

Trade Liberalization and Industrial Concentration: Evidence from Brazil *

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Abstract

This paper applies an endogenous lobby formation model to explain the extent of trade protection granted to Brazilian manufacturing industries during the 1988-1994 trade liberalization episode. Using a panel data set covering this period, we find that even in an environment in which a major regime shift has been introduced, more concentrated sectors have been able to obtain policy advantages, that lead to a reduction in international competition. The importance of industry structure appears to be substantial: In our baseline specification, an increase in concentration by 20% leads to an increase in protection by 5%-7%.

JEL Classification: F13.

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1 Introduction

Active trade policies are seldom justifiable on efficiency grounds. In most cases, they are instead the result of distortions introduced through the political process. While a large literature has highlighted the role of organized groups in the provision of trade protection, only few theoretical contributions have explicitly identified the link between industrial structure, the process of lobby formation and the determination of trade policy. In this paper we use Magee's (2002) model to understand the recent Brazilian trade liberalization experience.

The case of Brazil is very interesting for a variety of reasons. First, although widely discussed in the press, the role of lobbying by organized groups in shaping economic policy in the large Latin American country has been the subject of only sparse studies (Olarreaga and Soloaga (1998), Helfand (2000), Gawande, Sanguinetti, and Bohara (2003)). Secondly, the generalized trade liberalization that took place between 1988–1994 has been a major policy reversal, and represents a particularly challenging ground to test explanations of trade policy based on the lobbying activity of organized interests groups. Third, the existing empirical literature linking lobbying activity and industrial structure based on cross-sectional studies (Baldwin (1985), Trefler (1993), Goldberg and Maggi (1999) etc.) has not reached clear-cut conclusions on the role of industry structure in explaining protection. In particular, as Rodrik (1995) points out

“High levels of concentration in the affected industry itself are apparently not always conducive to protection: some studies find a negative relationship between seller concentration and protection (...), while many others find a positive relationship (...)” (page 1481).

This ambiguity is resolved in this paper using instead a panel data approach, that exploits some unique features of the recent Brazilian trade liberalization process. Explicitly allowing for time lags we show that more concentrated industries have been able to obtain policy advantages even during the “abertura comercial” (trade liberalization) pursued by the Collor

administration. Not only industry structure matters, but its impact appears to be substantial. In our baseline specification, an increase in concentration by 20 percentage points leads to an increase in protection by 5 to 7 percentage points.

Between 1988 and 1994, the Brazilian government implemented a generalized reduction of the tariff level, accompanied by the elimination of most non-tariff barriers. The extent of the policy reversal has been dramatic: In 1994 nominal tariffs in the manufacturing sector were, on average, one quarter of their 1988 levels, and one tenth of their 1985 levels. As a result, Brazilian manufactured imports (FOB, in current dollars) were in 1995 three times as large as in 1988. In certain industries, like “natural and synthetic” fabrics, imports increased more than ten times. The speed and the far reaching extent of the reform have represented a substantial shock to the domestic manufacturing sector, whose effects on growth and technology adoption have been documented, among others, by Ferreira and Rossi (2003), Muendler (2002) and Hay (2001).

While the reduction in the rate of protection took place across the board and was accompanied by a decline in the dispersion of tariffs, not all sectors were affected to the same extent. In particular, casual observation leads to conjecture that protection from international competition fell less for highly concentrated sectors, represented by a strong lobby (e.g. the motor vehicle industry), while it fell much more in competitive industries (e.g. textiles), which were not as able to voice their concerns to the federal government. Such anecdotal evidence is well explained by the recent literature linking endogenous lobby formation to industrial structure, and the purpose of this paper is to understand to what extent this pattern emerges systematically, when we consider the entire manufacturing sector. We perform our empirical analysis using a panel data set for Brazilian industries. The data encompass annual observations for the years 1988–1994 for a cross section of up to 42 industries. In most of our regressions we use two alternative measures of trade protection, i.e. nominal tariffs and

the effective rate of protection¹, while concentration is measured by the *CR4* index.² We show that industry structure matters, and the impact of concentration is substantial. We interpret these results as hinting that while an *ideological* change has occurred in Brazil, that has made import substitution an unacceptable strategy of development, the process through which the specific, cross sectional, pattern of protection is determined has not changed as a result of the liberalization effort. In particular, our estimates point out not only that more concentrated sectors have been able to organize themselves and effectively lobby politicians, but also that elected officials have continued to be highly responsive to the efforts of pressure groups.³

The role of lobbying by organized interest groups has long been recognized as an important determinant of commercial policy, but most of the literature explaining trade policy as the result of influence driven contributions (Grossman and Helpman (1994)) has taken as exogenously given the existence of pressure groups. In two interesting papers, Mitra (1999) and Magee (2002) have instead considered the endogenous formation of both lobbies and trade policies. While in Mitra (1999) a lobby is assumed to come about if the rents generated more than cover the fixed cost of forming a lobby, the paper by Magee (2002) explicitly takes into account the role of the industrial structure on the ability of firms to cooperate in the lobbying effort.⁴ The latter seems to fit very well the known stylized facts on the recent Brazilian experience and for this reason, we adapt this model to motivate our empirical investigation. The remaining of the paper is organized as follows. Section 2 provides the theoretical motivation, while section 3 reviews the recent Brazilian trade liberalization episode and relates it to the structure of Brazilian manufacturing. We present then the

¹We don't have data on quantitative restrictions, but this is not a serious limitation since almost all quantitative barriers had been eliminated before the beginning of our sample. See Geraldino da Silva (1999) for details.

²The share of the four largest companies in the total revenues of the sector.

³We will explicitly refer to the "weakness" of the Brazilian government later in the paper.

⁴Earlier attempts in a similar direction are Rodrik (1986) and Pecorino (1998), but here protection was simply modelled as an increasing function of the contributions received, and the bargaining between the government and the pressure group was not explicitly analyzed.

data set used to carry out the analysis and discuss the result of the estimation in section 4. Section 5 concludes the paper.

2 Model

To formalize the link between endogenous trade policy and industrial concentration and take into account some specific features of the Brazilian experience we adapt the model developed by Magee (2002). As in Grossman and Helpman (1994) trade policy is the result of the interaction between an organized group and an elected official, but while Grossman and Helpman (1994) take the existence of a pressure group as given, this model endogenizes its formation making it a function of industry characteristics, and in particular of industrial concentration.

Following Pecorino (1998) and Magee (2002) the setup of the model is kept as simple as possible in order to better understand the problem at hand. A small open economy produces two goods, a numéraire X_0 and an import competing good X_1 . The numéraire is manufactured using only labor, the supply of which is fixed and equal to L , while the import competing good X_1 produced by a set N of identical firms using a common, sector specific capital whose supply is normalized to 1. For both goods, the production function exhibits constant returns to scale and units are chosen so that one unit of the input is converted in one unit of output. The numéraire is freely traded in international markets, and its price is normalized to one. Given the production technology, this implies that the labor wage rate is also equal to one. The import competing good is traded on the international market at a price equal to p_w , and the domestic price will therefore be $p = p_w + t$, where t is an import tariff. Consumers-workers share the same quasi-linear preferences, $u = x_0 - \frac{1}{2}(a - x_1)^2$, so that the demand for the import competing good is given by $D(p) = a - p$. As in Rodrik (1986) we make the simplifying assumption that capitalists do not consume the X_0 output.⁵

⁵This is equivalent to assume that only a measure zero subset of the population actually owns capital, as in Maggi and Rodriguez-Clare (1998).

The endogenous formation of a lobby and the corresponding trade policy are the result of a two stage game between firms in the sector and the government. Players are infinitely lived. In the first stage, the identical firms decide whether or not to cooperate and contribute to the lobbying effort. In the second stage, the group of firms negotiate with an elected official a payment $C(t)$, in exchange for the implementation of a tariff t . The game is solved backwards, i.e., once the result of the negotiation is known, each firm decides whether to cooperate and contribute to the lobbying effort, or to be opportunistic. If one firm does not contribute, there is a perpetual reversal to the non cooperative outcome. Once the decision to cooperate or not has been reached, total contributions are collected and the actual trade policy is implemented.

As in Grossman and Helpman (1994), in choosing the optimal policy, the government trades off contributions against aggregate welfare ($W(t)$). To model the difference between “weak” and “strong” politicians, we choose the following specification for the government’s objective function $G(t)$:

$$G(t) = \begin{cases} C(t) + aW(t) & \text{if } C(t) > \underline{C} \\ aW(t) & \text{if } C(t) \leq \underline{C} \end{cases}$$

where a is the weight attached to aggregate welfare, which is defined as

$$W(t) = \left[\int_{p_w+t} D(p) dp \right] + L + n\pi(t) + t(D(p_w + t) - 1) \quad (1)$$

The first term is consumer surplus, the second represents labor income, the third aggregate profits and the last tariff revenues. The government’s objective function tells us that an elected politician is influenced by the lobby’s efforts only if the contributions paid are above a minimum threshold \underline{C} . If contributions are too low, the government will discard the efforts of the organized group and implement the socially optimal policy, which for a small open economy is represented by free trade. The threshold \underline{C} describes the “strength” of the

government, i.e. his ability to withstand the efforts of organized groups to influence policy determination. A strong government will be willing to compromise only if contributions are substantial.

The industry group maximizes instead aggregate profits net of contributions, or

$$\Pi(t) - C(t) = \sum_{i \in N} (\pi_i(t) - c_i(t)) = n(\pi(t) - c(t)) \quad (2)$$

where given our assumptions the expression for the specific factor's income takes the very simple form $\pi(t) = \frac{1}{n}(p_w + t)$. In the second stage the agents play a Nash bargaining game, and assuming that the two parties have the same bargaining power, the contribution schedule is given by

$$C(t) = \frac{1}{2}(\Pi(t) - \Pi(0)) + \frac{a}{2}(W(0) - W(t)) \quad (3)$$

where $\Pi(0)$ is the free trade profit level, while $W(0)$ is the free trade level of aggregate welfare⁶ This implies that the lobby and the government equally share the surplus generated by the introduction of the distortion.⁷ It is easy to show that contributions are monotonically increasing in the tariff rate and strictly convex. The function can therefore be inverted, obtaining a tariff schedule that is increasing in contributions and concave.

In the first stage of the game, each individual firm chooses to cooperate if and only if the present value of the net profit flow associated to cooperation ($\frac{1}{1-\delta}(\pi_c - c_c)$) is higher than the net profits arising from a one period deviation ($\pi_d - c_d$) followed by an infinite reversal to the non-cooperative outcome ($\frac{\delta}{1-\delta}(\pi_n - c_n)$). More formally, cooperation will be sustained if and only if

$$(\pi_d - c_d) + \frac{\delta}{1-\delta}(\pi_n - c_n) \leq \frac{1}{1-\delta}(\pi_c - c_c) \quad (4)$$

⁶This is the same contribution schedule as in Maggi and Rodriguez-Clare (1998).

⁷We consider this distribution of the bargaining weight as a focal case, but the analysis can be carried out in a more general setup were the government's share in the surplus deriving from the political relationship varies. Magee (2002) points out that an increase in the number of lobbies in this model is equivalent to an increase in the share of the surplus obtained by the government.

Let δ^* be defined as the minimum discount factor necessary for cooperation to be sustained in equilibrium, i.e.

$$\delta^* = \frac{(\pi_d - c_d) - (\pi_c - c_c)}{(\pi_d - c_d) - (\pi_n - c_n)} \quad (5)$$

Assuming that $\pi_d - c_d \geq \pi_c - c_c \geq \pi_n - c_n$, $\delta^* < 1$. Notice that δ^* measures the difficulty of enforcing cooperation and therefore an increase in its value can be interpreted as a worsening of the free rider problem. The main contribution of Magee (2002) is to characterize the relationship between the severity of the free rider problem and the number of firms active in a sector. In particular, he is able to show that

Proposition 1 *Under Nash bargaining, δ^* is monotonically increasing with the number of identical firms active in the industry.*

In other words, the free-rider problem will become worse if the number of firms active in the industry increase.

To gain some intuition for this result, let us first focus on the non cooperative outcome. In a non cooperative equilibrium, firms maximize their own profits, without considering the effect of their own lobbying on the other firms. The marginal benefit of a dollar spent on contributions by a firm that is not cooperating is given by⁸

$$\frac{\partial \pi_i}{\partial t} \frac{\partial t}{\partial c_i} = \frac{q}{nq/2} = \frac{2}{n} \quad (6)$$

but then of course, for any $n > 2$, the marginal benefit of contributing is smaller than the marginal cost.⁹

⁸Notice that

$$\frac{\partial C}{\partial t} = \frac{1}{2}nq - \frac{a}{2}(D'(p) - n\frac{\partial q}{\partial t})t.$$

where q is the firm's output. Evaluating the slope of the contribution schedule at $t = 0$, we have that $\frac{\partial C}{\partial t} = \frac{1}{2}nq$, from which the result follows.

⁹Notice that in a more general model this result, i.e. that in the non-cooperative equilibrium each firm will not contribute anything to the government continues to hold also in the presence of heterogenous firms, as long as the bargaining power of the elected politician is large enough, or, in other words, if there are enough active lobbies.

This implies that in the noncooperative equilibrium each firm's transfer to the politician will be nil. Given the preferences of the politician, his desired policy in the absence of contributions is free trade, and free trade will be chosen if cooperation cannot be enforced. Remembering that $\pi_c = \frac{1}{n}(p_w + t_c)$, $\pi_d = \frac{1}{n}(p_w + t_d)$ and $\pi_n = \frac{1}{n}(p_w)$, equation (5), simplifies to

$$\delta^* = \frac{t_d - (t_c - C_c)}{t_d} \quad (7)$$

Consider now the case in which one firm deviates from the cooperative outcome and decides to free ride. Assuming that the other firms continue to play the cooperative strategy, the total contributions paid to the government will now be $C_d = \frac{(n-1)}{n}C_c$. As the number of firms increases, C_d monotonically approaches C_c , and correspondingly the tariff t_d approaches t_c from below. This is the source of the difficulty in enforcing cooperation when the number of firms increases in this model. The point can be made clearer by examining the effect of an increase in the number of firms on the minimum discount factor needed to sustain cooperation, δ^* . It is easy to show that the sign of $\frac{d\delta^*}{dn}$ is the same as the sign of $\frac{dt_d}{dn}(t_c - C_c) > 0$.¹⁰ In other words, since the tariff under defection is growing closer to the cooperative level as the number of firms increases, the incentive to free ride becomes larger the larger is the number of firms active in the industry. Notice that key to this result is that the increase in the number of firms does not affect the non-cooperative outcome. Given that the lobby and the government equally share the surplus from the lobbying activity, as long as the industry is not a monopoly, in the non-cooperative equilibrium firms will contribute nothing and this outcome will not be affected by an increase in the number of firms active in the industry. Such an increase will instead increase the one period gains from a unilateral deviation, and it is in this sense that lobbying becomes more difficult.

While this result is by itself interesting, discount factors are in general not directly ob-

¹⁰Just notice that

$$\frac{d\delta^*}{dn} = \frac{\frac{dt_d}{dn}(t_c - C_c) - t_d \frac{d(t_c - C_c)}{dn}}{t_d^2}$$

and $\frac{dt_c}{dn} = \frac{dC_c}{dn} = 0$.

servable. In order to bring the model to the data a more useful approach is to assume that full cooperation cannot be enforced – in other words that $\delta < \delta^*$ – and study the effect of an increase in n on the maximum sustainable tariff. To do so, rewrite equation (4) as follows:

$$(1 - \delta)(\pi_d - c_d) + \delta(\pi_n - c_n) \leq (\pi_c - c_c) \quad (8)$$

Let $Z(\delta, t) = n[(1 - \delta)(\pi_d - c_d) + \delta(\pi_n - c_n)]$ represent the temptation to deviate from the cooperative outcome, while $V = n(\pi_c - c_c)$ represents the gains from cooperation. Using our functional form assumptions, we can show that

$$Z(\delta, t) = p_w + \frac{(1 - \delta)}{a} \left[\left(1 + \frac{a(n - 1)}{n} (2t + at^2) \right)^{\frac{1}{2}} - 1 \right] \quad (9)$$

and

$$V(t) = p_w + \frac{1}{2}t - \frac{at^2}{4} \quad (10)$$

Notice that $Z(\delta, t)$ is strictly increasing in t , since the non-cooperative outcome is not going to be affected by the cooperative tariff, while $V(t)$ is concave and initially increasing in t . Furthermore, V does not depend upon the number n of firms active in the sector. $Z(\delta, T)$ and $V(t)$ are represented in figure 1.

As we can see, the two curves intersect at the non-cooperative tariff level $t_n = 0$. When $\delta = \delta^*$, full cooperation can be enforced, and the corresponding maximum sustainable tariff (t_c) is defined as the solution of $Z(\delta^*, t) = V(t)$. For a sustainable tariff level $t_m \in [t_n, t_c]$ to exist, $\frac{\partial Z}{\partial t}(t = 0) < \frac{\partial V}{\partial t}(t = 0)$. Let $\bar{\delta}$ be the minimum value of δ such that this condition is satisfied. We are now ready to state the main result of the model

Proposition 2 *Under Nash bargaining, the maximum sustainable tariff t_m is monotonically decreasing with the number of identical firms active in the industry.*

Proof. Remember that the one period net return from defecting ($\pi_d - c_d$) is larger than the non-cooperative return ($\pi_n - c_n$). We can easily verify that $\frac{\partial Z}{\partial \delta} < 0$. For $\bar{\delta} < \delta < \delta^*$ there

exists then a maximum sustainable tariff t_m , i.e. a tariff value such that $Z(\delta, t_m) = V(t_m)$. From equation (9) we also know that $\frac{\partial Z}{\partial n} > 0$, i.e. the temptation to deviate is increasing with the number of firms n active in the industry, while V does not depend upon n . An increase in n will therefore move $Z(\delta, t)$ upwards, reducing the maximum sustainable tariff for a given discount factor δ .

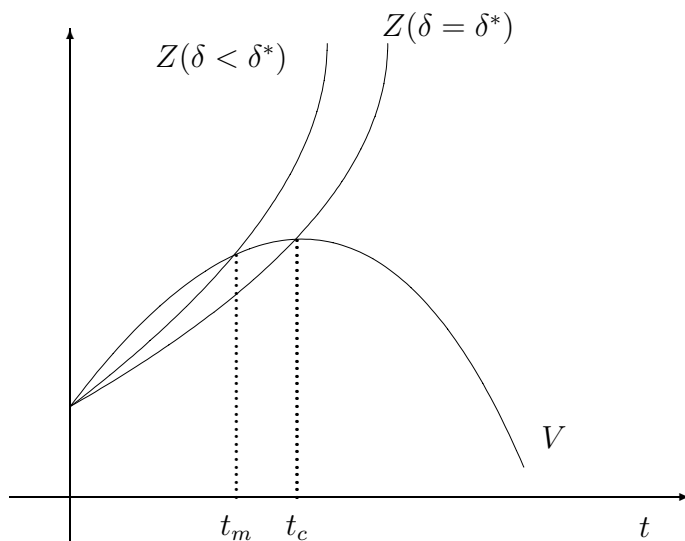


Figure 1: Maximum sustainable tariff

This model illustrates how the collective action problem first studied by Olson (1965) might arise when we consider the formation of a lobby interacting with an elected politician to provide tariff protection to an industry. This simple framework in which all firms are identical and the lobby shares with the government the surplus from their political relationship gives us an empirically assessable prediction: The observed tariff should be decreasing with the concentration of an industry. If, as in the case of Brazil, a paradigm shift has occurred in which an import substitution regime has been repudiated in favor of a liberalized regime, tough politicians could well not be sensitive to the influence efforts of organized groups, and completely liberalize trade. The remainder of this paper is dedicated to the evaluations of these predictions.

3 Trade and industrial concentration in Brazil

Until the late eighties the Brazilian government has pursued an aggressive import substitution industrialization strategy, that has involved the use of high tariff rates, exchange rate controls and interventions, and often prohibitive non-tariff measures.¹¹ The *New Industrial Policy* introduced in 1988 by the Sarney administration represents a strategy reversal, and the beginning of a process of progressive trade liberalization. While the approach was rather timid at first, and involved only the elimination of redundant tariffs, after 1990 the pace of reform accelerated, and the newly sworn in Collor administration actively embraced trade liberalization as a long term development strategy. The reforms introduced involved both the complete removal of quantitative restrictions, and the introduction of a time table for tariff reductions, which was implemented in four steps in February 1991, January 1992, October 1992 and July 1993. The first two steps emphasized reduction in tariffs on capital and intermediate goods, while the reduction in the protection granted to final (consumer) goods occurred later. As a result of the reform, by 1997 nominal tariffs were on average one-tenth as large as in 1987.

To explore systematically the possible link between industrial concentration and trade protection, we use a panel data set which has been constructed with data from two different sources. Measures of trade protection, i.e. nominal tariffs and effective rates of protection were obtained from Kume (1996) and cover 56 sectors over the period 1988 to 1994. Data on industrial concentration, measured using the share of a sector's total sales appropriated by the four largest firms (*CR4*) cover instead the period between 1986 and 1995 and include 51 sub-sectors. The same dataset includes annual series on capital-output ratio (*KY*), on total machine and equipment purchased as a proportion of revenues (*MP*), investment-output ratio (*INV*), on the total labor force employed in production (*LF*) and also a profitability measure (J ¹²). These series were constructed from the "Pesquisa Industrial Anual" (Annual

¹¹For a brief description of the main policy instruments used in this period, see Hay (2001).

¹²The variable J is defined as the cost of products and services bought by the sector divided by its net

Table 1: Tariffs, ERP and Concentration(1988-1994).

Year	NT			ERP			CR4		
	median	max	min	median	max	min	median	max	min
1988	0.41	0.90	0.15	0.35	1.83	-0.02	0.32	0.97	0.09
1989	0.34	0.85	0.10	0.37	2.20	0.01	0.31	0.97	0.09
1990	0.30	0.80	0.06	0.29	3.13	-0.07	0.31	0.98	0.08
1991	0.21	0.70	0.06	0.23	2.25	-0.03	0.32	0.98	0.08
1992	0.18	0.49	0.04	0.24	1.66	-0.02	0.33	0.98	0.08
1993	0.13	0.34	0.02	0.21	1.30	-0.03	0.32	0.98	0.09
1994	0.10	0.23	0.03	0.20	0.95	0.00	0.31	0.98	0.09

Industry Survey, FIBGE) and some were obtained from Geraldino da Silva(1999).

Out of the 56 sectors covered by the trade protection database, 10 cross-sections had to be removed. Eight observations involve agriculture and mining and have been eliminated because the focus of our analysis is manufacturing. Gasoline and oil production are public monopolies in Brazil, and for this reason they have also been excluded. This left us with 46 manufacturing sectors for which data on protection were available, to be matched with the 51 subsectors obtained from the PIA. Apart from the difference in the number of cross-section and time series observations, the two data sets differ in the aggregation level, and at times even in the definition of sectors.¹³ As a result, we carry out our benchmark analysis with 21 cross-sectional observations, which is the number of *exact* matches among industries in the two data sets. These industries represent 46% of the total value added in manufacturing. To evaluate the robustness of our analysis, we use also an extended data set. To do so, we have included industries where the matching of sectors is slightly less precise, and extending the dataset in this way, we have been able to use a total of 41 cross-sectional observations for each of the seven years in our sample. In 1994 these industries were responsible for more than 80% of the value added in the manufacturing sector.

Descriptive statistics on measures of trade protection and concentration are reported in

revenue. KY is the ratio between fixed assets and net revenue.

¹³See the appendix for more details on the construction of the data set.

Table 1. The median nominal tariff in the 41 manufacturing sectors in the extended data set decreased from 41% in 1988 to 10% in 1994¹⁴, while the median effective rate of protection dropped from 35% to 20%. At the same time, the median (and the mean) CR4 did not change dramatically, even if there were changes in several sectors. In particular, in some industries like “Processed Rice” or “Machines and Equipment” concentration almost doubled, while in others like “Sugar” the CR4 index declined to two thirds of its original 1986 value.

While the reduction of protection is a general phenomenon, the regime switch did not affect all sectors to the same extent. Consider for instance “automobiles, trucks and buses” and “artificial textile fibers”. Between 1988 and 1990, the average tariff among the 41 sub-sectors for which we have good data fell by a quarter, while in the automobiles, trucks and buses sub-sector it actually *increased* by 21 percent. As a result, the nominal tariff in this sub-sector went from about one and a half times the mean tariff in 1988 to 2.4 times in 1993 and 1.7 times in 1994. On the other hand, the average tariff levied on artificial textile fibers imports went from 1.4 the mean tariff in 1988 to less than 90% of the 1994 mean¹⁵. Clearly, there are forces specific to the automobiles, trucks and buses industry partially offsetting the general trend towards a reduction of protection in the Brazilian economy. At the same time, those forces seem to be weaker in the textile industry.

Figure 2 presents the evolution of nominal tariffs and concentration in these two sectors, normalized with respect to the median of manufacturing. Note that while concentration in the automobiles, trucks and buses industry throughout the period is at least twice the manufacturing median, the “artificial textile fibers” sector shows a below the median concentration level (fluctuating around 0.75). At the same time, while the average nominal tariffs in both sectors were almost the same as in 1988 at about 1.5 times the median, in 1994 the average protection was twice the median in automobiles, trucks and buses and

¹⁴The corresponding figures for the entire (56 sub-sectors) sample are 35.6 percent in 1988 and 10.07 percent in 1994.

¹⁵The behavior of the effective rate of protection is similar: between 1988 and 1991 it fell, on average, 35% but it increased by 23% in the auto industry. As for the textile industry, the change was in the opposite direction: its 1988 rate was very close to the mean, but only half the mean in 1992.

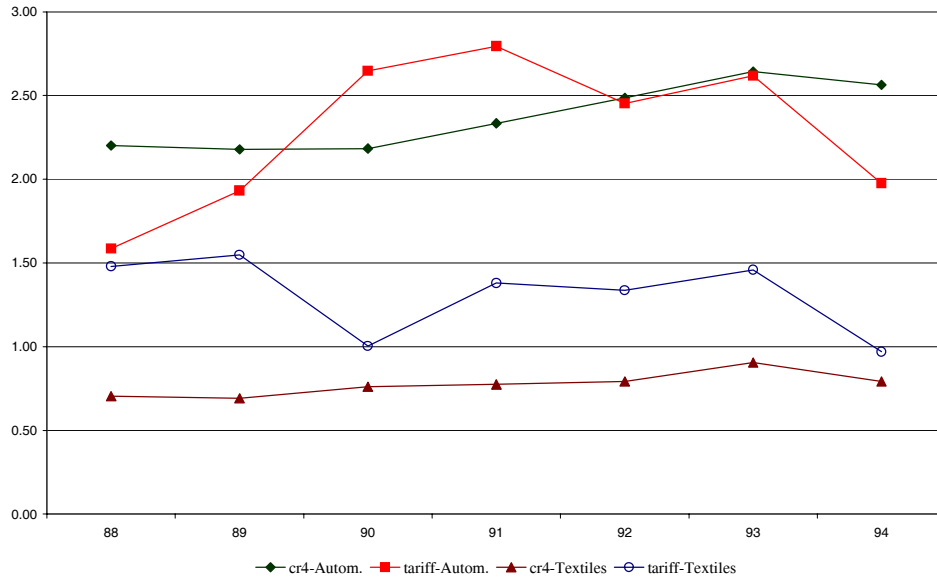


Figure 2: Protection and concentration

exactly the median in the textile industry.¹⁶ The poultry, the dairy and the vegetable oils (bulk) industries, are other interesting examples of sectors in which concentration was above (below) average in 1988, and trade protection did not fall as much as (fell more than) in the remaining industries.

This evidence suggests that the model's mechanism linking the maximum sustainable tariff and industrial concentration might well have been at work in the case of Brazil, and in the next section we formally test this hypothesis.

¹⁶Anecdotal evidence on the large political clout enjoyed by Anfavea, the official association of the automobiles, trucks and buses industry is abundant. This lobby has been able to obtain a large number of policy advantages for its members, ranging from a particularly favorable timetable for tariff reduction, to tax breaks and subsidies that sectors with less political muscle were not able to achieve. For instance, after the Asian crisis, the average nominal tariff in the sector jumped to 55% from 20%, while the average tariff of the manufacturing sector went from 11% to only 14%.

4 Model estimation

Our objective is to test the relationship derived in Section 2 between industry concentration and trade protection. The theoretical discussion suggests that *ceteris paribus*, the higher the concentration of a given industry, the higher the import tariffs applied on foreign imports. In order to benefit from the time structure of our dataset we initially used (one or two years) lagged CR4. Given that in the model causation goes from concentration to tariff, we found it natural to use a predetermined concentration index. Moreover, although the channel from industry structure to protection in the model is same-period contributions, one can think that in practice there is a considerable time period between the political decision of making a contribution and the final effect of obtaining a given level of tariff.

We used the following equation in all estimations:

$$T_{it} = \beta_i + \phi \cdot Z_{it} + \epsilon_{it}, \quad i = 1, \dots, 21, \quad t = 1988, \dots, 1994$$

where T_{it} is one of the two openness indicators for sector i at time t , Z_{it} is a vector of explanatory variables that always contains the concentration index and may or may not contain additional control variables, β_i is the industry-specific fixed effect, and ϵ is a zero mean error term.

Our main data set consists of a panel of 21 industries for seven years (from 1988 to 1994). In all our regression we have used industry fixed effects. Introducing industry fixed effects we can account for time invariant industry characteristics that are likely to have an effect on concentration, like for instance large fixed setup costs, and that might otherwise confound the interpretation of our results, making them for instance compatible with an infant industry argument. To statistically validate our choice, we also ran the Hausmann specification test to decide between the fixed-effects and the random-effects method. With nominal tariffs as the dependent variable, the result favored the fixed-effects method, which we therefore used in all regressions. When the effective rate of protection was instead used,

Table 2: NT regressions (fixed-effect method, lag concentration)

Model	Independent Variable			
	$CR4(-1)$	$CR4(-2)$	KY	$trend$
1	0.37 (3.35)			-0.23 (-29.43)
2	0.26 (2.95)		-0.10 (-2.29)	-0.21 (-27.50)
3		0.39 (4.29)		-0.23 (-29.22)
4		0.26 (3.60)	-0.09 (-2.97)	-0.20 (-27.52)

Note: t-statistic in parentheses; 21 cross-section observations

the results were ambiguous depending on the control variables included in the regression and the time period of the sample. We estimated our models using fixed effects also in this case. Table 2 presents the results for our first set of regressions. To avoid the potential endogeneity problems which could arise using simultaneous concentration indicators¹⁷ we consider first the results for nominal tariffs, NT and lagged concentration (all variables are in logs, except for the trend).¹⁸

The results above support the hypothesis that industry concentration impacts nominal tariffs, as the estimated coefficient of $CR4$ is positive and statistically significant at 5% in all regressions. Moreover, the estimated impact is large: for a given capital-output ratio, a difference of 20% in $CR4$ between industries implies 5% to 7% higher tariffs.

The inclusion of a time trend is meant to capture macroeconomic and policy changes that affected the economy as a whole in the period. As already mentioned, there was a generalized reduction in trade barriers for the manufacturing sector starting in 1988. In

¹⁷We will discuss these later on in the paper.

¹⁸We could not think of a solid theoretical argument that would justify the possible endogeneity of lagged concentration, as it appears unlikely that commercial policy today could affect industry concentration two years ago. Even if this were the case, the regressions run using the weighted two-stage least squares method obtained results very similar to those of OLS regressions.

our sample, the median tariff fell from 41.5% to 10.6%. But this decrease was not uniform across industries, as tariffs of some sectors were in 1994 still two times above the median tariff. The presence of the time trend in the regression simply excludes the common element of this phenomenon. In fact, the estimated coefficient had the expected sign and was highly significant in all regressions. The estimated result says that there was a 20% negative trend in the nominal tariff value in the period¹⁹.

The results are robust to the inclusion of new controls. We tested different specifications which included (various combinations of) capital intensity measures (KY), fixed capital formation (INV and MP), and profitability (J). The estimated coefficient of $CR4$ did not change considerably and remained always significant. In table 2 we report the coefficients for the capital output ratio, since this control has often been used in the literature. As in Treffer (1993) the estimated impact is negative, and this might indicate that KY acts as an entry barrier for both domestic and foreign competitors, so that it reduces the need for protection and hence the observed tariff levels.²⁰

Table 3 presents the outcome of the regressions in which we use our alternative measure of protection (ERP). The results are similar to those for nominal tariffs, although the estimated coefficients of $CR4$ are in most cases larger. The estimated trend remained around 0.20 and KY is significant and negative in all models. As for nominal tariffs, we tested the robustness of the model including different combinations of INV , MP , J in several regressions and the estimated coefficient of $CR4$, trend and KY did not change considerably and always

¹⁹Note that 20% annual reductions of the 1988 mean tariff (45.9%) for seven consecutive years almost matched the 1994 observed average tariff. The latter is 10.5% and the former 9.5%.

²⁰Treffer (1993), among others, included a measure of geographic concentration in his study as an additional control. Unfortunately this is not possible in our case, as there are no data available at the same disaggregation level used in the paper. The figures are not collected by the IBGE because the manufacturing sector in Brazil is highly concentrated in the state of São Paulo and in the Southern Region, so that in many states and for many industries the sample would not be representative. Around 50% of total manufacturing output of the country is produced in São Paulo and 75% in the Southern Region, and a similar pattern emerges also at sectoral level (e.g., using the available broader aggregation, consisting of 22 industries, one can verify that in only 4 of them São Paulo has less than 40% of total output). In this sense, even if there were data available, the extent of cross-sectoral variation would not be large enough to allow for a significant effect in the regressions.

Table 3: *ERP* regressions (fixed-effect method, lag concentration)

Model	Independent Variable			
	<i>CR4</i> (-1)	<i>CR4</i> (-2)	<i>KY</i>	<i>trend</i>
1	0.43 (2.96)			-0.22 (-22.82)
2	0.33 (3.11)		-0.11 (-2.48)	-0.20 (-27.50)
3		0.48 (5.12)		-0.22 (-22.85)
4		0.21 (5.09)	-0.15 (-8.10)	-0.17 (-29.77)

Note: t-statistic in parentheses; 21 cross-section observations

remained significant. The results in Table 3 are similar to the one obtained for nominal tariffs: After controlling for a common trend, in those industries where concentration is higher, trade protection is larger. According to our estimates, a 10% difference in concentration implies a 2% to 5% difference in the effective rate of protection. A possible interpretation of these results is that a given industry structure might well have an impact not only on the extent of protection *directly* granted to its output, but also, through the value chain, to the extent of protection granted to the intermediates required in the production process²¹.

We now turn to regressions with contemporary *CR4*. One important question to be addressed in this context is that of the potential endogeneity of our measure of concentration. One could well argue that the causation goes in a direction that is opposite to what we have hypothesized in our model: Higher tariffs could produce less competition and consequently higher concentration. If this were the case, our estimates would be biased and inconsistent. To test this hypothesis, we ran a version of the Hausman test proposed by Davidson and MacKinnon (1993) and used as an instrument the variable *J*, which is reasonable to assume as being correlated with *CR4* but not with *NT* and *ERP*²². Again, the results are ambiguous.

²¹Thus generalizing the stylized facts we discussed for the case of the automobile industry

²²The test consists of two OLS regressions. In the first, *CR4* is regressed on all exogenous variables (here

Table 4: *NT* regressions (fixed-effects method)

Method	Independent Variable		
	<i>CR4</i>	<i>KY</i>	<i>trend</i>
<i>OLS</i>	0.13 (0.22)		-0.22 (-26.96)
<i>OLS</i>	0.19 (2.22)	-0.14 (-4.22)	-0.20 (-21.13)
<i>2SLS</i>	-0.02 (-0.18)		-0.18 (26.94)
<i>2SLS</i>	0.27 (2.99)	-0.14 (-4.40)	-0.21 (-28.67)

Note: t-statistic in parentheses; J was the instrument in the two last equations. Variables are in logs.

For *NT* the test could not reject the hypothesis of consistent OLS estimates but for *ERP*, depending on the time period, the test marginally rejected this hypothesis. To compare the results, we will present in this case the OLS and (weighted) two-stage least square estimates in Table 4.

Concentration has the same effect on trade policy as in Table 2, provided that we control for capital intensity (*KY*): the estimated coefficient of concentration is once again significant and positive, and the trend is found to be around 0.20 and barriers to entry (*KY*) also appear to be significant. For this reason we cannot reject the hypothesis of current concentration affecting current trade policy. However, unlike in the case of past concentration, *CR4* becomes insignificant if *KY* is removed from the model, and the same result holds also when we introduce additional controls. One possible interpretation is that a model in which concentration affects trade policy without delay does not find strong supported in the data, as it has been found already in many other studies (Baldwin (1985), Goldberg and Maggi (1999)). Results for the effective rate of protection are similar. Exploiting the time

KY and a time trend) and the instrument and the residuals are retrieved. Then in the second regression, we re-estimate the *NT* or *ERP* equation including the residuals from the first regression as additional regressors. We then check if the coefficients in the first stage residuals are significantly different from zero. If this is the case, then the OLS estimates are consistent.

Table 5: Extended data set (fixed-effect method)

Dependent	Independent Variable			
	$CR4(-1)$	$CR4(-2)$	KY	$trend$
NT		0.42 (7.08)		-0.25 (-45.53)
NT		0.28 (5.21)	-0.07 (-5.24)	-0.23 (-45.30)
ERP		0.51 (6.81)		-0.24 (-31.52)
ERP		0.41 (6.42)	-0.08 (-3.68)	-0.22 (-29.91)
NT	0.21 (2.77)			-0.22 (-42.61)
NT	0.18 (2.70)		-0.10 (-5.87)	-0.22 (-43.61)
ERP	0.35 (4.18)			-0.21 (-32.55)
ERP	0.30 (4.05)		-0.10 (-5.05)	-0.20 (-34.76)

Note: t-statistic in parentheses; 41 cross-section observations

dimension of our panel we are instead able to highlight how *past* concentration plays an important role in determining current protection.

As a further robustness check, we have also estimated the specification discussed above using the extended data set, which includes 41 industries. The main results are presented in Table 5. The estimated elasticity of the NT or ERP with respect to our concentration measures ($CR4(-1)$ and $CR4(-2)$) as in the original data set, is always positive and significant. Moreover, the point estimates for $CR4(-2)$ are in general considerably higher than in Tables 2 and 3, and the present estimations imply that that a sector twice as concentrated as another would have nominal tariffs 40% to 30% higher than the latter. The estimated trend, as in all previous cases, is also around minus 20% a year in all regressions and entry barriers seems to play a significant role. Once again, the link between industry concentration and trade protection appears to be robust.

The relationship between industry structure and trade protection can also be tested by

Table 6: Tariffs normalized by the annual median

Dependent	Independent Variable	
	$CR4(-1)$	$CR4(-2)$
MNT	0.41 (4.20)	
MNT		0.49 (6.92)
$MERP$	0.33 (2.08)	
$MERP$		0.46 (5.42)

Note: t-statistic in parentheses;
21 cross-section observations

regressing CR4 on tariffs normalized by the median (or mean) tariff of a given year. Using this alternative strategy, we correct directly for the generalized reduction of nominal and effective tariffs, without assuming a constant trend year to year. This is done in Table 6, where MTN is the nominal tariff divided by the median of the corresponding year and $MERP$ is ERP divided by the median.

We used the (weighted) fixed-effect method in all regressions. The results above are evidence that the higher the seller concentration in a given industry, the greater the distance of its tariffs to the median tariff (with elasticities between one third and 50%). Moreover, the use of a constant trend did not affect the estimated coefficients of the concentration variables, as they remain significant and very similar in size to those of Tables 2 and 3. The results are robust to the inclusion of the additional controls available in our dataset.²³

To further evaluate the robustness of our results, we run a last group of regressions controlling for industry size. It is common in the literature (e.g., Caves (1976)) to argue that protection should be positively related to the number of employees of a given industry, as this might result in more votes being delivered to politicians deciding on trade measures.

²³To allow for an even more general time structure, we also estimated our models using time dummies. The results did not change significantly.

Table 7: Extended data set (fixed-effect method)

Dependent	Independent Variable				
	<i>CR4</i> (-1)	<i>CR4</i> (-2)	<i>KY</i>	<i>LF</i>	<i>trend</i>
<i>NT</i>		0.48 (11.80)		-0.29 (-6.60)	-0.27 (-49.50)
<i>NT</i>		0.52 (13.47)	-0.10 (-17.84)	-0.28 (-6.65)	-0.28 (-45.30)
<i>ERP</i>		0.55 (7.23)		-0.22 (-2.58)	-0.26 (-25.36)
<i>ERP</i>		0.48 (7.09)	-0.08 (-3.66)	-0.22 (-2.78)	-0.25 (-25.02)
<i>NT</i>	0.13 (1.91)			-0.25 (-3.96)	-0.24 (-34.62)
<i>NT</i>	0.17 (2.90)		-0.11 (-7.55)	-0.25 (-5.39)	-0.23 (-38.71)
<i>ERP</i>	0.38 (5.93)			-0.31 (-5.44)	-0.23 (-28.43)
<i>ERP</i>	0.32 (4.73)		-0.13 (-7.35)	-0.24 (-4.73)	-0.23 (-34.25)

Note: t-statistic in parentheses; 41 cross-section observations

In Table 5 we present regressions with the extended database in which we use “total labor force employed in production” (*LF*), to capture the role of industry size. Also when we account for the role of industry size, our estimates suggest that past concentration continues to play an important role in predicting protection. Controlling for employment does not alter the main results and the magnitudes of the estimated coefficients are close to those in Table 5.

5 Conclusions

The recent Brazilian trade liberalization episode is a natural experiment to evaluate the importance of industry structure as a determinant of tariff protection. In the past, a large body of literature has focused overwhelmingly on the United States to examine the problem in a cross sectional setup, and has failed to identify a robust relationship between tariff

protection and industrial concentration. In this paper we have instead taken advantage of the major policy shift implemented in Brazil in the early nineties to re-evaluate the problem using a panel data set covering the manufacturing sector. The inclusion of a time dimension in the data has allowed us to avoid some of the obvious endogeneity problems, and we have shown that industrial concentration is an important determinant of protection. Our results are robust to the various alternative specifications we have considered, and we hope that this might inspire additional work on trade policy and industrial structure, in which the time dimension is appropriately taken into account.

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