assumes that interest groups lobby for tariffs but not export subsidies. Similarly, the political-support function approach a la Hillman (1982) assumes that the policymaker wants support from import-competing interest groups but not from exporting ones.

instance a shock that changes the endowments of the specific factors in a way such that output of good 1 increases by 1 percent and that of good 2 decreases by 1 percent. This shock leads to a loss for the owners of the import-competing factor that looms larger than the gain of the owners of the export factor, and if the coefficient of loss aversion is sufficiently high, this effect (which we call the "loss aversion effect") dominates the effect of a higher output in the export sector than in the import-competing sector (the "size effect") and the tariff will be higher than the export subsidy. This contrasts with the GH (1994) model, in which we only have the size effect and, since the level of protection is proportional to industry output, the tariff turns out to be lower than the export subsidy.

We find that alternative shocks that lead the country to trade both of the non-numeraire goods, such as a technological shock that increases productivity in sector 1 and reduces productivity in sector 2 or a shock that increases the world price of good 1 and decreases the world price of good 2, will also generate an anti-trade bias if the coefficient of loss aversion is large enough. We also provide the condition that must hold to have an anti-trade bias when we do not impose any symmetry assumptions, and discuss the cases that take place under the different possible initial output relations. In addition, we show that the anti-trade bias also arises between two large countries even if cooperation removes the terms-of-trade motive for the use of trade protection.

We then endogenize lobby formation and show that, for a high enough coefficient of loss aversion, 1) more import-competing lobbies will form than under the original GH model, and 2) import competing sectors will be more likely to form a lobby than export sectors. The intuition for the first result is that, when the country opens to trade, the benefit of forming a lobby and avoiding a loss has an extra effect on utility once loss aversion is taken into account, and the additional protection associated with becoming organized is also higher than under the GH model. As for the second result, the reason is that if importers lose and exporters gain when the country opens to trade (in the absence of intervention), the cost of remaining unorganized is higher for the importers provided that the coefficient of loss aversion is sufficiently large.

The next section discusses the literature related to the anti-trade bias in trade policy and describes the concept of loss aversion, its implications and the empirical evidence that supports it. In Section 3 we present the model and solve for the equilibrium trade policy, and we show that if preferences exhibit loss aversion, higher protection will be given to sectors in which profits are declining, everything else equal. Section 4 shows that if there is loss aversion and the coefficient of loss aversion is sufficiently large, then trade policy will have an anti-trade bias. In Section 5 we endogenize lobby formation and show that, for a high enough coefficient of loss aversion, more import-competing lobbies will form than under the original GH model, and import competing sectors will be more likely to form a lobby than export sectors. In Section 6 we estimate the parameters of the model and provide empirical evidence of the relevance of loss aversion for trade policy determination and lobby formation. Section 7 concludes.

2. Literature

2.1. The Anti-Trade Bias

In this section we will cite some of the explanations that have been provided by the literature concerning the anti-trade bias in trade policy.[8] As Rodrik (1995) mentions, one possible answer is that tariffs were initially imposed for revenue reasons and that the anti-trade bias persists due to some bias toward the status quo. In that line, Fernandez and Rodrik (1991) provide an answer to the question of persistence on the basis of uncertainty regarding the redistribution of gains and losses from a reform. They show that there is a bias toward the status quo, and therefore against efficiency enhancing reforms such as trade liberalization, if some of the winners and losers from the reform cannot be identified ex ante. As a result, liberalization may be rejected under majority voting even though it would have received adequate political support ex post had it been adopted. Another explanation that relates the anti-trade bias to a status quo bias is due to a conservative welfare function postulated by Corden (1974), by which politicians place a larger weight on reductions than on increases in income[9]. However, these arguments do not address the important issue of explaining the initial structure of protection, but rather take it as given. In addition, except for the case of developing countries, we can question

[8] See Limão and Panagariya (2002) for a summary of this literature.

[9] Nonetheless, it is not clear why this is so. Also, we will focus on the effects of loss aversion on the behavior of firms and lobbying groups.

the importance of the revenue motive for the use of trade policy in most of the other countries at present, as well as for the use of quantity restrictions that do not produce revenue.[10]

Olson (1983) states that negative shocks will lead to more lobby formation due to the fact that they reduce the benefit for potential entrants to the industry and therefore the free-rider problem associated with lobby formation is attenuated. If negative shocks affect primarily import-competing sectors this could lead to an anti-trade bias. Nevertheless, those shocks would also increase the probability of exiting the industry, reducing the expected benefit of lobby formation.[11]

Combining analytical and numerical techniques, Eaton and Grossman (1985) show that trade policy will often have an anti-trade bias in a small economy that faces uncertain terms of trade if some factors are immobile ex post and insurance markets are incomplete. They assume that when capital is allocated between production activities the terms of trade are unknown. A tariff redistributes income toward the group with a higher marginal utility in either of the two states of nature considered, acting as a partial substitute for insurance. However, Dixit has shown in various papers that not explicitly modeling the causes for markets to be incomplete can yield erroneous policy proposals.[12]

Finally, Limão and Panagariya (2002) use a general equilibrium model to show that if the government's objective reflects a concern for inequality, or diminishing political support from factor owners, then trade policy exhibits an anti-trade bias. The reason is that, starting from a symmetric equilibrium, the same shock that leads the economy to trade leaves the owners of the import factor worse off relative to the owners of the export factor, and a tariff reverses some of this equity loss. Our approach differs from theirs in that we explicitly model the political process, and that we rely on loss aversion in individual preferences instead of an inequality concern on the part of the government to explain the anti-trade bias.

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[10] Finally, as Limão and Panagariya (2003) point out, even though tariff protection for a given industry is persistent in the short and medium run, over longer periods the pattern of trade changes significantly as countries develop, making it hard to argue that the status quo bias can explain persistence over decades.

[11] Moreover, it is not clear why import-competing sectors would be subject to more frequent and larger negative shocks.

[12] See, for instance, Dixit (1989). We should point out that, in contrast to theirs, our argument does not rely on uncertainty or incomplete markets.

2.2. Loss Aversion

In expected utility theory, the domain of the utility function is final assets, rather than gains or losses. Kahneman and Tversky (1979) provide evidence that indicates that value or utility is determined by changes in wealth, and thus they emphasize the importance of changes as opposed to final asset positions that include current wealth.[13]

Another important characteristic of preferences of which Kahneman and Tversky (1979) find evidence is that the disutility that one experiences in losing a sum of money is greater than the pleasure associated with gaining the same amount. This phenomenon is called *loss aversion* and it leads to a utility function that is steeper for losses than for gains. The concept was first defined in the framework of prospect theory and then extended to choice under certainty (Tversky and Kahneman [1991]).

An immediate consequence of loss aversion is what Thaler (1980) called the *endowment effect*: the loss of utility associated with giving up a valued good is greater than the utility gain associated with receiving it. Value seems to change once a good is incorporated into one's endowment. Kahneman, Knetsch and Thaler (1990) ran a series of experiments which provide evidence of the endowment effect and suggest a coefficient of loss aversion slightly greater than 2.[14] Tversky and Kahneman (1990) also observed a ratio of just over 2:1 in several experiments involving risky choices. In one gambling experiment with real payoffs, for instance, a 50-50 bet to win $25 or lose $10 was barely acceptable, yielding a ratio of 2.5 to 1. Similar values were obtained from choices involving larger gambles, over a range of several hundred dollars. They conclude that "[the] findings suggest that a loss aversion coefficient of about two may explain both

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[13] Markowitz (1952) was the first to propose that utility be defined on gains and losses rather than on final asset positions. Nonetheless, as the authors point out, the emphasis on changes does not imply that the value of a particular change is independent on the initial position. Value should be treated as a function in two arguments: the asset position and the magnitude of the change from the reference point (although the representation as a function of one argument can be a satisfactory approximation when changes are small or even moderate).

[14] In one of the experiments, a decorated mug with retail value of about $5 was given to some of the students in a classroom. These students ("the sellers") indicated the price at which they would be willing to sell their mug, and the students who had not received a mug (the "choosers") indicated their preferences between receiving a mug and certain sums of money. The sellers and choosers differ only in that the former evaluate the mug as a loss and the latter as a gain. Loss aversion requires that the rate of exchange between the mug and money be different in the two cases. Indeed, the median value of the mug was $7.12 for the sellers and $3.12 for the choosers in one experiment, and $7.00 and $3.50 in another.

risky and riskless choices involving monetary outcomes and consumption goods." (Tversky and Kahneman [1991], p.1054).

Another implication of loss aversion is what has been called the *status quo bias*: individuals have a strong tendency to remain at the status quo, because the disadvantages of leaving it receive more weight than the advantages.[15]

Finally, Kahneman and Tversky (1979) find evidence of what they call *diminishing sensitivity*: the marginal value of both gains and losses decreases with their size.

Based on the findings described above, Kahneman and Tversky (1992) propose a value function defined over gains and losses relative to some reference point -such as the status quo- with a slope that changes abruptly at the reference point, consistent with loss aversion. Specifically, they propose a function of the following form:

$$v(x) = \begin{cases} x^{\alpha} & if \;\; x \geq 0 \\ -\lambda(-x)^{\beta} & if \;\; x < 0 \end{cases}$$

where λ is the coefficient of loss aversion. They estimated α and β to be 0.88 (consistent with diminishing sensitivity) and λ to be 2.25.[16] Also, x is measured as the difference in wealth with respect to the last time wealth was measured.

We should point out that although the fact that the displeasure from a monetary loss is greater than the pleasure from a similar gain is also implied by a standard concave utility function, loss aversion implies that the slope of the value function changes abruptly at the reference level, so that we have a pronounced asymmetry even for arbitrarily small gains and losses. As Tversky and Kahneman (1992) say "The observed

[15] The experiment mentioned above is an illustration of this. Knetsch (1989) conducts an experiment where students in two undergraduate classes were required to answer a brief questionnaire. Immediately after, students in one of the classes were given decorated mugs as compensation, while students in the other class received a large bar of Swiss chocolate. Then, students were asked if they wanted to trade their gift for the other by raising a card with the word "Trade" written on it. Although the transaction costs were small, about 90 percent of the participants chose to retain the gift they had received. See also Samuelson and Zeckhauser (1988), who demonstrated this effect using different experiments.

[16] The estimation was based on an experiment involving 25 graduate students from Berkeley and Standford, in which subjects indicated preferences between different sure outcomes and a risky prospect. Certainty equivalents were thus derived from observed choices, and the authors used a nonlinear regression procedure to estimate the parameters separately for each subject and then obtained their median values.

asymmetry between gains and losses is far too extreme to be explained by income effects or by decreasing risk aversion." (p. 298). In fact, an important aspect of loss aversion is that it can resolve the criticism on expected utility put forward by Rabin (2000) and Rabin and Thaler (2001), who show that for *any* concave utility function, even very little risk aversion over modest stakes implies an absurd degree of risk aversion over larger stakes.[17]

Besides the experimental evidence on loss aversion, we can mention some other studies related to the topic. These include Dunn (1996), who using survey evidence from seven labor markets, presents empirically determined indifference functions for income and leisure which exhibit the phenomenon of loss aversion, and this in turn can explain the theoretically unexpected stability observed in labor markets when there is an overtime premium. Some theoretical papers that incorporate loss aversion into worker's preferences are Bhaskar (1990) and Mc Donald and Sibly (2001). In addition, Shea (1995) finds that consumption responds more strongly to predictable income declines than to predictable income increases. That asymmetry is consistent with models in which preferences exhibit loss aversion. Benartzi and Thaler (1995) use loss aversion to explain the equity premium puzzle. In recent years, loss aversion has also been frequently applied in behavioral finance. For example, Barberis et al. (2001) introduce loss aversion into investor preferences and show that their model reproduces some puzzling features of aggregate asset pricing data, such as the high mean, volatility and predictability of stock returns. Similarly, Barberis and Huang (2001) use loss aversion to explain the time series and cross-sectional behavior of individual stocks.

3. The Model

We consider a small competitive economy that takes the world prices as given.[18] Individuals have identical preferences but may differ in their factor endowments. They maximize their utility, which is given by

[17] For example, Rabin (2000) shows that a person who turns down a 50-50 bet of losing $100 and gaining $110 would also turn down a 50-50 bet of losing $1000 and gaining *any* amount of money!

[18] In section 4.2 we consider the case of large economies.

$$u = \begin{cases} x_0 + \sum_{i=1}^{n} u_i(x_i) - \lambda\left[-\left(\widetilde{E} - \widetilde{E}^{(-1)}\right)/\,\widetilde{E}^{(-1)}\right]^{\beta} & \text{if } \widetilde{E} < \widetilde{E}^{(-1)} \\ x_0 + \sum_{i=1}^{n} u_i(x_i) + \left[\left(\widetilde{E} - \widetilde{E}^{(-1)}\right)/\,\widetilde{E}^{(-1)}\right]^{\alpha} & \text{if } \widetilde{E} \geq \widetilde{E}^{(-1)} \end{cases} \qquad (1)$$

where x_0 is consumption of the numeraire good; x_i denotes consumption of good i, $i = 1, 2, \ldots, n$; $\widetilde{E}$ is income derived from the sale of factor endowments; the superscript (-1) denotes that the variable is lagged one period; and $\lambda > 1$ is the coefficient of loss aversion. The sub-utility functions are differentiable, increasing and strictly concave.

In contrast to the GH (1994) model, individuals in our model derive utility (or value) not only from consumption levels but also from *changes* in their income, with losses looming larger than gains, consistent with the theory developed by Kahneman and Tversky (1979). Thus, the first term in (1), given by $x_0 + \sum u_i(x_i)$, reflects utility over consumption. The second term captures the idea that individuals care about changes in their wealth or income in a way consistent with loss aversion.[19]

An individual with income E will consume $x_i = d_i(p_i) = [u'_i(p_i)]^{-1}$ of good i, and $x_0 = E - \sum_i p_i d_i(p_i)$ of the numeraire good. The indirect utility function is:

$$v(\mathbf{p}, E) = \begin{cases} E - \lambda\left[-\left(\widetilde{E} - \widetilde{E}^{(-1)}\right)/\,\widetilde{E}^{(-1)}\right]^{\beta} + s(\mathbf{p}) & \text{if } \widetilde{E} < \widetilde{E}^{(-1)} \\ E + \left[\left(\widetilde{E} - \widetilde{E}^{(-1)}\right)/\,\widetilde{E}^{(-1)}\right]^{\alpha} + s(\mathbf{p}) & \text{if } \widetilde{E} \geq \widetilde{E}^{(-1)} \end{cases} \qquad (2)$$

where **p** is the vector of domestic prices and the consumer surplus derived from the non-numeraire goods is given by $s(\mathbf{p}) = \sum_i u_i\left(d_i(p_i)\right) - \sum_i p_i d_i(p_i)$.

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[19] Other authors have incorporated loss aversion in a similar manner. For instance, Barberis et al. (2001) and Barberis and Huang (2001) model utility as the sum of one term capturing utility over consumption and another term capturing the effect of changes in wealth. As they point out, it is important to note that even if the second term were not present, individuals would still care about changes in income just because of what those changes mean for consumption, and that by adding the second term we take the view that changes in income generate utility *over and above* the indirect utility that comes through consumption. (See Barberis et al. [1999] p. 8 , Barberis et al. [2001] pp. 6-7 and Barberis and Huang [2001] p. 1256 for a discussion).

Good 0 is manufactured from labor alone with constant returns to scale and an input-output coefficient equal to 1. It is assumed that the supply of labor is large enough to ensure that some of this good is always produced. Then, the wage rate equals 1 in equilibrium. Each of the non-numeraire goods is produced using labor and a sector-specific factor, with constant returns to scale. The supply of the specific factors is fixed. Since the wage is fixed, the rents derived from the specific factors are a function of the domestic price only. We denote these rewards by $\Pi_i(p_i)$. By Hotelling's lemma, output is given by $y_i = \Pi_i'(p_i)$.

The government can implement trade taxes and subsidies. The net per capita revenue from all taxes and subsidies is:

$$r(\mathbf{p}) = \sum_i (p_i - p_i^*)\left[d_i(p_i) - \frac{1}{N} y_i(p_i)\right] \tag{3}$$

where p_i^* is the world price of good *i* and *N* measures the total population. We assume that the government redistributes revenue uniformly to all of the individuals (voters) and so $r(\mathbf{p})$ gives the net transfer to each individual.

An individual derives income from wages and government transfers, and maybe from the ownership of some specific factor. We assume that they own at most one of the specific factors. The owners of the specific factor used in industry *i* may decide to organize themselves into lobby groups. For now we will assume that in some exogenous set of sectors *L*, the specific factors have been able to organize for political activity, as in GH (1994).[20] Each lobby offers the government a contribution schedule, $C_i(\mathbf{p})$, which maps every policy that the government might choose into a campaign contribution level. We denote the joint welfare of the members of lobby *i* by $V_i = W_i - C_i$, where W_i is their gross-of-contributions joint welfare, given by:[21]

[20] Later on we will endogenize lobby formation.
[21] We assume that either there is a single owner of each specific factor or that each lobby evaluates its welfare as a group.

$$W_i = \begin{cases} l_i + \Pi_i(p_i) - \lambda\left[-\left(\widetilde{E}_i - \widetilde{E}_i^{(-1)}\right)/\widetilde{E}_i^{(-1)}\right]^{\beta} + \theta_i N[r(\mathbf{p}) + s(\mathbf{p})] & if\ \widetilde{E}_i < \widetilde{E}_i^{(-1)} \\ l_i + \Pi_i(p_i) + \left[\left(\widetilde{E}_i - \widetilde{E}_i^{(-1)}\right)/\widetilde{E}_i^{(-1)}\right]^{\alpha} + \theta_i N[r(\mathbf{p}) + s(\mathbf{p})] & if\ \widetilde{E}_i \geq \widetilde{E}_i^{(-1)} \end{cases} \quad (4)$$

where l_i is the labor supply (also labor income) of the owners of the specific input used in industry *i*, and θ_i is the fraction of the population that owns some of this factor. We will assume, for simplicity, that ownership in any given sector is highly concentrated, so that $\theta_i \to 0$. This allows us to abstract from the effects of lobby competition and focus on the interaction between the government and each of the lobbies. Therefore, we have that, for lobby *i*, $E_i \equiv l_i + \Pi_i(p_i) + \theta_i r(\mathbf{p}) = l_i + \Pi_i(p_i) \equiv \widetilde{E}_i$ and:[22]

$$W_i = \begin{cases} l_i + \Pi_i(p_i) - \lambda\left[\left(\Pi_i(p_i^{(-1)}) - \Pi_i(p_i)\right)/E_i^{(-1)}\right]^{\beta} & if\ \Pi_i(p_i) < \Pi_i(p_i^{(-1)}) \\ l_i + \Pi_i(p_i) + \left[\left(\Pi_i(p_i) - \Pi_i(p_i^{(-1)})\right)/E_i^{(-1)}\right]^{\alpha} & if\ \Pi_i(p_i) \geq \Pi_i(p_i^{(-1)}) \end{cases} \quad (5)$$

where $\Pi_i(p_i^{(-1)})$ denotes last period's profits for the lobby.

The government maximizes a weighted sum of contributions and social welfare:

$$G = \sum_{i \in L} C_i(\mathbf{p}) + aW(\mathbf{p}), \qquad a \geq 0 \quad (6)$$

where social welfare is given by:

$$W(\mathbf{p}) = l + \sum_{i=1}^{n} \Pi_i(p_i) - \sum_{\Pi_i < \Pi_i^{(-1)}} \lambda\left[\left(\Pi_i(p_i^{(-1)}) - \Pi_i(p_i)\right)/E_i^{(-1)}\right]^{\beta} + \sum_{\Pi_i \geq \Pi_i^{(-1)}} \left[\left(\Pi_i(p_i) - \Pi_i(p_i^{(-1)})\right)/E_i^{(-1)}\right]^{\alpha} + N[r(\mathbf{p}) + s(\mathbf{p})] \quad (7)$$

[22] We take the factor endowments of each individual as constant across periods. Therefore, $\Pi_i(p_i) < \Pi_i(p_i^{(-1)})$ if and only if $E_i < E_i^{(-1)}$ and $\Pi_i(p_i) \geq \Pi_i(p_i^{(-1)})$ if and only if $E_i \geq E_i^{(-1)}$.

The game is a two-stage noncooperative game in which the lobbies simultaneously choose their political contribution schedules in the first stage and the government sets the policy and collects the contributions associated with it in the second, as in GH (1994). They define the equilibrium drawing on the work of Bernheim and Whinston (1986).[23]

In the Appendix we derive the equilibrium policies for both organized and unorganized sectors, and obtain a general equation for the equilibrium policies:

$$\frac{\tilde{t}_i}{1+\tilde{t}_i} = \begin{cases} \dfrac{1}{a}\left\{ I_i + (I_i + a)\beta\lambda \dfrac{\left[\Pi_i\left(\tilde{p}_i^{(-1)}\right) - \Pi_i\left(\tilde{p}_i\right)\right]^{\beta-1}}{\left(E_i^{(-1)}\right)^{\beta}} \right\} \dfrac{\tilde{z}_i}{\tilde{e}_i} & \text{if } \Pi_i\left(\tilde{p}_i\right) < \Pi_i\left(\tilde{p}_i^{(-1)}\right) \\ \dfrac{1}{a}\left\{ I_i + (I_i + a)\alpha \dfrac{\left[\Pi_i\left(\tilde{p}_i\right) - \Pi_i\left(\tilde{p}_i^{(-1)}\right)\right]^{\alpha-1}}{\left(E_i^{(-1)}\right)^{\alpha}} \right\} \dfrac{\tilde{z}_i}{\tilde{e}_i} & \text{if } \Pi_i\left(\tilde{p}_i\right) > \Pi_i\left(\tilde{p}_i^{(-1)}\right) \end{cases} \tag{8}$$

where $\tilde{t}_i = (\tilde{p}_i - p_i^*)/p_i^*$ is the equilibrium *ad valorem* trade tax or subsidy, $I_i = 1$ if $i \in L$ and zero otherwise, $\tilde{z}_i = y_i(\tilde{p}_i)/m_i(\tilde{p}_i)$ is the equilibrium ratio of domestic output to imports (negative for exports) and $\tilde{e}_i = -m_i'(\tilde{p}_i)\,\tilde{p}_i / m_i(\tilde{p}_i)$ is the elasticity of import demand (defined to be positive) or export supply (defined to be negative).

The presence of protection for the unorganized sectors is due to the direct effect on utility generated by changes in income with respect to its reference level.[24] In addition, we can distinguish the effect that loss aversion has on protection from a status-quo bias effect. For a sector that experiences a loss, loss aversion works in the direction of increasing protection in order to attenuate the negative effect the loss has on utility, and hence in that case we could say that it moves the agents toward their status quo utility

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[23] In particular, they state that $\left(\{C_i^0\}_{i\in L}, \mathbf{p}^0\right)$ is a subgame-perfect Nash equilibrium if and only if: **a)** C_i^0 is feasible for all $i \in L$; **b)** $\mathbf{p}^0$ maximizes $\sum_{i\in L} C_i^0(\mathbf{p}) + aW(\mathbf{p})$ on *P*; **c)** $\mathbf{p}^0$ maximizes $W_j(\mathbf{p}) - C_j^0(\mathbf{p}) + \sum_{i\in L} C_i^0(\mathbf{p}) + aW(\mathbf{p})$ on *P* for every $j \in L$; and **d)** for every $j \in L$ there exists a $\mathbf{p}^j \in P$ that maximizes $\sum_{i\in L} C_i^0(\mathbf{p}) + aW(\mathbf{p})$ on *P* such that $C_j^0(\mathbf{p}_j) = 0$.

[24] Thus, we should also point out that if exporters gain when the country opens to trade, the fact that a gain increases utility leads to protection for the exporters even if they are unorganized.

level. However, if we consider a sector that experiences a gain, loss aversion also leads to an increase in protection,[25] because gains have a positive effect on utility and, therefore, in that case it tends to move the agents *further away* from the status quo.[26]

Recalling that the GH model yields the following solution for the equilibrium policies:

$$\frac{\tilde{t}_i}{1+\tilde{t}_i} = \frac{1}{a} I_i \frac{\tilde{z}_i}{\tilde{e}_i} \tag{9}$$

we can see that in that model past profits, and more precisely whether the sector is better off or worse off with respect to the previous period, play no role in determining the levels of protection.

The result of our model implies that, given symmetry between two sectors in everything (including size) except in that one experienced a loss $\left(\Pi_i\left(p_i\right) < \Pi_i\left(p_i^{(-1)}\right)\right)$, and the other a gain $\left(\Pi_i\left(p_i\right) > \Pi_i\left(p_i^{(-1)}\right)\right)$, with the magnitude of the loss and gain being also similar, the sector that experienced a loss receives higher protection (a higher import tariff or export subsidy) than the one that gained. The reason is that under loss aversion losses loom larger than gains. In particular, if we recall that Kahneman and Tversky (1992) estimated both α and β to be 0.88 and λ to be about 2, the second term inside the brackets in (8) would be approximately twice as large for the sector that is worse off as compared to that for the sector that is better off. Hence, while the GH model does not explain why protection is usually given to sectors in which profits are declining, our model implies that, if there is loss aversion, higher protection will be given to those

[25] Nonetheless, for two sectors that are symmetric in everything except that one had a loss and the other a gain of equal magnitude, loss aversion leads to higher protection for the sector that experienced a loss. Below we say more about this.

[26] This does not imply, however, that loss aversion is inconsistent with a status quo bias in the sense that Tversky and Kahneman (1991) defined it. For example, consider a trade reform that would benefit the export sector and hurt the import sector, and suppose there is uncertainty about which individuals would end up working in the export sector and which in the import sector, as in Fernandez and Rodrik (1991). In that case loss aversion may enhance a status quo bias because losses will be weighted more heavily than gains, and thus it would increase the probability of rejecting reforms even if they would benefit a majority ex post.

sectors in which profitability is declining, everything else equal. This will also have implications for the prediction of an anti-trade bias, as we discuss next.[27]

4. The Anti-trade Bias Puzzle

As Rodrik (1995) says, it is still a puzzle the fact that the net effect of trade policy is to restrict rather than promote trade (i.e., it contracts imports by more than it expands exports). The current leading political economy model of trade policy, due to GH (1994) not only cannot explain this puzzle but also, as Levy (1999) shows, under some symmetry assumptions predicts a pro-trade bias. Given its neutrality assumptions, this is the most natural starting point to study the bias that arises when an economy begins to trade with the rest of the world due to some shock. Later on we look at the cases in which the initial situation is not symmetric. In addition, the fact that the starting point in the case considered by Levy is an autarky situation is convenient given the importance of explaining initial protection. But, more broadly, we focus primarily on that case because our main objective is to explain how an anti-trade bias can arise under loss aversion *in the same context* that the GH model has been shown to predict a pro-trade bias.

4.1. A small economy

Since the case that Levy (1999) analyzes is the benchmark against which we will first compare our results, we proceed to explain the intuition behind it. Consider the GH model with two non-numeraire goods, good 1 and good 2. Start with complete symmetry between sectors in consumption and production and assume that under autarky their domestic prices are equal to their respective world prices, which in turn equal unity by the choice of units. Suppose that the endowments of the specific factors change in a way such that the output of good 1 increases by 1 percent and that of good 2 contracts by 1 percent. Good 1 then becomes an export good and good 2 and import good, with trade

[27] We should also point out that even though we have referred to the reference income simply as income in the previous period, given the static nature of the model we shall think of it as the level of income before the last shock occurred, so that the optimal protection levels will not change as long as no new shocks occur.

balancing between them under no intervention. Now recall that the GH model predicts the equilibrium policy given by (9) and therefore an export subsidy on good 1 and a tariff on good 2 (provided that both sectors are organized). Moreover, given the symmetry assumption, the rate of the import tariff is lower than that of the export subsidy due to the fact that the export sector is larger and the level of protection is proportional to output. This implies that exports increase by more than imports decrease and therefore there is a *pro*-trade bias.[28]

Let us now turn to the results under our model. Consider again two non-numeraire goods and similar symmetry assumptions. Introduce the same shock that increases output of good 1 by 1 percent and contracts output of good 2 by 1 percent. Given that the loss (in the absence of intervention) for the import sector is of equal magnitude than the gain for the export sector, without further assumptions the model can predict a pro or anti-trade bias. The reason is that while on the one hand we have that the lower output in the import sector calls for a lower level of protection (the "size effect"), the loss experienced by that sector looms larger than the similar gain of the export sector, due to loss aversion, and the direction of the bias will depend on which of these two effects dominates. In particular, the model predicts an anti-trade bias if the following condition holds (at $t_1 = t_2 = 0$) (See the Appendix for the proof):

$$\lambda > \frac{1}{\beta \dfrac{\left[\Pi_2\left(p_2^{(-1)}\right) - \Pi_2\left(p_2\right)\right]^{\beta-1}}{\left(E^{(-1)}\right)^{\beta}}} \left\{ \frac{y_1 - y_2}{(1+a)y_2} + \alpha \frac{\left[\Pi_1\left(p_1\right) - \Pi_1\left(p_1^{(-1)}\right)\right]^{\alpha-1}}{\left(E^{(-1)}\right)^{\alpha}} \frac{y_1}{y_2} \right\} \quad (10)$$

If we set $\alpha = \beta$[29] and let $\Delta\Pi \equiv \Pi_2\left(p_2^{(-1)}\right) - \Pi_2\left(p_2\right) = \Pi_1\left(p_1\right) - \Pi_1\left(p_1^{(-1)}\right)$, we obtain:

$$\lambda > \frac{\Delta\Pi / \left(\Delta\Pi / E^{(-1)}\right)^{\beta}}{\beta(1+a)} \frac{y_1 - y_2}{y_2} + \frac{y_1}{y_2} \quad (11)$$

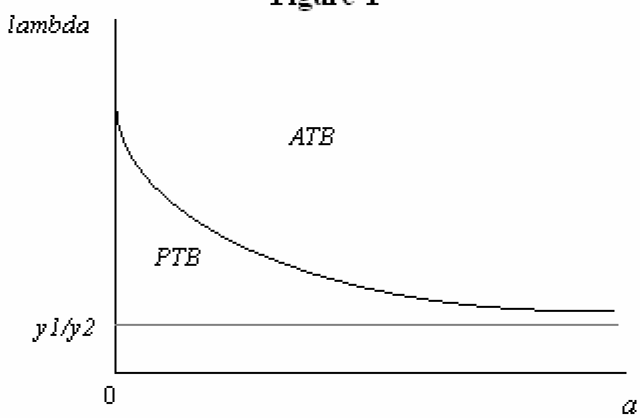
[28] We should point out that it is possible to obtain an anti-trade bias in the Grossman and Helpman model if, for instance, there is only one non-numeraire good and it is imported.

[29] This is reasonable if we recall that Kahneman and Tversky (1992) estimated α and β to be 0.88. We also find empirical support for the assumption that $\alpha = \beta$, as shown in Section 6.

That is, for a sufficiently large coefficient of loss aversion, the model generates an anti-trade bias. We should stress that $\lambda > 1$ is a necessary condition for (11) to hold, so that we need loss aversion to be present *and* the coefficient of loss aversion to be large enough.[30]

Note that the inequality is more likely to hold if: a) the output of good 1 is not too large as compared to the output of good 2 (because if it were the export sector would have more to gain from protection); and b) the weight that the government places on social welfare is not too small (so that the asymmetry between the importers' loss and the exporters' gain receives more weight in the government's objective). Figure 1 shows the values of λ (*lambda*) and a for which the model predicts an anti-trade bias[31].

Figure 1



More generally, without imposing the symmetry assumptions, any shock that increases the endowment of the specific factor used in the export sector and decreases that of the factor used in the import sector will generate an anti-trade bias if and only if:

[30] If we do not set $\alpha = \beta$ one could have the condition holding for β sufficiently larger than α even if $\lambda = 1$. However, having β greater than α would be an alternative way of modeling loss aversion, since it implies a larger effect on utility of losses versus gains. We prefer to model loss aversion by means of the coefficient λ, and let α and β capture diminishing sensitivity, as do Kahneman and Tversky (1992). The main point is that, in any case, we need a discontinuity in the slope to obtain an anti-trade bias, and thus just having concavity on the change in income would not generate the result.

[31] The intercept when $a = 0$ is at $\frac{\Delta\Pi / \left(\Delta\Pi / E^{(-1)}\right)^{\beta}}{\beta} \frac{y_1 - y_2}{y_2} + \frac{y_1}{y_2}$.

$$\lambda > \frac{1}{\beta \frac{\left[\Pi_2\left(p_2^{(-1)}\right)-\Pi_2\left(p_2\right)\right]^{\beta-1}}{\left(E_2^{(-1)}\right)^{\beta}} \frac{y_2}{-p_2 m_2'}} \left\{ \frac{\frac{y_2}{p_2 m_2'} - \frac{y_1}{p_1 m_1'}}{(1+a)} + \alpha \frac{\left[\Pi_1\left(p_1\right)-\Pi_1\left(p_1^{(-1)}\right)\right]^{\alpha-1}}{\left(E_1^{(-1)}\right)^{\alpha}} \frac{y_1}{-p_1 m_1'} \right\} \quad (11')$$

Any technological shock that increases productivity in sector 1 and reduces productivity in sector 2 will have the same implications.

Finally, consider again a situation in which the domestic prices of goods 1 and 2 under autarky are equal to their respective world prices. A shock that increases the world price of good 1 and decreases the world price of good 2 will cause good 1 to be exported and good 2 to be imported, generating an anti-trade bias if and only if (11') holds.

We can generalize the results of this section by saying that *any shock that induces the country to trade both of the non-numeraire goods causing a loss for the import sector (in the absence of protection) leads to* $t_2 > t_1$ *(i.e., the trade policy has an anti-trade bias) if and only if the coefficient of loss aversion is sufficiently large, such that equation (11') holds.*

Before relaxing the small-country assumption, let us go back to the asymmetric cases (i.e., without imposing any symmetry assumptions). Consider first a pre-trade situation in which output in sector 1 is larger than output in sector 2[32] and there is a shock that leads the country to export good 1 and import good 2 causing a loss for the import sector[33]. As a result, after the shock we still have $y_1 > y_2$. Then the size effect calls for a lower level of protection in sector 2 than in sector 1, but the loss aversion effect goes in the opposite direction, calling for higher protection in the import sector. Hence, if the coefficient of loss aversion is high enough for condition (11') to hold, there will be an anti-trade bias.

Now suppose that, initially, output is larger in sector 2 and introduce the same type of shock. If the ordering of outputs is reversed so that $y_2 < y_1$ after the shock, we have a situation similar to the one previously discussed in terms of the direction of the

[32] Both prices still equal one by the choice of units.

[33] From our previous discussion of the various shocks that have these effects one can see that nearly all the possible shocks that lead the country to trade both of the non-numeraire goods will cause a loss from the import-competing sector.

effects, i.e. the size effect and the loss aversion effect work in opposite directions, and there will be an anti-trade bias if and only if equation (11') holds. On the other hand, if the output ranking is preserved, that is, $y_2 > y_1$ after the shock, then both the size effect and the loss aversion effect work in the same direction, making the anti-trade bias condition more likely to hold. In particular, if $\left(\Delta\Pi_2 / E_2^{(-1)}\right)^{\beta} / \Delta\Pi_2 = \left(\Delta\Pi_1 / E_1^{(-1)}\right)^{\beta} / \Delta\Pi_1$, and $p_2 m_2' = p_1 m_1'$ after the shock, the right hand side of (11') will be less than 1[34]. In that case (11') will always hold (since it is sufficient that $\lambda \geq 1$) and we get an anti-trade bias for sure. Finally, if $y_2 = y_1$ after the shock, then only the loss aversion effect is present, which works in the direction of an anti-trade bias. In particular, in the case in which $\left(\Delta\Pi_2 / E_2^{(-1)}\right)^{\beta} / \Delta\Pi_2 = \left(\Delta\Pi_1 / E_1^{(-1)}\right)^{\beta} / \Delta\Pi_1$ and $p_2 m_2' = p_1 m_1'$, the right hand side of (11') will equal 1 and we get an anti-trade bias (since by definition $\lambda > 1$ under loss aversion).[35]

4.2. Two large countries

We now turn to the case of large economies. Consider a world with two countries, home and foreign, that are identical in all respects. Initially there is no motive for trade or for a tariff or subsidy. Next, consider a shock that causes the following: $y_1 = y_2^* > y_2 = y_1^*$,[36] where the stars denote foreign country variables.

Since the optimum tariff argument can easily generate an anti-trade bias, we look at the cooperative case to ensure that our results are not driven by the terms of trade

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[34] Recall that $\alpha = \beta$ according to the estimates of Kahneman and Tversky (1992).

[35] We can also consider a situation in which the country is initially trading with the rest of the world and introduce a shock that goes in the opposite direction, that is, one that reduces output in sector 1 and increases output in sector 2. Now it is the export sector the one that loses, and loss aversion calls for higher protection in that sector (the size effect doing the opposite). Although in this case it is possible to obtain a pro-trade bias, it is also possible to still have an anti-trade bias if protection ends up being higher in sector 2 than in sector 1, either because the size effect dominates or if we started out with a situation in which $t_2 > t_1$ (recall that this is what the model predicts that would arise when the country opens to trade, provided that the loss aversion coefficient is large enough). In addition, if the shock is sufficiently large we could have that the country reverts to autarky, in which case it is not clear that the government would want to protect sector 1 with an export subsidy instead of an import tariff, or even that the export sector turns into an import-competing sector and so the optimal policy becomes an import tariff. Consequently, we can have negative shocks to the export sector and still get an anti-trade bias.

[36] For example, consider a transfer of δ units of the specific factor of sector 2 from home to foreign and δ units of the factor specific to sector 1 from foreign to home.

motive. Let $p_i = \tau_i p_i^w$, where $\tau_i < 1$ denotes an import subsidy or an export tax and $\tau_i > 1$ denotes an import tariff or an export subsidy, and p_i^w denotes the world price of good *i*. Under the GH model we have: [37]

$$\tau_2 - \tau_2^* = -\frac{1}{ap_2^w m_2'}(y_2 - y_2^*) \tag{12}$$

The right hand side is negative since $y_2^* > y_2$, and therefore the export subsidy in the foreign country on good 2 would exceed the domestic tariff on good 2[38]. Thus, the net effect of trade intervention across the two countries is to promote trade.[39]

In our model we have:

$$\begin{aligned}\tau_2 - \tau_2^* = &\frac{1}{a}\left\{1 + (1+a)\beta\lambda \frac{\left[\Pi_2^{(-1)} - \Pi_2\right]^{\beta-1}}{\left(E_2^{(-1)}\right)^{\beta}}\right\}\frac{y_2}{-p_2^w m_2'} \\ &-\frac{1}{a}\left\{1 + (1+a)\alpha \frac{\left[\Pi_2^* - \Pi_2^{*(-1)}\right]^{\alpha-1}}{\left(E_2^{*(-1)}\right)^{\alpha}}\right\}\frac{y_2^*}{-p_2^w m_2'}\end{aligned} \tag{13}$$

Therefore, $\tau_2 - \tau_2^*$ is positive if and only if:

$$\lambda > \frac{1}{\beta \frac{\left[\Pi_2^{(-1)} - \Pi_2\right]^{\beta-1}}{\left(E_2^{(-1)}\right)^{\beta}}}\left\{\frac{y_2^* - y_2}{(1+a)y_2} + \alpha \frac{\left[\Pi_2^* - \Pi_2^{*(-1)}\right]^{\alpha-1}}{\left(E_2^{*(-1)}\right)^{\alpha}}\frac{y_2^*}{y_2}\right\} \tag{14}$$

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[37] See Levy (1999) or Grossman and Helpman (1995).

[38] We could also have an import subsidy that exceeds an export tax, since τ_2 and τ_2^* are set so as to effect a transfer between the countries. But in any case, the net effect of intervention is to promote trade.

[39] We should point out that the original GH model does not rule out an anti-trade bias. We could introduce some asymmetries such as a larger weight on social welfare in one country. Nonetheless, this would make one country more likely to impose protection in all sectors, and as the predicted policies for one country become more plausible, the predicted policies for the other country would become less plausible.

which is exactly condition (10) replacing y_2^* for y_1. Hence, we have that if the coefficient of loss aversion is sufficiently large, there will be an anti-trade bias in trade policy in a model with two large economies.

5. Endogenous Lobby Formation

So far we have considered the set of organized industries as exogenous. Mitra (1999) provides a theory of lobby formation in the framework of the GH model. We follow his approach in this section.

The model now has the following two stages: In the first stage, the owners of each kind of specific factor decide whether to contribute to the financing of the fixed costs of forming a lobby. The second stage reproduces the previous model where the lobbies provide the government with their contribution schedules and then the government sets trade policy to maximize a weighted sum of political contributions and social welfare.

Let now η denote the number of non-numeraire goods and therefore the potential number of lobbies, and let n denote the actual number of lobbies formed. In the second stage of the game we take the number of lobbies as given and solve for the equilibrium policies, obtaining the result given by (8). It then remains to solve for the number of lobbies that form in the first stage.

Let Ω_o and Ω_u respectively be the equilibrium gross welfare of an organized group and that of an unorganized group[40]. Also, let C be the equilibrium contribution by a representative lobby and let the fixed cost of lobby formation for the ith group of specific factors be denoted by F_i. Then, this group will form a lobby if and only if:

$$\Omega_o - \Omega_u - C > F_i \tag{15}$$

Let the groups be indexed in ascending order of their fixed costs, such that

[40] They do not depend on n, since the equilibrium policies are independent of n by the assumption of concentration of ownership of the specific factors.

$$F_{\min} \leq F_1 < F_2 \cdots < F_n < F_{n+1} \cdots < F_\eta \leq F_{\max}$$

Take the case of a continuous number of lobbies, with the total mass of non-numeraire goods normalized to unity, so that $n \in [0, 1]$. Then $F'(n) > 0$. Let NB represent the net benefit from forming a lobby (net of contributions), with

$$NB = \Omega_o - \Omega_u - C \tag{16}$$

The gross benefit is then:

$$\begin{aligned} GB &= \Omega_o - \Omega_u \\ &= \begin{cases} \Pi_o + \left[\left(\Pi_o - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^\alpha - \left\{\Pi_u - \lambda\left[\left(\Pi_u^{(-1)} - \Pi_u\right)/E^{(-1)}\right]^\beta\right\} & if\ \Pi_u < \Pi_u^{(-1)} \\ \Pi_o + \left[\left(\Pi_o - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^\alpha - \left\{\Pi_u + \left[\left(\Pi_u - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^\alpha\right\} & if\ \Pi_u \geq \Pi_u^{(-1)} \end{cases} \end{aligned} \tag{17}$$

assuming a situation in which a country opens to trade and allowing for a gain (with respect to the previous period) if the group becomes organized and either a loss or a gain if it remains unorganized. We will work under this context in the remainder of the section.[41]

In the GH model, the gross benefit is given by $GB^{GH} = \Pi_o^{GH} - \Pi_u^{GH}$. Therefore,

$$GB - GB^{GH} = \begin{cases} \Pi_o - \Pi_o^{GH} + \left[\left(\Pi_o - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^\alpha + \Pi_u^{GH} - \Pi_u + \lambda\left[\left(\Pi_u^{(-1)} - \Pi_u\right)/E^{(-1)}\right]^\beta & if\ \Pi_u < \Pi_u^{(-1)} \\ \Pi_o - \Pi_o^{GH} + \left[\left(\Pi_o - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^\alpha + \Pi_u^{GH} - \Pi_u - \left[\left(\Pi_u - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^\alpha & if\ \Pi_u \geq \Pi_u^{(-1)} \end{cases}$$

We have that $\Pi_o > \Pi_o^{GH}$ and $\Pi_u > \Pi_u^{GH}$ since protection is higher under loss aversion, making the sign of $(\Pi_o - \Pi_u) - (\Pi_o^{GH} - \Pi_u^{GH})$ unclear. But the additional protection associated with becoming organized is larger under loss aversion than under the GH

[41] For simplicity, we do not explicitly include the case where the sector has a loss if it is organized, but doing so would not qualitatively change the results.

model.[42] Furthermore, we have two extra terms that are positive in the previous equation: $\left[\left(\Pi_o - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^{\alpha} + \lambda\left[\left(\Pi_u^{(-1)} - \Pi_u\right)/E^{(-1)}\right]^{\beta} > 0$ and $\left[\left(\Pi_o - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^{\alpha} - \left[\left(\Pi_u - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^{\alpha} > 0$, for the cases when $\Pi_u < \Pi_u^{(-1)}$ and $\Pi_u \geq \Pi_u^{(-1)}$, respectively.[43] These terms reflect the fact that the (extra) gain associated with becoming organized has an additional effect on utility under loss aversion. The only effect that could go in the opposite direction is that the increase in output from becoming organized may be lower when the initial price (i.e. the price if the sector remains unorganized) is higher, as it is under loss aversion compared to the GH model, but recall that the increase in the price itself is also higher under loss aversion, as we already mentioned. Consequently, as long as profits are not too convex in the price, the gross benefit with loss aversion will exceed the gross benefit under the GH model.

With truthful contributions, the equilibrium contribution by an organized group is given by $C_o = \Omega_o - b_o$, where $b_o = \Omega_o - C_o$ is the net of contributions welfare (determined in equilibrium). As in Mitra (1999), we can show that in equilibrium a lobby contributes just enough to compensate for the reduction in social welfare brought about by its formation. Letting W_o and W_u denote welfare (the sum of producer surplus, consumer surplus and tariff revenue) generated by an organized sector and that generated by an unorganized sector respectively, we can write that condition as follows:

$$C = -a(W_o - W_u) \tag{18}$$

We also have:

$$W_u = \begin{cases} \Pi_u - \lambda\left[\left(\Pi_u^{(-1)} - \Pi_u\right)/E^{(-1)}\right]^{\beta} + Ns(p_i^u) + (p_i^u - p_i^w)m_i(p_i^u) & \text{if } \Pi_u < \Pi_u^{(-1)} \\ \Pi_u + \left[\left(\Pi_u - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^{\alpha} + Ns(p_i^u) + (p_i^u - p_i^w)m_i(p_i^u) & \text{if } \Pi_u \geq \Pi_u^{(-1)} \end{cases} \tag{19}$$

---

[42] To see that, compare (A3) minus (A5) (given in the Appendix) to (9). Note that (9) is the additional protection associated with becoming organized under the GH model, since unorganized groups get zero protection.

[43] The term $\left[\left(\Pi_o - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^{\alpha} - \left[\left(\Pi_u - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^{\alpha}$ is positive since $\Pi_o > \Pi_u$.

where $s(p_i^u) = u\left(d_i(p_i^u)\right) - p_i^u d_i(p_i^u)$; and

$$W_o = \Pi_o + \left[\left(\Pi_o - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^\alpha + Ns(p_i^o) + (p_i^o - p_i^w)m_i(p_i^o) \qquad (20)$$

From equations (16) and (18) to (20) we can obtain:

$$NB = \begin{cases} (1+a)\left\{(\Pi_o - \Pi_u) + \left[\left(\Pi_o - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^\alpha + \lambda\left[\left(\Pi_u^{(-1)} - \Pi_u\right)/E^{(-1)}\right]^\beta\right\} \\ + a\left[(p_i^o - p_i^w)m_i(p_i^o) - (p_i^u - p_i^w)m_i(p_i^u)\right] - aN\left[s(p_i^u) - s(p_i^o)\right] \text{if } \Pi_u < \Pi_u^{(-1)} \\ \\ (1+a)\left\{(\Pi_o - \Pi_u) + \left[\left(\Pi_o - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^\alpha - \left[\left(\Pi_u - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^\alpha\right\} \\ + a\left[(p_i^o - p_i^w)m_i(p_i^o) - (p_i^u - p_i^w)m_i(p_i^u)\right] - aN\left[s(p_i^u) - s(p_i^o)\right] \text{if } \Pi_u \geq \Pi_u^{(-1)} \end{cases} \qquad (21)$$

Since $NB'(n) = 0$ and $F'(n) > 0$, there is a unique equilibrium with n^* organized groups, where $NB = F(n^*)$.

Under the original GH model, we have[44]:

$$NB^{GH} = (1+a)\left(\Pi_o^{GH} - \Pi_u^{GH}\right) + a\left(p_i^{GH} - p_i^w\right)m_i(p_i^{GH}) - aN\left[s(p_i^w) - s(p_i^{GH})\right] \qquad (22)$$

We can compare the net benefit of forming a lobby under loss aversion and under the GH model, by subtracting (22) from (21):

[44] Note that if the sector remains unorganized it does not receive protection and the relevant price for that product is the world price.

$$NB - NB^{GH} = \begin{cases} (1+a)\left\{(\Pi_o - \Pi_u) - (\Pi_o^{GH} - \Pi_u^{GH}) + \left[\dfrac{\Pi_o - \Pi_u^{(-1)}}{E^{(-1)}}\right]^{\alpha} + \lambda\left[\dfrac{\Pi_u^{(-1)} - \Pi_u}{E^{(-1)}}\right]^{\beta}\right\} \\ + a\left[(p_i^o - p_i^w)m_i(p_i^o) - (p_i^u - p_i^w)m_i(p_i^u) - (p_i^{GH} - p_i^w)m_i(p_i^{GH})\right] \\ - aN\left[\left(s(p_i^u) - s(p_i^o)\right) - \left(s(p_i^w) - s(p_i^{GH})\right)\right] \qquad if\ \Pi_u < \Pi_u^{(-1)} \\ \\ (1+a)\left\{(\Pi_o - \Pi_u) - (\Pi_o^{GH} - \Pi_u^{GH}) + \left[\dfrac{\Pi_o - \Pi_u^{(-1)}}{E^{(-1)}}\right]^{\alpha} - \left[\dfrac{\Pi_u - \Pi_u^{(-1)}}{E^{(-1)}}\right]^{\alpha}\right\} \\ + a\left[(p_i^o - p_i^w)m_i(p_i^o) - (p_i^u - p_i^w)m_i(p_i^u) - (p_i^{GH} - p_i^w)m_i(p_i^{GH})\right] \\ - aN\left[\left(s(p_i^u) - s(p_i^o)\right) - \left(s(p_i^w) - s(p_i^{GH})\right)\right] \qquad if\ \Pi_u \geq \Pi_u^{(-1)} \end{cases} \tag{23}$$

If we consider a sector that loses when opening the country to trade, we have that $NB > NB^{GH}$ if and only if:

$$\lambda > \frac{1}{\left[\left(\Pi_u^{(-1)} - \Pi_u\right)/E^{(-1)}\right]^{\beta}} \left\{ \frac{a}{1+a}\left(N\left[\left(s(p_i^u) - s(p_i^o)\right) - \left(s(p_i^w) - s(p_i^{GH})\right)\right] \right. \right. \\ \left. - \left[(p_i^o - p_i^w)m_i(p_i^o) - (p_i^u - p_i^w)m_i(p_i^u) - (p_i^{GH} - p_i^w)m_i(p_i^{GH})\right]\right) \\ \left. - \left[(\Pi_o - \Pi_u) - (\Pi_o^{GH} - \Pi_u^{GH})\right] - \left[\left(\Pi_o - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^{\alpha} \right\} \tag{24}$$

That is, for a sufficiently high coefficient of loss aversion, the net benefit of forming a lobby will be higher than under the GH model, provided again that profits are not too convex in the price. This means that, for a given fixed cost, sectors that experience a loss when the country opens to trade will tend to form more lobbies once loss aversion is taken into account, since the additional protection associated with becoming organized is higher and there is an extra positive effect on utility from avoiding a loss.[45]

Consider the shocks that were mentioned in the previous section, such as a shock that increases the endowment of the specific factor used in one sector and decreases that of the factor used in the other sector, a technological shock that increases productivity in

[45] Note that as λ increases the direct effect of the sector's loss in social welfare raises and that also tends to reduce the contribution that the sector has to give to the government. (See equations (18), (19) and (20)).

one sector and reduces productivity in the other, or a shock that increases the world price of one good and decreases the world price of the other. These shocks will cause the country to trade and lead to a loss for the import sector in the absence of protection. Hence, importers will be more likely to form a lobby once loss aversion is taken into account if λ is high enough, since their net benefit is then higher than in the GH model. As for the exporters (the sector that gains), we can see from equation (23) that we have the negative term $\left[\left(\Pi_u - \Pi_u^{(-1)}\right)/E^{(-1)}\right]^\alpha$ instead of the positive term $\lambda\left[\left(\Pi_u^{(-1)} - \Pi_u\right)/E^{(-1)}\right]^\beta$, making it less likely that the net benefit under loss aversion exceeds the net benefit under the GH model. The reason is that exporters will experience a gain either if they become organized or not, and that reduces the cost of remaining unorganized.

Also, if profits are not too convex in the price and importers lose and exporters gain when the country begins to trade, we have that for a sufficiently high loss aversion coefficient, the net benefit of forming a lobby will be higher for the importers than for the exporters.[46, 47] Consequently, for a fixed cost that is lower than the net benefit for the importers but higher than that of the exporters, we have that importers will lobby for protection but exporters will not. These results make more likely that the trade policy will exhibit an anti-trade bias, the exact outcome depending on the fixed costs and net benefits of each sector. In particular, consider a situation in which we start with a symmetric equilibrium with a total mass of non-numeraire sectors normalized to unity and introduce a shock that increases the endowment of the specific factors used in, say, the sectors $n \in [0, 1/2]$ and decreases that of the factors used in the sectors $n \in [1/2, 1]$. Then, the

[46] The exact condition is:

$$\lambda > \frac{1}{\left[\left(\Pi_u^{(-1)} - \Pi_u\right)/E^{(-1)}\right]^\beta} \left\{ (\Pi_o^E - \Pi_u^E) - (\Pi_o - \Pi_u) + \left[\frac{\Pi_o^E - \Pi_u^{(-1)}}{E^{(-1)}}\right]^\alpha - \left[\frac{\Pi_o - \Pi_u^{(-1)}}{E^{(-1)}}\right]^\alpha - \left[\frac{\Pi_u^E - \Pi_u^{(-1)}}{E^{(-1)}}\right]^\alpha \right.$$
$$+ \frac{a}{1+a}\left[N\left(\left[s(p_i^u) - s(p_i^o)\right] - \left[s(p_i^{uE}) - s(p_i^{oE})\right]\right) - \left((p_i^o - p_i^w)m(p_i^o) - (p_i^u - p_i^w)m(p_i^u)\right)\right.$$
$$\left.\left. + (p_i^{oE} - p_i^{wE})x(p_i^{oE}) - (p_i^{uE} - p_i^{wE})x(p_i^{uE})\right)\right] \right\}$$

where the superscript E is used to denote the variables corresponding to the export sector, and $x(p_i^{oE})$ are exports of good i.

[47] Having profits not to be too convex guaranties that when the coefficient of loss aversion increases, the increase in the extra effect on utility obtained from avoiding a loss plus the increase in the additional protection associated with becoming organized outweigh the potential effect that convexity would generate from the fact that the initial protection (i.e. the protection obtained when unorganized) also rises.

first half of sectors become export sectors and the remaining ones import sectors. Given symmetry in the fixed costs of becoming organized, we have that if the coefficient of loss aversion is sufficiently high, more import lobbies will form than export ones.

6. Empirical Evidence

In this section we provide empirical evidence of the effects of loss aversion on trade policy. We focus initially on the protection equation and in section 6.4 we present evidence on loss aversion and lobby formation.

6.1. Econometric Specification and Predictions

We apply a nonlinear regression procedure to directly estimate the structural parameters of the model and their standard errors. This differs from Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000), which use linear specifications.[48] We describe the methodology in more detail in subsection 6.3. The prediction for the protection equation when we account for loss aversion is given by equation (8), on the basis of which we specify the following equation to be estimated:

$$\frac{\tilde{t}_i}{1+\tilde{t}_i}\frac{\tilde{e}_i}{\tilde{z}_i} = \frac{1}{\gamma_0} I_i + \frac{1}{\gamma_0}\gamma_1\gamma_2\left(I_i \times D_i \times \frac{\left[\Pi_i\left(\tilde{p}_i^{(-1)}\right) - \Pi_i\left(\tilde{p}_i\right)\right]^{\gamma_1 - 1}}{\left(E_i^{(-1)}\right)^{\gamma_1}}\right) + \gamma_1\gamma_2\left(D_i \times \frac{\left[\Pi_i\left(\tilde{p}_i^{(-1)}\right) - \Pi_i\left(\tilde{p}_i\right)\right]^{\gamma_1 - 1}}{\left(E_i^{(-1)}\right)^{\gamma_1}}\right)$$
$$+ \frac{1}{\gamma_0}\gamma_1\left(I_i \times (1-D_i) \times \frac{\left[\Pi_i\left(\tilde{p}_i\right) - \Pi_i\left(\tilde{p}_i^{(-1)}\right)\right]^{\gamma_1 - 1}}{\left(E_i^{(-1)}\right)^{\gamma_1}}\right) + \gamma_1\left((1-D_i) \times \frac{\left[\Pi_i\left(\tilde{p}_i\right) - \Pi_i\left(\tilde{p}_i^{(-1)}\right)\right]^{\gamma_1 - 1}}{\left(E_i^{(-1)}\right)^{\gamma_1}}\right) + \varepsilon_i \quad \text{(E1)}$$

We decided to take $\tilde{z}_i / \tilde{e}_i$ into the left-hand side for various reasons. First, the elasticities are likely to be measured with error. Second, both variables are potentially endogenous.[49] Finally, leaving $\tilde{z}_i / \tilde{e}_i$ on the right-hand side would mean to have it interacted with all the

[48] Mitra (2002) also performs a nonlinear estimation of the GH model for Turkey.

[49] Having those variables on the left-hand side eliminates the need to either instrument or specify separate equations for them. The alternative approach of leaving both variables on the right hand side and specifying additional equations for them has the caveat that, as Goldberg and Maggi (1999) point out, it is difficult to come out with a sensible reduced specification for the elasticities.

right-hand-side terms and that might confound the effect that losses and gains have on protection, which is our main focus, as well as introduce potential collinearity problems. In equation (E1), D_i is a dummy variable that is equal to one if the sector experienced a loss (i.e., if $\Pi_i(\widetilde{p}_i) < \Pi_i(\widetilde{p}_i^{(-1)})$) and zero otherwise (i.e., if it experienced a gain, that is if $\Pi_i(\widetilde{p}_i) > \Pi_i(\widetilde{p}_i^{(-1)})$). The use of that dummy allows us to estimate different coefficients for losses and gains, as predicted by the theory. We denote the parameters to be estimated by γ_j, where $j = 0, 1, 2$, and the regression error term by ε_i. The error term is included to capture potential measurement error in the variables and other factors (not accounted for in the model) that may influence the determination of the policy. Since Kahneman and Tversky estimated both α and β to be 0.88, we set $\alpha = \beta$ when we specify equation (E1).[50] From equations (8) and (E1), we obtain the following identities (which allow us to directly estimate the parameters of the model) and predictions:

i) $\gamma_0 = a > 0$,

ii) $\gamma_1 = \beta \in (0, 1)$, and

iii) $\gamma_2 = \lambda > 1$.

The first prediction simply follows from the fact that the weight that the government places on social welfare should be positive. The second one comes from the fact that, according to the theory developed by Kahneman and Tversky (1979) there is diminishing sensitivity (i.e., the marginal value of both gains and losses decreases with their size) and hence β should be between zero and one. The last prediction is implied by the definition of loss aversion, according to which losses have a larger impact on value or utility than gains, and therefore the coefficient of loss aversion should be greater than one.

6.2. Data

The data we use consists of 241 four digit SIC U.S. industries in 1983. Part of the data was kindly provided by Kishore Gawande, and the rest was obtained from the Annual Survey of Manufactures (henceforth ASM).

[50] Later on we will mention what happens when we relax this assumption.

Protection is measured by the NTB coverage ratio. Even though the theory calls for the use of *ad valorem* tariffs, an argument in favor of the use of NTBs is that U.S. tariffs in 1983 were determined by multilateral (GATT) tariff negotiations, while the model assumes that the country can set its tariffs unilaterally. We should point out that the use of coverage ratios has the potential problem that it may under or overstate protection; however, they are considered the best available measure of NTBs.[51] The import elasticities come from the estimates of Shiells et al. (1986), and since they have high standard errors, they were purged of the errors-in-variables problem by Gawande and Bandyopadhyay (2000) (henceforth GB).[52] z is measured as the gross output to import ratio. The politically organized industries were determined by GB (2000) by regressing the ratio of PAC spending to value added on bilateral import penetration (for five major partners) interacted with twenty two-digit SIC dummies. Those industries for which the predicted value of the dependent variable was positive were considered organized in the trade arena. The union of the sets of organized industries obtained for the five partners was then taken.

The terms that measure the losses and gains were obtained using data from the ASM. The numerator of $\left[\Pi_i\left(\tilde{p}_i^{(-1)}\right)-\Pi_i\left(\tilde{p}_i\right)\right]^{\beta-1} / \left(E_i^{(-1)}\right)^{\beta}$ was measured as the absolute value of the change in value added (VA) between 1983 and 1982 (raised to the power of $\beta-1$). We use the change in VA as a measure of the change in the industry's reward to the specific factors. The term in brackets in the denominator was defined as VA in 1982.[53] We examined the sensitivity of the results to modifying the measures for the loss and gain variables, as we discuss in the next section. Finally, the value of D_i was determined according to whether the change in VA between 1983 and 1982 for industry *i* was negative or positive.

51 Trefler (1993) found a high correlation (0.78) between ad valorem tariffs and their coverage ratios, providing some evidence in favor of the use of coverage ratios. A more detailed discussion on the use of NTB coverage ratios can be found in Goldberg and Maggi (1999). Gawande and Bandyopadhyay (2000) and Goldberg and Maggi (1999), among others, also use NTB coverage ratios as the measure for protection.

52 A description of the procedure can be found in GB (2000).

53 The model strictly calls for payments to the industry's specific factors plus labor income in the denominator, but since we do not have a measure of labor income that the members of an industry may have from working elsewhere, we use VA as the best available proxy for E.

6.3. Estimation

6.3.1. Methodology

From (E1) it can be seen that the right-hand side expression of the protection equation is nonlinear in both variables and parameters. In addition, the right-hand side variables may be correlated with the error term due to potential endogeneity of the political organization variable and the magnitude of the loss/gain of each industry, and to measurement error associated with *I* due to possible misclassification. Consequently, we will estimate the equation by nonlinear two-stage least squares (NL2SLS).[54]

The instruments that we use include mainly industry characteristics, such as the capital-labor ratio interacted with industry-group dummies; the fraction of workers classified as unskilled, scientists and engineers, and managerial; output per firm (scale); the four-firm concentration ratio; the Herfindahl index of firm concentration; the share of output sold as intermediate goods; and a Herfindahl measure of intermediate-goods-output buyer concentration. Those variables are included to instrument for the political organization variable, as has been done by other authors under the argument that they are correlated with that variable but not with the regression error. They can also be good instruments for the loss/gain variables since higher concentration or capital and skilled-labor intensity may be associated with larger profits. But due to the presence of the loss/gain we also include the change in the wage between 1983 and 1982 (in percentage terms),[55] and the dummy variable that equals one if the industry's change in VA is negative and zero if it is positive. [56,57] The validity of the instruments was evaluated

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[54] According to that procedure the instruments can include not only the levels of the exogenous variables, but also their quadratic terms and cross-products.

[55] This variable was obtained as the ratio of payments to employees divided by the number of employees, using data from the ASM.

[56] The dummy is included to address an issue arising from the nonlinearity, since the protection equation is decreasing in the absolute value of the change in VA (i.e., it increases when the change in VA lies in the interval $(-\infty, 0)$ and it decreases when it lies in $(0, \infty)$) and the limit for the loss and gain terms is being defined at zero.

[57] Since including all the possible cross products would imply having too many instruments we include the linear terms, the squared terms, and the interaction of the linear terms with the dummy, scale, the Herfindahl index and the share of output sold as intermediate goods (this choice was based on the statistical significance of these variables in the first stage regressions). We estimated the model including interactions with other variables and the results were not significantly affected.

performing an overidentification test (described below). Also, we reestimate the model excluding some instruments that can be suspected to be at least "somewhat endogenous", as we report later.

6.3.2. Results

The results of the NL2SLS estimation are presented in Table 1. All three parameters - β, λ and a- are statistically significant at the 1% level (individually and jointly). Moreover, the predictions i) to iii) (described in section 6.1.) are satisfied even though no restrictions were imposed in the estimation. The estimated value of β was 0.81, which is positive and lower than one (consistent with diminishing sensitivity), and it is close to the value of 0.88 obtained by Kahneman and Tversky (1992). Furthermore, we cannot reject the null hypothesis that $\beta = 0.88$ (the probability was 0.25). λ was estimated to be 1.95, which is greater than one, providing evidence in favor of loss aversion (losses have a larger effect on protection than gains). Moreover, it is close to 2, consistent with the results of the previous literature. Also, we cannot reject the null hypothesis that $\lambda = 2.25$, as estimated by Kahneman and Tversky (1992) (the probability was 0.67). Finally, the estimated value of a was positive, as expected, and lower than the value obtained by GB (2000). Their estimates of a, however, are very large and, as Gawande and Krishna (2003) say "(...) enough to cast doubt on the value of viewing trade policy determination through this political economy lens." (p.20)

In addition, to evaluate the statistical significance of the right-hand side variables, we tested the hypotheses that the composite coefficients of

$I_i \times D_i \times \left[\Pi_i\left(\tilde{p}_i^{(-1)}\right) - \Pi_i\left(\tilde{p}_i\right)\right]^{\gamma_1 - 1} / \left(E_i^{(-1)}\right)^{\gamma_1}$, $D_i \times \left[\Pi_i\left(\tilde{p}_i^{(-1)}\right) - \Pi_i\left(\tilde{p}_i\right)\right]^{\gamma_1 - 1} / \left(E_i^{(-1)}\right)^{\gamma_1}$

and $I_i \times (1 - D_i) \times \left[\Pi_i\left(\tilde{p}_i\right) - \Pi_i\left(\tilde{p}_i^{(-1)}\right)\right]^{\gamma_1 - 1} / \left(E_i^{(-1)}\right)^{\gamma_1}$ are significant. That translates into the following hypotheses:

1) $H_0 : \frac{1}{\gamma_0}\gamma_1\gamma_2 = \frac{1}{a} \times \beta \times \lambda = 0$,

2) $H_0' : \gamma_1\gamma_2 = \beta \times \lambda = 0$, and

3) $H_0'' : \frac{1}{\gamma_0}\gamma_1 = \frac{1}{a} \times \beta = 0$.

The hypotheses involve nonlinear restrictions and therefore we used a Wald test. All three hypotheses can be rejected. The probabilities were 0.001, 0.013 and 0.003 for 1), 2) and 3) respectively.

Table 1
NL2SLS Estimates

Parameter	Value	Std. Error
β	0.808***	0.063
λ	1.948***	0.714
a	0.022***	0.007
R^2	0.154	
Adj. R^2	0.147	
Log-likelihood	-1909.286	
Observations	241	

*** Significant at 1%.

We also carried out a White test for heteroskedasticity. The probability was 0.26, indicating that we cannot reject the null hypothesis of homoskedasticity.

We should point out that although the dependent variable is censored below zero, the model is not predicting negative values for it.

We also estimated the model without setting $\alpha = \beta$. The estimated value of β was 0.82 and α was 0.69. Although the value of α was lower than the one of β , the former was estimated with less precision (the standard error was 0.296, compared to only 0.065 for β).[58] Moreover, we cannot reject the null hypothesis that $\alpha = \beta$, providing support for our assumption that both parameters are equal when we estimated equation (E1).

6.3.3. Robustness

We examined the sensitivity of the results to changing the measure of the loss and gain variables. Instead of using VA, we used VA excluding payments to non-production

[58] The values of the other parameters do not vary much (the value of λ was 2.29 and a was estimated to be 0.03).

workers (in the numerator and in the denominator of $\left[\Pi_i\left(\tilde{p}_i^{(-1)}\right)-\Pi_i\left(\tilde{p}_i\right)\right]^{\beta-1}/\left(E_i^{(-1)}\right)^{\beta}$). An argument for the use of this measure is that non-production workers may be considered more mobile.[59] The results still hold. All three parameters were statistically significant at the 1% level. β was equal to 0.84, λ was 1.37 (which is lower than the previous value but still greater than one, consistent with loss aversion), and *a* was 0.02.

In addition, we evaluated the sensitivity of the results to alternative treatments of the political organization variable. First, we experimented with the alternative of estimating a probit regression of *I* on the instruments and replacing the fitted values from that regression into the right-hand side of equation (E1) before doing the nonlinear estimation. The estimated values of β, λ and *a* were 0.84, 2.07 and 0.02, respectively, which are very close to those from the previous estimation. Second, we also did the estimation treating *I* as econometrically exogenous. The estimated β was 0.75, λ was 2.28 and *a* was 0.03 (all were statistically significant at least at the 5% level). Again, the results do not vary significantly.[60] Finally, given that we have obtained predictions on the lobbying side by endogenizing lobby formation and in Section 6.4 we estimate a political organization equation, in that section we also discuss the results that we obtain by replacing the data on *I* with an ex post classification based on that regression.

We performed a test of overidentifying restrictions to asses the validity of the instruments and we find that cannot reject the joint null hypothesis that the excluded instruments are uncorrelated with the error and correctly excluded from the estimated equation, providing support for the assumption that the set of instruments is valid.[61]

As we mentioned before, however, some of the instruments can be suspected to be endogenous (although they have been used by previous authors), in particular the capital-labor ratios and the fraction of workers in each category.[62] We reestimated equation (E1) excluding those variables from the set of instruments. The estimated values

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[59] The argument for the use of VA without excluding payments to non-production workers, however, is that the owners of capital in an industry may also own the skilled labor.
[60] Goldberg and Maggi (1999) also say that their results remain very similar when they treat *I* as exogenous.
[61] The statistic was 102.55 and the corresponding Chi-squared value was 104.13. The statistic was calculated as the number of observations times the uncentered R^2 from a regression of the NL2SLS residuals on the instruments. The number of degrees of freedom for the Chi-squared equals the number of overidentifying restrictions.
[62] Factor shares could be endogenous because they may respond to price changes induced by protection.

of β, λ and a were 0.84, 1.72 and 0.02, respectively, which do not differ much from the ones previously obtained. Also, they were all significant at the 1% level.

Furthermore, although one could expect the right-hand side variables in equation (E1) to be potentially endogenous, we performed a Hausman test to evaluate such possible endogeneity.[63] We found that we cannot reject the null hypothesis that the right-hand side variables are exogenous. The results of estimating the model treating the right-hand side variables as exogenous (by nonlinear least squares) are reported in Table 2. They are qualitatively similar to those that we obtained when we used instrumental variables, and quantitatively they do not change much. In particular, the coefficient of loss aversion is estimated to be 2.39, which is again greater than one, as predicted by loss aversion, and close to 2, consistent with the findings of the previous literature.

Table 2
NLLS Estimates

Parameter	**Value**	**Std. Error**
β	0.774***	0.056
λ	2.386***	0.918
a	0.032***	0.011
R^2	0.160	
Adj. R^2	0.153	
Log-likelihood	-1908.380	
Observations	241	

*** Significant at 1%.

Nonetheless, an argument for the use instrumental variables is that when we applied the same Hausman test to an estimation that is linear in the parameters we did reject the null hypothesis of exogeneity. The linear estimation (linear in the parameters although not in the regressors) was performed using two-stage least squares with the same set of instruments described earlier. The loss and gain terms were defined replacing β by a numerical value (instead of estimating it) and all their coefficients were found to be positive, as expected, and statistically significant at either the 1% or 5% level. We used 0.88 as the value of β, based on the estimates obtained by Kahneman and Tversky

[63] The test was carried out by including the residuals obtained from regressing each of the potentially endogenous variables on the instruments into the equation to be estimated by NLLS and then testing for the joint significance of those residuals.

(1992).[64] There were again four terms related to the losses/gains (one for the loss interacted with *I*, one for the loss interacted with (1- I) and two corresponding terms for the gains).[65] With the linear estimation we do not immediately obtain the estimate of the coefficient of loss aversion (λ), but it is still possible to obtain it as the ratio of the loss and gain coefficients (according to the model, the ratio is exactly equal to λ for both the organized and the unorganized industries, i.e., the terms interacted with *I* and 1- I). We found that ratio to be equal to 2.85 for the unorganized industries and 2.10 for the organized ones, providing evidence in favor of loss aversion. Moreover, we cannot reject the null hypothesis that those two ratios are equal, as predicted by the model (the probability was 0.68). A Wald test to determine whether the coefficients of losses and gains are different was also carried out, and we find that we reject the null hypothesis that they are equal for both organized and unorganized industries, with probabilities 0.017 and 0.037, respectively. This result is necessary for loss aversion to hold.

6.3.4. Quantification

In this subsection we use the results that we obtained in the NL2SLS estimation to quantify the effects that the change in VA has on protection, comparing the effects of losses and gains as well as the cases of organized and unorganized industries.

As we mentioned before, diminishing sensitivity means that the marginal value of both gains and losses decreases with their size. This in turn implies that, everything else equal, higher protection will be given to industries with lower changes (for both, losses

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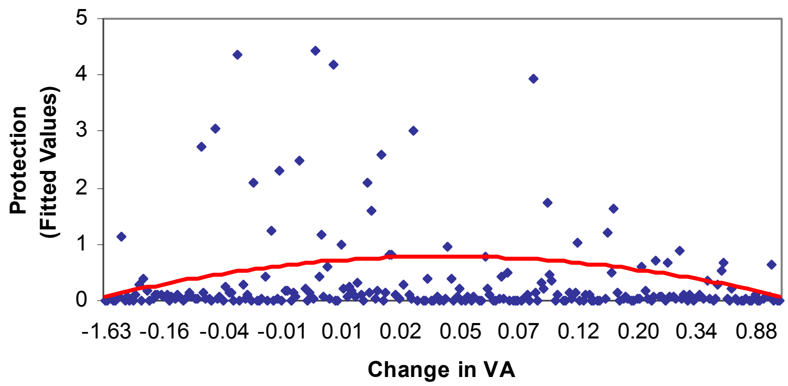
[64] We also experimented with the value of β that we obtained in the nonlinear estimation, 0.81, and the results were qualitatively similar, and quantitatively they changed very little. According to the theory, β should take values between zero and one, consistent with diminishing sensitivity. Hence, to study the sensitivity of the results to the value of that parameter, we did the linear estimation replacing β with values starting with 0.1 and adding 0.1 each time until 0.9 was reached (a value of 0.95 was also used). The value of β that was associated with the highest R^2 was 0.8 (the R^2 decreases monotonically as we either increase or decrease the value of β from 0.8). Again, this value is close to the one estimated by Kahneman and Tversky (1992).

[65] This is equivalent to having the losses and gains interacted with *I* and then not interacted (instead of interacted with 1- I), in the sense that they are both structural estimations, and only the interpretation of the coefficient changes. The reason why we did not follow the other possibility is that in that case multicollinearity problems are more likely to arise (the correlation between the term interacted with *I* and the one not interacted was 0.97 for losses and 0.88 for gains, while the correlation between the term interacted with *I* and that interacted with 1- *I* was only -0.06 for losses and -0.14 for gains).

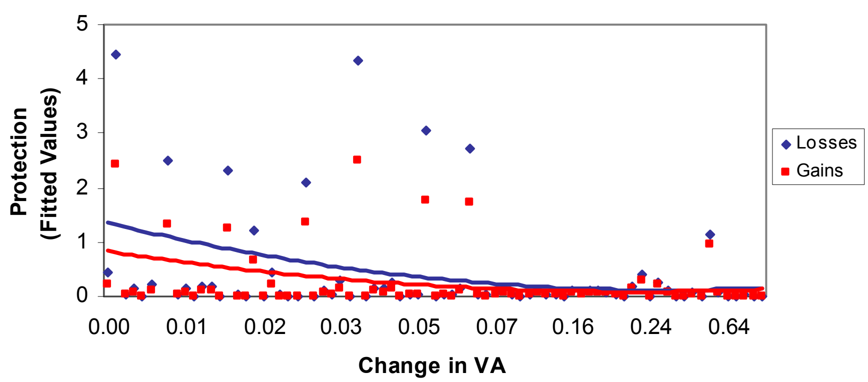
and gains), as can be seen from equation (8). That relation can be observed in Figure 3, which plots the fitted values of the protection variable (given by NTB/(1+NTB)) against the change in VA (in billion dollars) and includes a second order polynomial trend line (in red).[66]

Figure 3



To compare the effects that losses and gains have on protection, we calculated the fitted values of protection that the industries with losses would receive according to the estimated values of the parameters, and also the values of protection that those same industries would receive had their losses been gains instead. [67] It can be seen in Figure 4 that losses are associated with higher protection than gains (everything else equal), and that the absolute value of the difference decreases with the value of the change in VA.

Figure 4
Losses versus Gains



[66] We should point out that since there is a direct effect on utility generated by changes income with respect to its reference level, if a sector experiences a gain, loss aversion leads to an increase in protection. (Nonetheless, for two sectors that are symmetric in everything except that one had a loss and the other a gain of equal magnitude, loss aversion leads to higher protection for the sector that experienced a loss).
[67] That is, multiplying the changes in VA by minus one and computing the protection values using the parameters corresponding to gains, keeping everything else equal

Whereas in Figure 3 we included all industries, Figure 5 plots the fitted values of protection only for the organized industries, and Figure 6 plots the values of protection that would correspond to those same industries if they were unorganized.[68] We include these additional figures because under loss aversion we have, besides the political economy motive for protection, a social welfare motive, and we want to quantify how important the latter is relative to the former. We can see that the unorganized industries get much lower protection,[69] indicating that the political economy motive for protection is much more significant than the social welfare motive that arises from loss aversion.

Figure 5
Organized Industries

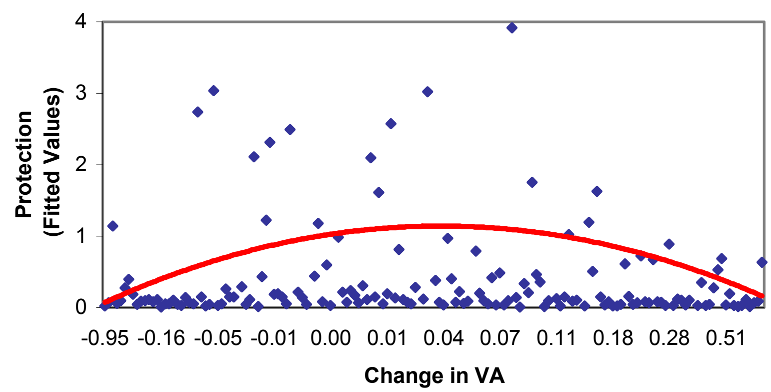
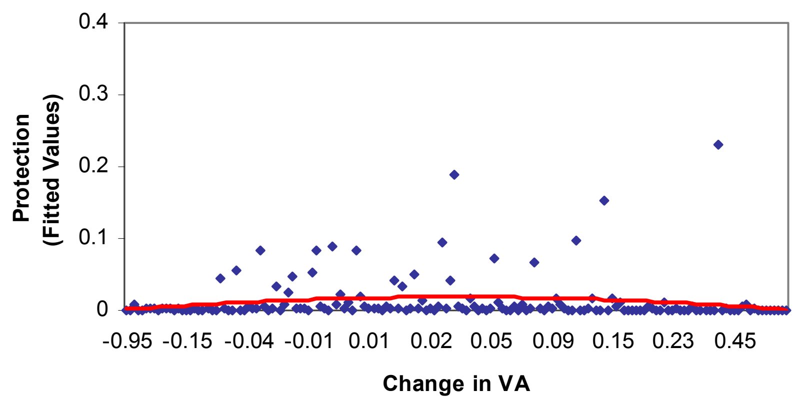


Figure 6
Unorganized Industries



[68] That is, changing only the value of the political organization variable from one to zero.
[69] Note that the scale of the vertical axis is different in both figures.

Row (2) of Table 3 shows the predicted value of protection calculated at the mean value of z/e for an organized and an unorganized industry assuming that the change in VA is zero. Row (1) shows the predicted value of protection assuming a 10% change in VA (calculated at the mean value of VA in 1982 and z/e), for an organized industry for which the change was negative (a loss), an organized industry for which the change was positive (a gain), and similarly for an industry that is unorganized.[70] We can see that the increase in protection (shown in row (3)) when we compare the cases of no change and 10% change in VA is roughly twice as much if the change is negative than if it is positive (for both organized and unorganized industries). The table also shows that, everything else equal, an organized industry gets much higher protection than an unorganized one, as we mentioned before.

Table 3

NTB/(1+NTB)

	Organized		**Unorganized**	
	Loss	***Gain***	***Loss***	***Gain***
(1) 10% change in VA	0.7382	0.5368	0.0089	0.0046
(2) No change in VA	0.3244		0.0000	
(3) Increase: (1) – (2)	0.4138	0.2124	0.0089	0.0046

6.3.5. Model Selection

Table 4 presents some information criteria corresponding to our model and the original GH model (i.e., dropping the four regressors associated to the losses and gains from the right-hand side of (E1)).[71] Lower values are preferred and thus both the Akaike (AIC) and the Schwarz information criterion (SIC) provide evidence in favor of our model.

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[70] We should point out that a 10 percent change is the median change in VA for the whole sample, and it is very close to the median changes for both organized and unorganized industries, which are 11 percent and 9 percent, respectively.

[71] The prediction for protection in the GH model (with z/e in the left-hand side) is given by $\left(\tilde{t}_i/(1+\tilde{t}_i)\right)/(\tilde{z}_i/\tilde{e}_i) = (1/a)I_i$. The coefficient of the political organization variable in the estimation of the GH model was positive (as expected) and significant at the 1% level.

Table 4
Information Criteria
(NL2SLS Estimation)

Criterion	Loss Aversion	GH 1994
Akaike[1]	15.870	16.077
Schwarz[2]	15.913	16.091
Log Likelihood	-1909.286	-1936.237

1. AIC = -2L/n + 2k/n
2. SIC = -2L/n + k logn/n

Since in the theoretical model we made the assumption of concentration of ownership of the specific factors, two additional model comparisons may be worthy. The first one is comparing the original GH model without imposing that assumption (which we will call the unrestricted GH model)[72] against the GH model including the assumption (the information appearing in Table 4 corresponds to the last case). The second one is to compare our loss aversion model to the GH model without concentration in specific factor ownership, which is a comparison of nonnested models.

We estimated the unrestricted GH model by 2SLS, and obtained a value of 16.026 for the AIC and 16.055 for the SIC.[73] These values are lower than those of the GH model that includes the assumption of concentration (which appear in Table 4). Hence, both information criteria favor the unrestricted GH model over the restricted one.

Since the unrestricted GH model was estimated by a linear regression procedure (linear in the parameters), we compare it to the linear estimation of the model with loss aversion, which was discussed in the previous subsection. The models are nonnested, and therefore we use the *J* test proposed by Davidson and MacKinnon.[74] When we include the fitted values from the unrestricted GH model in the estimation of our model we find that they are not statistically significant (the probability was 0.37), and thus we reject the GH model. On the other hand, when we include the fitted values from the loss aversion

[72] In that case the protection equation is: $\left(\tilde{t}_i/(1+\tilde{t}_i)\right)/(\tilde{z}_i/\tilde{e}_i) = \left(1/(a+\alpha_L)\right)I_i - \left(\alpha_L/(a+\alpha_L)\right)$, where α_L denotes the proportion of the population that is organized.

[73] With z/e in the left-hand side the unrestricted model is equal to the restricted one plus a constant term, and both models can be nested.

[74] See Davidson and McKinnon (1993).

model in the GH model estimation we find that they are significant (the probability was 0.00), and therefore we cannot reject the loss aversion model. Hence, we conclude that the data also favors our model over the unrestricted GH model.

6.4. Evidence on Loss Aversion and Lobby Formation

In this section we estimate a lobby formation equation based on the prediction that we obtained in Section 5, and test for the presence of loss aversion in lobby formation. Equation (21) shows the net benefit of forming a lobby. We will not perform a structural estimation because we do not have information that allows us to directly measure the effects that an industry that becomes organized generates on producer surplus, consumer surplus and tariff revenue (i.e., to compare each of these if the industry is organized and if it is unorganized). The equation that we estimate is given by:

$$I_i = \delta_0 + \delta_1\left(d_i \times \frac{(\Delta\Pi_i)^{\beta-1}}{\left(E_i^{(-1)}\right)^{\beta}}\right) + \delta_2\left((1-d_i) \times \frac{(\Delta\Pi_i)^{\beta-1}}{\left(E_i^{(-1)}\right)^{\beta}}\right) + \delta_3 e_i + \delta_4 \frac{m_i}{y_i} + \mathbf{X}_i\varphi + \mu_i \quad \text{(E2)}$$

In equation (E2), the dependent variable is the political organization dummy (see section 6.2). A prediction of the model is that, for a sufficiently high coefficient of loss aversion, a sector that experienced a loss will be more likely to form a lobby than one that experienced a gain, because the direct effect on utility as well as the extra protection associated with becoming organized are higher for the sector with a loss. Since in a one year period there may not be sufficient activity in terms of lobby formation, we measure the losses and gains over a longer period of time (1979-1983). Thus, d_i is a dummy variable that equals one if the change in VA between 1979 and 1983 was negative and zero if it was positive. To determine the change in VA between 1979 and 1983 we calculated a rate of growth using the percentage changes between 1979-80, 1980-81 and 1982-1983, since due to a change in the reporting instructions the data of 1983 and 1982 are not directly comparable to those of the previous years.[75] Given that besides the

[75] Since $(\Delta\Pi)^{\beta-1}/\left(E^{(-1)}\right)^{\beta} = \left(\Delta\Pi / E^{(-1)}\right)^{\beta-1}/E^{(-1)}$ and the percentage change in VA for the period gives us a measure of term inside brackets in the numerator, we then divide the numerator (raised to the power of $\beta-1$) by the initial income, measured as VA in 1979.

loss/gain of the industry, the amount of the deadweight loss also affects the net benefit of forming a lobby we include e_i, which denotes the elasticity of import demand; m_i / y_i is the import-output ratio;[76] $\mathbf{X}_i$ is a vector that contains measures of concentration traditionally used in the political economy literature and that could also proxy to some extent for the fixed cost of forming a lobby, as well as factor shares; and μ_i is the error term. More precisely, $\mathbf{X}_i$ includes the four-firm concentration ratio (Conc4), the Herfindahl index of concentration (LHerf), the capital-labor ratio interacted by industry group dummies (KL_Cap, KL_Res and KL_Mfg), and the fraction of workers classified as unskilled (P_Uns), scientists and engineers (P_Sci), and managerial (P_Man).

We should point out that since the GH (1994) model treats lobby formation as exogenous, the fact that we test some predictions obtained by endogenizing lobby formation differs from Goldberg and Maggi (1999), who estimate a separate equation for I but only including variables of the kind that we have on the $\mathbf{X}_i$ vector, and from GB (2000), who estimate an equation on contributions but not on lobby formation.

Since the dependent variable is binary and some of the right-hand side variables are potentially endogenous (the loss/gain, the elasticity and the import-output ratio), we estimate a probit model using the two-stage conditional maximum likelihood (2SCML) estimator proposed by Rivers and Vuong (1988).[77] We use the same instruments as before.[78] The results appear on Table 5, which includes two estimations: one in which we replace β by 0.88 (the value estimated by Kahneman and Tversky [1992]), and the other one with $\beta = 0.81$ (the value that we obtained in the nonlinear estimation of the protection equation). Both regressions give similar results. We found that we cannot reject the null hypotheses of exogeneity of the right-hand side variables.[79] The main predictions that we want to test are that losses and gains are statistically significant and that losses have a

[76] We would expect this variable to negatively affect the probability of forming a lobby since higher imports imply a larger social cost from an increase in protection and a lower output means that the industry has less to gain from higher protection.
[77] According to that procedure, in the first stage we regress the potentially endogenous variables on the instruments (by least squares) and then we estimate the probit model including the residuals from the first stage as additional regressors. A convenient feature of the procedure is that we can test for exogeneity by evaluating the statistical significance of those residuals.
[78] Changes between 1983 and 1982 were replaced by changes between 1983 and 1979. We should point out that all the first-stage R-squares were greater than 0.40.
[79] The residuals added to the probit regressions were not statistically significant (individually nor jointly).

higher coefficient than gains, that is $\delta_1 > \delta_2$. As predicted, we find that both losses and gains are statistically significant at the 5% level, and that losses have a larger coefficient than gains, consistent with loss aversion. The ratio of those coefficients was 1.94 when $\beta = 0.88$, suggesting a coefficient of loss aversion that is again in the neighborhood of 2. Moreover, we can not reject the null hypotheses that the ratio is equal to 2.25, which is the value estimated by Kahneman and Tversky (1992) (the probability was 0.77). When $\beta = 0.81$, the ratio was 1.76, which is lower but still not statistically different from 2.25 (the probability was 0.56). Thus, we find evidence of loss aversion in lobby formation. An industry is more likely to become organized if it experienced a loss, everything else equal.

As for the other variables, the import-output ratio has the expected sign and it is significant at the 10% level. The elasticity has a positive coefficient (contrary to what we would expect) but it is not significant. Regarding the variables included in the $\mathbf{X}_i$ vector, as Goldberg and Maggi (1999) point out, the literature does not yield unambiguous predictions for the signs of their coefficients. According to our results the proportion of scientists and engineers and managers, as well as the capital labor ratios (except for one group of industries) are statistically significant. Mitra (1999) finds that when introducing heterogeneity on the capital stock, industries with high levels of capital stock get organized. This seems consistent with our finding that all the capital labor ratios have positive coefficients.

As we mentioned in section 6.3.3, we did a last sensitivity analysis by reestimating the protection equation (E1) using a political organization variable obtained based on the estimation of equation (E2). We classified an industry as organized if the predicted probability of being organized from the probit estimation discussed in this section was at least 0.6.[80] The estimated values of β, λ and a were 0.84, 2.15 and 0.02, respectively, which are very close to the results shown in section 6.3 (all three parameters were significant at the 1% level).

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[80] This gives us 149 organized industries. We should point out that using $\beta = 0.88$ (the value obtained by Kahneman and Tversky [1992]) and using $\beta = 0.81$ (the value that we obtained when we estimated the protection equation) give exactly the same results in terms of which industries are classified as organized.

Table 5
Probit (2SCML) Estimates

Variable	$\beta = 0.88$ Coef.	S. Error	$\beta = 0.81$ Coef.	S. Error
Constant	-0.741	1.825	-0.747	1.831
Loss[1]	0.219**	0.088	0.167**	0.068
Gain[2]	0.113**	0.058	0.095**	0.047
e	0.631	0.572	0.615	0.573
m/y	-2.023*	1.156	-1.926*	1.146
Conc4	-0.756	1.312	-0.737	1.311
P_Uns	-2.040	3.065	-2.036	3.085
P_Sci	11.837***	3.659	11.736***	3.651
P_Man	-6.118*	3.443	-6.006*	3.437
KL_Cap	0.014	0.023	0.015	0.023
KL_Res	0.514***	0.105	0.512***	0.105
KL_Mfg	0.110**	0.051	0.111**	0.052
LHerf	-0.074	0.246	-0.072	0.246
Log Likelihood	-109.67		-109.61	
McFadden R^2	0.27		0.27	
Observations	241		241	

*** Significant at 1%, ** Significant at 5%, * Significant at 10%.

1. Loss = $d_i \times (\Delta\Pi_i)^{\beta-1} / \left(E_i^{(-1)}\right)^{\beta}$

2. Gain = $(1-d_i) \times (\Delta\Pi_i)^{\beta-1} / \left(E_i^{(-1)}\right)^{\beta}$

7. Conclusion

We study the effects of loss aversion on trade policy determination and show how it allows us to explain some important and puzzling features of trade policy. As Rodrik (1995) points out, it constitutes an important puzzle the fact that trade policy is typically biased in favor of import competing sectors, and it is therefore trade restricting rather than trade promoting. The current leading political economy model of trade protection, due to Grossman and Helpman (1994), cannot explain the anti-trade bias in trade policy and, in fact, as Levy (1999) shows, under some symmetry assumptions it predicts a pro-trade bias. Likewise, it does not explain why protection is usually given to sectors in which profits and employment are declining. We show that if individual preferences exhibit loss aversion and the degree of loss aversion is sufficiently large, there will be an anti-trade bias under the same neutrality assumptions made by Levy (1999). The cases in which symmetry is not imposed are also analyzed, leading to a qualitatively similar conclusion. The results hold for a variety of shocks that lead the country to trade with the rest of the world. They also hold for two large countries even after the terms-of-trade motive for protection is removed. By allowing lobby formation to be endogenous, we then show that, for a sufficiently high coefficient of loss aversion, more import-competing lobbies will form than under the GH model, and that import-competing sectors will be more likely to form a lobby than export sectors, which reinforces the anti-trade bias result. We also show that, if there is loss aversion, sectors in which profitability is declining will receive higher protection, everything else equal.

We use a nonlinear regression procedure to directly estimate the parameters of the model and test the empirical validity of its predictions. We find empirical support for the model and, very importantly, we obtain estimates of the parameters that are very similar to those estimated by Kahneman and Tversky (1992) using experimental data. In particular, we find that losses have a larger impact on protection than gains, and we obtain estimates of the coefficient of loss aversion that are about 2. To our knowledge, no previous paper has provided econometric estimates from other than experimental data of *all* the parameters of the value function proposed by Kahneman and Tversky (1992). We also find that the data favors our model over the GH model. These results contrast with those of Gawande and Bandyopadhyay (2000) and Goldberg and Maggi (1999), who find that the introduction of additional variables in the estimation of the GH model does not significantly improve its explanatory power. Our approach differs from theirs, however, in that we have a well-specified alternative hypothesis.

Additionally, we estimate a Probit equation on political organization using the two-stage conditional maximum likelihood estimator proposed by Rivers and Vuong (1988) and we find evidence of loss aversion in lobby formation, consistent with our theoretical prediction. The fact that we test some predictions derived by endogenizing lobby formation also differs from the empirical work of Gawande and Bandyopadhyay (2000) and Goldberg and Maggi (1999), who estimate a version of the GH model in which lobby formation is considered exogenous.

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Appendix

A. Equilibrium Policies

First, we derive the equilibrium policies for the organized sectors. Given that there is no interaction between lobbies, the condition that, for every lobby i, the equilibrium price vector maximizes the joint welfare of that lobby (net of contributions) and the government (condition (c) on footnote 23), implies that:

$$p_i^0 \equiv \arg\max \left\{W_i(p_i) - C_i^0(p_i)\right\} + \left\{C_i^0(p_i) + aW(\mathbf{p})\right\} = W_i(p_i) + aW(\mathbf{p}) \qquad \text{(A1)}$$

The first-order condition is:

$$\frac{\partial W_i}{\partial p_i} + a\frac{\partial W}{\partial p_i} = 0 \qquad \text{for all } i \in L \qquad \text{(A2)}$$

Using (5), (7) and (A2) we can obtain the equilibrium policies for $i \in L$:

$$\frac{\widetilde{t}_i}{1+\widetilde{t}_i} = \begin{cases} \dfrac{1}{a}\left\{1 + (1+a)\beta\lambda \dfrac{\left[\Pi_i\left(\widetilde{p}_i^{(-1)}\right) - \Pi_i\left(\widetilde{p}_i\right)\right]^{\beta-1}}{\left(E_i^{(-1)}\right)^{\beta}}\right\}\dfrac{\widetilde{z}_i}{\widetilde{e}_i} & \textit{if } \Pi_i\left(\widetilde{p}_i\right) < \Pi_i\left(\widetilde{p}_i^{(-1)}\right) \\[2ex] \dfrac{1}{a}\left\{1 + (1+a)\alpha \dfrac{\left[\Pi_i\left(\widetilde{p}_i\right) - \Pi_i\left(\widetilde{p}_i^{(-1)}\right)\right]^{\alpha-1}}{\left(E_i^{(-1)}\right)^{\alpha}}\right\}\dfrac{\widetilde{z}_i}{\widetilde{e}_i} & \textit{if } \Pi_i\left(\widetilde{p}_i\right) > \Pi_i\left(\widetilde{p}_i^{(-1)}\right) \end{cases} \qquad \text{(A3)}$$

where $\widetilde{t}_i = (\widetilde{p}_i - p_i^*)/p_i^*$ is the equilibrium *ad valorem* trade tax or subsidy for $i \in L$, $\widetilde{z}_i = y_i(\widetilde{p}_i)/m_i(\widetilde{p}_i)$ is the equilibrium ratio of domestic output to imports (negative for exports) and $\widetilde{e}_i = -m_i'(\widetilde{p}_i)\,\widetilde{p}_i / m_i(\widetilde{p}_i)$ is the elasticity of import demand (defined to be positive) or export supply (defined to be negative).

In the case of the unorganized sectors, the first-order condition (A2) becomes:

$$a\frac{\partial W}{\partial p_i} = 0 \qquad \text{for all } i \notin L \qquad \text{(A4)}$$

Using (7) and (A4) we can obtain, for $i \notin L$:

$$\frac{\widetilde{t}_i}{1+\widetilde{t}_i} = \begin{cases} \beta\lambda \dfrac{\left[\Pi_i\left(\widetilde{p}_i^{(-1)}\right) - \Pi_i\left(\widetilde{p}_i\right)\right]^{\beta-1}}{\left(E_i^{(-1)}\right)^{\beta}}\dfrac{\widetilde{z}_i}{\widetilde{e}_i} & \textit{if } \Pi_i\left(\widetilde{p}_i\right) < \Pi_i\left(\widetilde{p}_i^{(-1)}\right) \\[2ex] \alpha \dfrac{\left[\Pi_i\left(\widetilde{p}_i\right) - \Pi_i\left(\widetilde{p}_i^{(-1)}\right)\right]^{\alpha-1}}{\left(E_i^{(-1)}\right)^{\alpha}}\dfrac{\widetilde{z}_i}{\widetilde{e}_i} & \textit{if } \Pi_i\left(\widetilde{p}_i\right) > \Pi_i\left(\widetilde{p}_i^{(-1)}\right) \end{cases} \qquad \text{(A5)}$$

Using (A3) and (A5) we can write a general equation for the equilibrium policies:

$$\frac{\tilde{t}_i}{1+\tilde{t}_i}=\begin{cases}\frac{1}{a}\left\{I_i+(I_i+a)\beta\lambda\frac{\left[\Pi_i\left(\tilde{p}_i^{(-1)}\right)-\Pi_i\left(\tilde{p}_i\right)\right]^{\beta-1}}{\left(E_i^{(-1)}\right)^{\beta}}\right\}\frac{\tilde{z}_i}{\tilde{e}_i} & \textit{if } \Pi_i\left(\tilde{p}_i\right)<\Pi_i\left(\tilde{p}_i^{(-1)}\right)\\ \frac{1}{a}\left\{I_i+(I_i+a)\alpha\frac{\left[\Pi_i\left(\tilde{p}_i\right)-\Pi_i\left(\tilde{p}_i^{(-1)}\right)\right]^{\alpha-1}}{\left(E_i^{(-1)}\right)^{\alpha}}\right\}\frac{\tilde{z}_i}{\tilde{e}_i} & \textit{if } \Pi_i\left(\tilde{p}_i\right)>\Pi_i\left(\tilde{p}_i^{(-1)}\right)\end{cases}$$

where $I_i=1$ if $i\in L$ and zero otherwise.

B. Anti-Trade Bias Condition (Small Economy)

Using equation (A3) we have that protection in sector 2 will exceed protection in sector 1 if and only if:

$$\left\{1+(1+a)\beta\lambda\frac{\left[\Pi_2\left(p_2^{(-1)}\right)-\Pi_2\left(p_2\right)\right]^{\beta-1}}{\left(E_2^{(-1)}\right)^{\beta}}\right\}\frac{y_2(p_2)}{-p_2m_2'(p_2)}>\left\{1+(1+a)\alpha\frac{\left[\Pi_1\left(p_1\right)-\Pi_1\left(p_1^{(-1)}\right)\right]^{\alpha-1}}{\left(E_1^{(-1)}\right)^{\alpha}}\right\}\frac{y_1(p_1)}{-p_1m_1'(p_1)}$$

which, after invoking symmetry and simplifying, becomes:[81]

$$\lambda>\frac{1}{\beta\frac{\left[\Pi_2\left(p_2^{(-1)}\right)-\Pi_2\left(p_2\right)\right]^{\beta-1}}{\left(E^{(-1)}\right)^{\beta}}}\left\{\frac{y_1-y_2}{(1+a)y_2}+\alpha\frac{\left[\Pi_1\left(p_1\right)-\Pi_1\left(p_1^{(-1)}\right)\right]^{\alpha-1}}{\left(E^{(-1)}\right)^{\alpha}}\frac{y_1}{y_2}\right\}$$

[81] We also use $E^{(-1)}=E_1^{(-1)}=E_2^{(-1)}$, given symmetry.