ELSEVIER

The Quarterly Review of Economics and Finance
45 (2005) 432–446

The QUARTERLY REVIEW of ECONOMICS And FINANCE

Trade liberalization and industrial concentration: Evidence from Brazil

Pedro Cavalcanti Ferreira [a], Giovanni Facchini [b, *]

[a] *Graduate School of Economics, Fundacao Getulio Vargas, Rio de Janeiro, Brazil*
[b] *Department of Economics, University of Illinois at Urbana Champaign, 470 D Wohlers Hall, MC-706, 1206 S. Sixth Street, Champaign, IL 61820, USA*

Accepted 3 December 2004
Available online 20 February 2005

Abstract

This paper studies the relationship between industrial structure and 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

Keywords: Trade liberalization; Industrial concentration; Manufacturing industries

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, and a large literature has shown that the activities of organized groups might be very important in shaping the

* Corresponding author. Tel.: +1 217 265 0644; fax: +1 217 244 6678.
E-mail addresses: ferreira@fgv.edu (P.C. Ferreira), facchini@uiuc.edu (G. Facchini).

1062-9769/$ – see front matter
doi:10.1016/j.qref.2004.12.013

trade policy outcome. Recent theoretical papers (Magee, 2002; Pecorino, 1998) have also highlighted the link between industry structure and lobby formation on the one hand, and trade protection on the other. In this paper we will use this work to inspire our analysis of the Brazilian 'abertura comercial' (trade liberalization).

The experience 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 (Gawande, Sanguinetti, & Bohara, 2004; Helfand, 2000; Olarreaga & Soloaga, 1998). Secondly, the generalized trade liberalization that took place between 1988 and 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; Goldberg & Maggi, 1999; Trefler, 1993, 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, which exploits some unique features of the recent Brazilian trade liberalization process.

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 10 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 carry out our empirical analysis in two stages. First we use two cross-sectional observations (1985 and 1988) to establish whether concentration was an important determinant of protection in the pre-liberalization period. We then use a panel data-set to study the robustness of this relationship during the 'abertura comercial'. The panel 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 protection,[1] while concentration is measured by the *CR*4 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 remaining of the paper is organized as follows. Section 2 discusses the theoretical literature that links trade protection and industrial concentration, while Section 3 reviews the recent Brazilian trade liberalization episode and relates it to the structure of Brazilian manufacturing. Section 4 provides cross-sectional evidence for the relationship between industry structure and trade protection before the implementation of the 'abertura comercial' while in Section 5 we carry out our panel analysis. Section 6 concludes the paper.

2. Industry structure and lobbying

A large and distinguished literature has highlighted the link between the efforts of organized groups and trade policy outcome. The approach developed by Grossman and Helpman (1994) has been particularly successful thanks both to the elegance of the formal structure, as well as the substantial support it has found in empirical studies.[4] One limitation of the standard protection for sale framework is that it takes as exogenously given the identity of the sectors of the economy that are able to organize. In other words, no explicit formalization of the process through which interest groups manage to overcome the free rider problem is provided. An older literature, pioneered by Olson (1965), and formalized in the trade context by Rodrik (1986), has linked instead the formation of pressure groups to industry structure, even if then the process through which a particular sector obtains protection from the government remains very stylized.

The basic idea behind Rodrik's static model is that from the point of view of the firms in the import competing industry a tariff is a public good. As a result, the lobbying activity aimed at tariff seeking is likely to be underprovided from the point of view of the industry as a whole in a non-cooperative equilibrium. The problem becomes more serious, the larger

[1] We 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.

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

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

[4] US data have been used by Goldberg and Maggi (1999), Gawande and Bandyopadhyay (2000), Eicher and Osang (2002), while the model has been found to describe well the political economy of trade policy in Australia (?), as well as Turkey (Mitra, Thomakos, & Ulubasoglu, 2002).

the number of producers in the industry. In particular, under standard assumptions Rodrik is able to show that there is negative monotonic relationship between the number of firms active in a sector, the total amount of resources employed in the lobbying effort and the amount of protection received by the industry. At the same time, since production of the import competing good has become less profitable, the total output of that industry will also shrink as the number of firms in the sector increases.

In a closely related paper, Pecorino (1998) extends Rodrik's analysis modeling the tariff seeking behavior as a repeated game. In this setting, cooperation in the provision of the public good can be enforced through a simple trigger strategy, and some interesting new result emerge even if the tariff formation process continues to be modeled in a highly simplified fashion. For cooperation to be sustained in equilibrium, individuals should not discount the future too much. If they do, they will fall prey to the temptation of deviating in the current period, even if they know that a Nash reversal will be implemented in the future. The key parameter of the analysis becomes then the minimum discount factor needed to sustain cooperation, and to understand the effects of industrial structure on tariff protection, we need to study the effect of a change in the number of firms on this parameter. As it turns out, this relationship is ambiguous in sign. The basic intuition behind this result is as follows. On the one hand, the one period defection becomes more desirable with an increase in the number of firms in the industry because the tariffs under defection grows closer to the tariff under cooperation. On the other, as the number of firms increases the non-cooperative equilibrium becomes less attractive (as shown by Rodrik) and without an additional understanding of the tariff formation process, the ambiguity in the sign cannot be resolved.

In a recent paper Magee (2002) addresses exactly this issue. The basic structure of the economy is the same as in Rodrik (1986) and Pecorino (1998), while the interesting innovation is in the way the political process is modeled. While in the older literature the tariff formation process was described as a black box in which the tariff implemented was an increasing and concave function of the contributions paid to the government,[5] in this paper the pressure group and the government engage in a generalized Nash bargaining game to determine how the surplus associated to the introduction of the tariff has to be split between the parties. In this sense, the structure of the political interaction is very similar to the menu auction used by Grossman and Helpman (1994) in the protection for sale framework. As a result, Magee (2002) is able to provide a clear characterization of the conditions under which an increase in the number of firms makes cooperation more difficult to sustain. As Pecorino had already pointed out, there are two potentially offsetting effects of an increase in the number of firms. Key is to understand what happens to the non-cooperative equilibrium outcome when the number of firms increase. If the bargaining share accruing to the policy maker is large enough, firms will not contribute anything in the non-cooperative equilibrium, and of course this outcome will not be affected by an increase in the number of firms in the sector. In this way the ambiguity pointed out by Pecorino is then solved, and a decrease in the extent of concentration will make cooperation more difficult to sustain. Interestingly, Magee provides also an analogous characterization of the

[5] Or, more generally, of the effort spent in the lobbying activity.

relationship between the maximum sustainable tariff when cooperation is not complete and the industry structure. We use this characterization to guide our empirical analysis of the Brazilian experience.

3. Trade liberalization and protection dispersion

The trade liberalization episode experienced by Brazil between 1988 and 1994 represents a major policy modification, involving both a reduction in the tariffs level and in their dispersion and the elimination of non-tariff restrictions. Quantitative restrictions have been completely eliminated at the beginning of the process, and a time-table for tariff reductions was introduced, 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. On average, nominal tariffs in the manufacturing sector were in 1994 one quarter of the 1988 figures. If we consider 1985 as the base year, the decline was even more dramatic, with 1994 average tariffs being at only one tenth of the original level. As a consequence, the volume of Brazilian imports in the manufacturing sector in 1995 (FOB, in current dollars) was three times as big as in 1988. In specific industries, such as natural and synthetic fabrics, imports increased more than 10 times.

Table 1 presents the average nominal tariff for 16 sectors of the Brazilian manufacturing industry at a level that roughly corresponds to the US 2-digit SIC level of classification. In

Table 1
Average nominal tariffs

Industry	Year	
	1985	1997
Nonmetal mineral products	98.7	7.30
Metalworking	72.8	12.80
Machinery	62.1	13.90
Electronic and communication equipment	100.4	14.55
Transportation and motor vehicles	115.9	16.70
Paper and paper products	82.2	11.90
Rubber products	101.7	12.80
Chemicals	34.2	8.23
Pharmaceuticals	42.2	10.00
Perfumes, soap and candles	184.4	10.00
Plastic products	164.3	16.50
Textiles	161.6	15.80
Cloth, fabric production and footwear	192.2	19.60
Food	84.2	12.15
Beverages	183.3	14.50
Tobacco	204.7	9.00
Median	101.05	12.80
DP	56.01	3.40
Ratio maximum/minimum	5.99	2.68

Table 2
Nominal tariffs (1988–1994)

	Maximum	Median	Minimum	Coefficient of variation
1988	90.3	41.0	9.7	6.82
1989	85.0	33.6	5.1	9.06
1990	79.6	29.7	5.0	8.17
1991	70.0	21.0	3.0	8.19
1992	49.0	17.9	1.8	5.50
1993	34.0	12.8	1.7	2.49
1994	22.5	10.1	1.2	2.40

1985 the ratio between the maximum and the minimum nominal tariff was almost 6, but in 1997 it fell to 2.7, while the median tariff dropped to one tenth of the initial value. The standard deviation in 1985 was almost half the (non-weighted) average tariff while in 1997 it was close to one quarter, for a mean tariff 10 times smaller. The figures for the effective rate of protection (*ERP*) are even more revealing. In 1985 the *ERP* has been estimated to be 427% for the plastic product industry and negative for the tobacco and beverages industries. In addition, the standard deviation was of the same order of magnitude as the average *ERP* (about 100%). After liberalization, the average rate fell to less than 20% and the standard deviation to one third of this number.

A similar pattern can be observed from more disaggregate data. From data at a level that roughly corresponds to the 4-digit level SIC classification, we can observe that in 1988 the highest estimated effective rate of protection among the 46 sub-sectors for which data are available was 270% in the resins industry, while the smallest were, respectively, −0.7 and 16%, in the fertilizer and "basic steel products" industries. Likewise, in the same year the mean rate and the standard deviation were extremely high, around 70 and 60%, respectively. Six years later, the mean rate fell to 17% and the dispersion to 12.8%. The behavior of nominal tariffs during the liberalization period is displayed in Table 2.

Although the reduction of protection is a general phenomenon, it did not affect all sectors to the same extent. The decrease in tariffs is notably larger in less concentrated industries and well connected sectors were able to obtain advantages in the form of smaller reduction in overall protection. The strong political power of the automobiles, trucks and buses industry is reflected in the behavior of Anfavea, the official industry federation. Anfavea is in fact a powerful lobby and has been able to obtain a number of advantages in terms of the structure of the timetable for tariff reduction, as well as tax breaks and subsidies that sectors with less political muscle were not able to achieve.[6] At the same time, in the auto-parts sub-sector, tariffs dropped steadily and rapidly and as a result most Brazilian firms were either closed down or were sold to foreign companies. This, of course, benefited the final producer of motor vehicles even further. It is important to notice that concentration in the auto industry, as measured by the share of revenue obtained by the four largest firms in the sector, is two and half above the manufacturing industry median.

Another well known example is given by the toy industry. In this sector there is a dominant domestic player, Estrela, which was exposed by the initial liberalization to strong

[6] 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%.

competition from foreign (especially Chinese) producers. After intense political pressure, the sector has managed to obtain a special regime, with higher protection and a longer tariff reduction timetable. Furthermore, the reduction timetable has not been respected and even today tariffs in the toy industry are well above the manufacturing average. Other noteworthy cases are the poultry industry, the dairy industry, the vegetable oils (bulk) industry, among the many for which concentration was above (below) average in 1988, but trade protection did not fall as much as (fell more than) on the remaining industries.

In the case of Brazil trade liberalization involved also membership in the Mercosul preferential trading arrangement, and the negotiations that lead to the agreement are a very interesting example of the role of lobbying in shaping trade policy. From the notorious automotive and sugar cases, to the 175 exceptions negotiated by Brazil in the Ouro Prieto Protocol, the role of politically active pressure groups is even too apparent. Table 3 should make our point clearer. While the average common nominal tariff implemented by Mercosul was below 14%, the automobile sector managed to obtain a 49% tariff. Similarly, specific industries like 'refrigerators' or 'bicycles' managed to maintain tariff protection at levels that are more than twice the average. These are not infant industries—potentially deserving protection for a limited period of time. These are instead some of the more politically articulated sectors, some of them highly concentrated (e.g., automobiles, trucks, audio and video) and most of them with active associations or employers unions. It is not a secret that many of these players participated actively in the Mercosul negotiations, in some cases as observers during the talks (e.g., represented by industry federations at state or national level), and in many others as consultants and or via direct talks with government officials.

4. Concentration and protection: a cross sectional analysis

Using the dataset discussed in Macedo and Portugal (1995), we run a first basic set of regression to establish whether industrial concentration is positively correlated to tariff levels or to the estimated effective rate of protection before the *New Industrial Policy* was

Table 3
Some exceptions to the common Mercosul tariff

Sector	Mean nominal tariff
Fans	32
Heaters	29
Refrigerators	29
Utensils	30
Audio	31
Washing machines	29
Video projectors	32
Tractors	45
Automobiles	49
Trucks	45
Motorcycles	32
Bicycles	32
Bicycles parts	30

actually implemented by the Sarney administration. For this cross-sectional analysis, we have data on three different measures of industrial concentration: The share of the largest four firms in the sector total revenues (*CR*4), the share of the largest eight firms in the sector total revenues (*CR*8), and a Herfindhal index. We can also use two cross-sections: 1985 and 1988. Table 4 reports the concentration indexes for 1985.

Obviously, when we run cross section regressions on these rather aggregate data, we will have only a very limited number of degrees of freedom, and we should consider this analysis as purely indicative. The results can only hint at the sign and the size of the relationship between protection and industrial concentration. We have run a Hausman test to check for the potential endogeneity of our concentration measures, and since the result rejected this hypothesis, we have used ordinary least squares in all the specifications in this section. We have regressed 1985 and 1988 nominal tariff levels (*NT*85 and *NT*88) on our measures of concentration. In all regressions we have also controlled for the sector capital requirement (*RAK*, defined as the product of the mean size of the efficient plant and the sector capital intensity). All variables are in logs, and the results for nominal tariffs are reported in Table 5.

The results we obtain seem to favor the hypothesis that industrial concentration is positively correlated with protection. Not only the coefficients are statistically significant for all measures of concentration considered and for both years, but they are also economically important. A 100% difference in industry concentration implies tariffs 30–45% higher for the *CR*4 and *CR*8 indexes, and 20% for the Herfindhal index. Notice also that the R^2 is consistently above 70% if the dependent variable is *NT*88, i.e., our model performs very well in explaining the cross sectional distribution of trade protection at the beginning of the liberalization process.

When we run the same regressions using the effective rate of protection as the dependent variable, the results seem to be less robust. There is no substantial difference in the relationship between concentration and protection if we use the 1988 series for nominal tariffs

Table 4
Concentration indexes (1985)

Sector	*CR*4	*CR*8	*H*
Nonmetal mineral products	0.128	0.188	0.009
Metalworking	0.200	0.278	0.015
Machinery	0.103	0.161	0.006
Electronic and communication equipment	0.156	0.228	0.012
Transportation and motor vehicle	0.425	0.54	0.055
Paper and paper products	0.170	0.274	0.015
Rubber products	0.606	0.661	0.116
Chemicals	0.458	0.498	0.168
Pharmaceuticals	0.180	0.285	0.019
Perfumes, soap and candles	0.490	0.642	0.115
Plastic products	0.155	0.210	0.010
Textiles	0.088	0.134	0.005
Cloth, fabric products and footwear	0.009	0.136	0.005
Food	0.071	0.120	0.004
Beverages	0.245	0.339	0.025
Tobacco	0.686	0.831	0.277

Table 5
Cross-sectional analysis, nominal tariffs

Dependent variable	*CR*4	*CR*8	*H*	*RAK*	R^2
*NT*85	0.44(2.67)			−0.42 (−4.19)	0.57
*NT*88	0.30(3.78)			−0.29 (6.08)	0.74
*NT*85		0.46(2.38)		−0.40 (−3.98)	0.54
*NT*88		0.32(3.45)		−0.28 (5.70)	0.72
*NT*85			0.22(2.43)	−0.43 (−3.99)	0.55
*NT*88			0.15(3.23)	−0.30 (5.49)	0.70

or for the *ERP*. The estimated coefficients of the concentration indexes used are always positive and significant, and the magnitudes are very similar to the figures we have reported in Table 5, although the R^2 is smaller (around 0.5). When we instead evaluate this relationship using as dependent variable the *ERP* in 1985, the estimated coefficients are significant (at the 10% level) only when *CR*4 is used. If concentration is instead measured using the *CR*8 or Herfindhal indexes, the estimates are not significant. This seems to indicate that the link between industrial structure and protection in the pre-liberalization period is more robust when we look only at final goods rather than taking into account the entire value chain.

5. Concentration and protection: a panel analysis

To further test the relationship between industrial structure and protection, we have constructed a panel data-set using two different sources. We obtained figures for nominal tariffs and effective rates of protection for the period 1988 to 1994 from Kume (1996). They originally included 56 sub-sectors, but eight of these were either agricultural or mining sectors and for this reason have been eliminated. Moreover, gasoline and oil are public monopolies and this has lead to their exclusion from our sample. The median nominal tariff of the 45 remaining industries went from 41% in 1988 to 11% in 1994.[7] In 1988 the lowest tariff was applied to 'fertilizers' (14%) while the highest to 'other textile products' (80%). In 1994 the less protected sector was instead 'artificial textile fibers' (with a tariff of 2.26%), while the most protected one was 'processed milk' (30%). The behavior of the effective rate of protection is similar: its median declined from 52.65% in 1988 to 15.29% in 1994.

Data for industrial concentration, measured using the share of the sector revenue appropriated by the four largest firms (*CR*4 index), cover instead 51 industries for the period 1986–1995. Apart from the difference in the number of cross-section and time series observations, the two data sources differ sometimes in the sectors included, in the aggregation level, and even in the definition of sectors. As a consequence, in our benchmark analysis the number of cross-section observations has been reduced to 21, which are the number of exact matches among industries in the two data bases. These industries represent 46% of the total value added in manufacturing. Later we will also perform robustness checks using a larger database, where matches are not as precise, but that allows us to consider

[7] The figures for the entire sample are 35.6% in 1988 and 10.07% in 1994.

Table 6
NT regressions (fixed-effect method, lag concentration)

Model	Independent variable			
	*CR*4 (−1)	*CR*4 (−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.

42 industries, representing more than 80% of the total value added in manufacturing. In addition to concentration, we have data on the capital–output ratio (*KY*), on total machine and equipment purchased as a proportion of revenues (*MP*), investment–output ratio (*INV*) and also a profitability measure (*J*).[8] These series were constructed from the "Pesquisa Industrial Anual" (Annual Industry Survey, IBGE), and some were obtained from Geraldino da Silva (1999).

Our basic dataset consists, therefore, of a panel of 21 industries for 7 years (from 1988 to 1994). In all our regressions we include industry fixed effects. This allows us to capture time invariant industry characteristics that might potentially have an effect on concentration and that might otherwise confound the interpretation of our results, making them for instance compatible with an infant industry argument. Furthermore, we validate our approach using a Hausmann specification test. When nominal tariffs were used as the dependent variable the results favored the fixed-effects method, which we, therefore, used in all regressions. When the effective rate of protection was used the results were ambiguous and depended upon the control variables included in the regression and the time period of the sample. For the sake of comparison, only the estimations that used the fixed-effect method will be presented.

We used the following equation in all our specifications:

$$T_{it} = \beta_i + \phi Z_{it} + \varepsilon_{it}, \quad i = 1, \ldots, 21, \quad t = 1988, \ldots, 1994$$

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.

In order to benefit from the time structure of our dataset we initially used (1 or 2 years) lagged *CR*4. Given that in the theoretical literature causation goes from concentration to tariff, we found it natural to use a predetermined concentration index. Moreover, 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. All variables used are in logs, with the exception of the time trend. Table 6 presents the results for our first set of regressions. As we can see, we find strong support for the hypothesis that industry concentration impacts nominal tariffs, as the estimated coefficient of *CR*4 is positive and

[8] The variable *J* is defined as the cost of products and services bought by the sector divided by its net revenue. *KY* is the ratio between fixed assets and net revenue.

Table 7
ERP regressions (fixed-effect method, lag concentration)

Model	Independent variable			
	*CR*4 (−1)	*CR*4 (−2)	*KY*	Trend
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.

statistically significant at the 5% level in all regressions. Moreover, the estimated impact is large: for a given capital–output ratio, a difference of 20% in *CR*4 between industries implies 5 and 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 our sample, the median tariff felt from 41.5 to 10.6%. But this decrease was not uniform across industries, as the 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 period.[9]

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 *CR*4 did not change considerably and remained always significant. In Table 6 we report the coefficients for the capital output ratio, since this control has often been used in the literature. As in Trefler (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.[10]

Table 7 presents the outcome of the regressions in which we use our alternative measure of protection, the effective rate of protection (*ERP*). The results are similar to those for nominal tariffs, although the estimated coefficients of *CR*4 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

[9] Note that 20% annual reductions of the 1988 mean tariff (45.9%) for 7 consecutive years almost matched the 1994 observed average tariff. The latter is 10.5% and the former 9.5%.

[10] Trefler (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 8
NT regressions (fixed-effects method)

Method	Independent variable		
	*CR*4	*KY*	Trend
OLS	0.13 (0.22)		−0.22 (−26.96)
OLS	0.19 (2.22)	−0.14 (−4.22)	−0.20 (−21.13)
2SLS	−0.02 (−0.18)		−0.18 (26.94)
2SLS	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.

of *INV*, *MP*, *J* in several regressions and the estimated coefficient of *CR*4, trend and *KY* did not change considerably and always remained significant. The results in Table 7 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 2–5% 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 process.[11]

We now turn to regressions with contemporary *CR*4. 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 *CR*4 but not with *NT* and *ERP*.[12] Again, the results are ambiguous. 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 8.

Concentration has the same effect on trade policy as in Table 6, 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, *CR*4 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,

[11] Thus, generalizing the stylized facts we discussed for the case of the automobile industry.

[12] The test consists of two OLS regressions. In the first, *CR*4 is regressed on all exogenous variables (here *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 0. If this is the case, then the OLS estimates are consistent.

Table 9
Extended data-set (fixed-effect method)

Dependent	Independent variable			
	*CR*4 (−l)	*CR*4 (−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.

as it has been found already in many other studies (Baldwin, 1985; Goldberg & Maggi, 1999). Results for the effective rate of protection are similar. Exploiting the time dimension of our panel we are instead able to highlight how *past* concentration plays an important role in determining current protection.

Finally, 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 9. The estimated elasticity of the *NT* or *ERP* with respect to our concentration measures (*CR*4 (−1) and *CR*4 (−2)) as in the original data-set, is always positive and significant. Moreover, the point estimates for *CR*4 (−2) are in general considerably higher than in Tables 6 and 7, and the present estimations imply that that a sector twice as concentrated as another would have nominal tariffs 40–30% 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.

6. 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 to understand the link between trade policy and industrial structure.

Acknowledgments

Some of the ideas of this paper were fostered during conversations with Boyan Jovanovic, to whom we wish special thanks. We gratefully acknowledge the comments of Werner Baer, Andrew Horowitz, Joao Issler, Leonardo Rezende and Cecilia Testa, and seminar audiences at Torquato di Tella, Lacea Conference in Rio de Janeiro, USP, IPEA, University of Southern Illinois and the Hewlett Foundation Brazilia meeting. Many thanks to Honorio Kume and Gilson Geraldino da Silva from some of the data used, and CNPq, PRONEX (Ferreira) and the Hewlett Foundation (Facchini) for financial support.

References

Baldwin, R. (1985). *The political economy of US import policy*. Cambridge, MA: MIT Press.

Davidson, R., & MacKinnon, J. G. (1993). *Estimation and inference in econometrics*. New York: Oxford University Press.

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

Ferreira, P. C., & Rossi, J. L. (2003). New evidence from Brazil on trade liberalization and productivity growth. *International Economic Review*, *44*, 1383–1405.

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

Gawande, K., Sanguinetti, P., & Bohara, A. K. (2004). Trade diversion and declining tariffs: Evidence from mercosur. *Journal of International Economics*, *64*, 65–88.

Geraldino da Silva, G. (1999). *Estrutura de mercado e desempenho: Evidencias empiricas para setores industriais brasileiros a partir de dados em painel*. mimeo, CEDEPLAR.

Goldberg, P. K., & Maggi, G. (1999). Protection for sale: An empirical investigation. *American Economic Review*, *89*(5), 1135–1155.

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

Hay, D. A. (2001). The post-1990 Brazilian trade liberalization and the performance of large manufactuiring firms: Productivity, market share and profits. *Economic Journal*, *111*, 620–641.

Helfand, S. M. (2000). Interest groups and economic policy: Explaining the pattern of protection in the Brazilian agricultural sector. *Contemporary Economic Policy*, *18*, 462–476.

Kume, H. (1996). A política de importação no plano real e a estrutura de proteção efetiva. Texto para Discussão 423, IPEA.

Macedo, P., & Portugal, S. (1995). Estrutura de mercado e desempenho na industria brasileira. *Rivista Brasileira de Economia*, *49*, 685–696.

Magee, C. (2002). Endogenous trade policy and lobby formation. *Journal of International Economics*, *57*, 449–471.

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

Muendler, M.-A. (2002). *Trade, technology and productivity: A study of Brazilian manufacturers, 1986–1998*. mimeo, University of California, Berkeley.

Olarreaga, M., & Soloaga, I. (1998). Endogenous tariff formation: The case of Mercosur. *World Bank Economic Review*, *12*, 297–320.

Olson, M. (1965). *The logic of collective action*. Harvard University Press.

Pecorino, P. (1998). Is there a free-rider problem in lobbying? Endogenous tariffs, trigger strategies and the number of firms. *American Economic Review*, *88*, 652–660.

Rodrik, D. (1986). Tariffs, subsidies and welfare with endogenous policy. *Journal of International Economics*, *21*, 285–299.

Rodrik, D. (1995). Political economy of trade policy. In G. M. Grossman & K. Rogoff (Eds.), *Handbook of international economics* (Vol. 3, pp. 1457–1494). Amsterdam and New York: North Holland.

Trefler, D. (1993). Trade liberalization and the theory of endogenous protection: an econometric study of U.S. import policy. *Journal of Political Economy, 101*, 138–160.