

# A Comprehensive Empirical Analysis of Trade Policy in a Small Country with Monopolistic Competition\*

Carlos A. Cinquetti<sup>†</sup>(Sao Paulo State University)

Keith E. Maskus (University of Colorado)

Ricardo G. Silva (Votorantim Bank - Department of Credit Risk)

## Abstract

A comparative advantages model with monopolistic competition is proposed to perform a comprehensive analysis of the effects of protectionism on competition, economies of scale and resource allocation, plus a non-cost competition term. Evidence is based on Brazil's period of import substitution industrialization. The foreign economy is a set of (integrated) developed countries, which both improves the accuracy of the comparative advantage calculations and raises access to data for the computations of fixed costs. Only the period under protection is considered, so that the comparative statics, aimed to corroborate the above policy effects, are drawn on within-period counterfactuals.

*JEL:* F12 F13 F14.

---

\*For comments and suggestions on older versions, we also thank, with the usual disclaimers, Scott Bradford, Daniel Bernhofen, Aquiles Kalatzis, J. Bento Ferreira Filho, Carlos Martins-Filho, and participants at the following conferences and seminars: the VIII JOLATE/Workshop in Mathematical Economics, the EcoMod 2008, the Lacea-Lames 2008 meeting, the Eastern Economic Association 2010, and the University of Colorado Department of Economics. Financial support from CAPES, CNPq, and Fapesp are gratefully acknowledged.

<sup>†</sup>Corresponding author address: UNESP - Dep. Economics Araraquara, SP 14800-901. Brazil. Phone/Fax: 55 16 3301-6214/6258. E-mail: cinquett@fclar.unesp.br

# 1 Introduction

We attempt a comprehensive industry-level analysis of trade-policy effects under imperfect competition, building on the efficiency basis of comparative advantages (Deardorff, 1980). Evidence is based on Brazil's period of import-substitution industrialization (ISI) from the late 1960s to the late 1980s, which offers a rich experience for studying this subject.

Since bilateral trade is affected by specific trade costs, the foreign economy was expanded to a set of developed countries taken as an integrated economy, which further assures a more reliable index of Brazil's revealed comparative advantage. True, this three-country (with rest of the world) framework renders meaningless the geographic basis of trade, but it makes ampler room to comparative advantages.

As known, imperfect competition and trade-policy barriers not only weaken, but can even invert the comparative-advantage linkages, as given by the negative N-industry correlation between net exports and countries' characteristics. To avoid one such a conclusion grounded on misleading statistical procedures we expanded both (i) the foreign economy, thus reaching the above *RCA*, and (ii) the period, to the entire ISI period. This long-time span also enables us to refrain from disputable statistics experiments with the ensuing trade-openness period, which was largely affected by simultaneous non-trade related reforms in Brazil's case. Our comparative-static exercises are, instead, based on counterfactuals that also allow simultaneously addressing some related development issues over that ISI period.

In theory, imperfect competition and trade-policy barriers can weaken and even invert comparative-advantage linkages, as given by the negative N-industry correlation between net exports (or *RCA*) and countries' characteristics (Deardorff, 1979, 1980). To avoid drawing conclusions based on misleading statistical inferences, we both use our integrated foreign economy, permitting calculation of the above *RCA*, and expand the period to the entire ISI era. This long time span also enables us to refrain from disputable statistics experiments with the ensuing trade-openness period, which was also largely affected by simultaneous non-trade related reforms in Brazil's case.<sup>1</sup> Our comparative-

---

<sup>1</sup>The isolation of trade policy can be quite difficult, as witnessed in Tyler and Gurgel (2008).

static exercises are, instead, based on within-sample counterfactuals that also allow simultaneously addressing some related development issues over that ISI period.

At the same time, using the pre-1980 years greatly reduced the availability of internationally comparable data. The number of total employees, for instance, is the only direct marginal-cost information available for the seven included countries. This prompted us to develop a latent opportunity-cost variable, based on the impact of unobserved differences in factor proportions. Additionally, given that Brazil's wide-ranging protectionism cannot be adequately characterized by either nominal tariffs or the effective rate of protection (ERP), we attempt a counterfactual based on a more accurate (than RCA) trade-performance measure: the revealed comparative efficiency in manufacturing RCEM. This provides more conclusive evidence about the trade-policy effect on allocative-efficiency.

Entailed in the RCA index is the possibility, grounded on monopolistic competition, of exporting from sectors without comparative advantages. Monopolistic competition further back up a non-price competition argument through product differentiation, which is empirically captured with those international markets with the greatest demand expansion.

The spatial monopolistic competition model (Lancaster, 1984; Schmitt, 1990) grants the existence of both the scale (productive efficiency) and the market-power effects from trade policy.<sup>2</sup> The former is related to inefficient entry that affects firm size (Horstmann and Markusen, 1986), whereas the latter, also called the pro-competitive effect of trade, is the industry-size outcome of protection (Markusen, 1981; Lancaster, 1984). Unlike previous empirical studies of these scale and market-power effects (Harrison, 1994; Tybout et al, 1991; Feenstra, 2003; Head and Ries, 1999), which are partial-equilibrium developments based on the production function, ours is a general equilibrium development based on the transformation function.

To reinforce the identification of non-observable fixed costs we work with both corporate and plant costs. The former is proxied with a factor-intensity variable and the latter with a composite measure of average firm size and inputs of production (operative) workers. This composite variable provides a more reliable evidence of variation in economies of scale due to variation in firm size. Ac-

---

<sup>2</sup>This approach may be contrasted with the comprehensive theoretical analysis of international trade on economic performance by Melitz and Ottaviano (2008), which rests on a Chamberlinian quasi-linear utility

tually, this comprehensive variable of economies of scale, together with the controls of both marginal cost and corporate fixed costs, respond to a concern in the literature (Tybout, 1993) (Tybout, 1993) on identifying whether the measured productive-efficiency effect stems from changes in firm size or from something else.

The integrated foreign economy is crucial for assessing these fixed costs, since relevant data not available for all developed countries was drawn from the United States alone. However, the pro-competitive effect is proxied by the effective rate of protection (ERP), whose association with the wedges between prices and marginal cost is reinforced by further statistics experiments.

Three policy effects are then examined: on allocative efficiency, productive efficiency (scale), and competition intensity (pricing). The non-price component has no definite relationship with policy, nor with the varieties effect in consumer welfare (Arkolakis et al, 2008). We stress an empirical complementarity that aids in identification: marginal costs help single out the pricing and fixed cost terms, while the latter reduce the risk of spurious comparative-advantages linkages from trade policy. On the same ground, our general-equilibrium empirical framework helps compensate for the inferior technological accuracy of an industry-level analysis, especially for assessing some distortions that are not specific to firms.<sup>3</sup>

In fact, the statistics results of both the exploratory analysis and regression estimates suggest that all of these forms of economic inefficiency are in the data. This shows that Brazil's ISI regime not only engendered extreme allocative inefficiency, as found in Tyler (1985), but also established welfare losses from both higher average costs and higher market power.

The paper is structured as follows. The models are worked out in Section 2, followed by a description of the empirical variables in Section 3. In Section 4, an exploratory statistical analysis briefly describes Brazil's experience, while Section 5 presents the basic regression results, and Section 6 takes up further statistical experiments. Conclusions follow.

---

<sup>3</sup>Bernard et al (2003, p. 1271-72) assert "how little industry explains about exporting and productivity", but their Table 2 shows that, conditional on industry, differences in exporters' productivity fall from 33% to 11%.

## 2 Theory and Empirical Specification

We start with the closed-economy, focusing on both market conduct and the temporal change in industry sizes, and eventually shift to the international-economy model, focusing on relative export sizes, as initially given by both comparative costs and distorted prices, and subsequently by inefficient firm entry.

### 2.1 Industry Size in Autarky

Consider an economy having a competitive sector,  $y$ , produced with unskilled labor, and  $N$  manufacturing industries  $X_i$ , each producing horizontally differentiated varieties with unskilled and skilled labor under internal increasing returns to scale. Consumers are heterogeneous in their preferences to varieties, as described by this upper-level utility function:

$$U(y, x, d) = y^{1-\xi} \prod_{i=1}^N x_i^{\xi_i}, \quad \xi = \sum_{i=1}^N \xi_i < 1, \quad (1)$$

where  $\xi_i$  is the Cobb-Douglas expenditure share on variety  $i$  and  $x'_{mi} = x_{mi}/h(d_i)$  is the quality-adjusted quantity each consumer attains from the most preferred variety,  $x_{mi}$ , given a distance  $d_{mi}$  from her *ideal variety* (Lancaster, 1979, 1984). The compensating function,  $h(d_i) \geq 1$ , following Lancaster (1979, 1984), defines the above quality-adjusted amount. The quality space is in a unit circle, where the  $n_i$  firms are symmetrically spaced, so that  $d_{mi} = d_i = 1/n_i$ , and the heterogeneous consumers are uniformly distributed. Aggregating those for whom  $p_{mi}h(d_{mi})$  is minimized one reaches firm's clientele, whose price-elasticity  $\sigma_i(n_i)$  is fully determined by the number of firms<sup>4</sup>.

Given (1), the aggregate demand for each manufactured product  $i$ , after accounting for the symmetric (in price and size of firms) zero-profit equilibrium, will be

$$X_i = S_i \left( \frac{1}{\theta_i c_i} \right), \quad i = 1, \dots, N, \quad (2)$$

where  $S_i = \xi_i Y$  is the size of industry  $i$ , irrespective of prices, and  $Y$  is the available income of

<sup>4</sup>As remarked by Helpman and Krugman (1985, 6.3) and demonstrated by Cinquetti and Balistreri (2010) in a fully specified model, using  $h(d)$  as in Lancaster (1984). Other developments of this approach into trade theory are Schmitt (1990) and Vogel (2008), with heterogeneous firms and non-local competition.

the economy. The denominator within brackets is the optimum price (relatively to the numeraire  $y$ ): marginal cost,  $c_i$ , times the markup  $\theta_i = [1 - 1/\sigma_i(n_i)]^{-1}$ , where  $n_i$  stands for the number of  $i$ -goods varieties.

Normalizing (2) by  $Y_t$ , yields:

$$x_i = \xi_i [\theta_i(\mathbf{w}\mathbf{a}_i(\mathbf{w}))]^{-1}, \quad (3)$$

where  $x_i = X_i/X$  is the relative sales of manufacturing industry  $i$  and  $w$  and  $a_i$  are, respectively, the factor-price and factor-input vectors in marginal cost.

To cast (3) in a time dimension, we add subscript  $t$  to each variable and substitute  $\xi_i$  by  $\eta_{it} = d \log \xi_{it} / d \log Y_t$ , yielding:

$$x_{it} = \eta_{it} [\theta_{it}(\mathbf{w}_t \mathbf{a}_{it}(\mathbf{w}_t))]^{-1}. \quad (4)$$

As suggested, the  $\eta_{it}$  comes from temporal changes in consumer preferences to products.

## 2.2 Export Size

Partitioning the economy into several non-symmetric countries that are integrated only by international trade, without geographic barriers, then the share of each country  $k$  in the world market of  $i$ ,  $x_i^k$ , can be drawn from (4), adjusting its arguments to countries' characteristics.

For instance, marginal cost shifts to  $\mathbf{w}_t^k \mathbf{a}_{it}^k(\mathbf{w}_t^k)$ . But, having only total employees and its prices as evidence of marginal costs, how can we further characterize this component of opportunity costs in each country? The Rybczynski theorem provides the clue. That is, controlling for fixed-input requirement in a sector  $i$ ,  $\bar{v}_i$ , the relationship between a positive factor-endowment change in  $v_l$  and the relative output change in a small country is:

$$\hat{x}_i = Z \hat{v}_l > 0, \quad \hat{x}_j = Z' \hat{v}_l < 0, \quad (5)$$

Where  $x_i$  and  $x_j$  are sectors intensive and not intensive in  $v_l$ , respectively, whereas  $Z$  and  $Z'$  are technological parameters. Hence, the vector of tradable-sector output in each country has a definite relationship with its factor endowment as compared to the world economy, which can be referred to

their distinct opportunity cost for a given industry's relative size (Feenstra, 2003, ch.1). Therefore, if  $v/v^*$  is the ratio of factor endowment of home and foreign countries, its relationship with the vector of relative exports,  $x^T/x^{T^*}$ , can be indirectly conveyed by the following correlation with the vector of relative output,  $x/x^*$ :

$$\text{corr}[(x_i^T/x_i^{T^*}), x_i(v)/x_i^*(v^*)] = \gamma, \quad \gamma > 0. \quad (6)$$

$\gamma$ , which is controlled for fixed costs, indirectly conveys the efficiency relationship Deardorff (1980) between comparative exports and factor proportions - home's comparative marginal cost.  $n$  factors abundant in country  $k$ , then  $k$  tends to have higher share in the world output (and exports) of  $i$  (Harrigan, 1997)<sup>5</sup>,

In the separable unit-cost function, plant and corporate fixed costs,  $G_i(y_i)$  and  $F_i(y_i)$ , are given by fixed technical coefficients (see Markusen and Venables, 2000):

$$c_i(w^k, y_i) = a_i^k(w^k)w^k + (G_i/y_i)w^k + (F_i/y_i)w_s^k, \quad (7)$$

where  $y_i$  are firms output in industry  $i$ , whereas  $w^k$  and  $w_s^k$  are the prices of unskilled and skilled labor respectively. Technology designs servicing various plants are mainly used as technology transfer in a developing country,  $F_i^h < F_i$ , meaning lower technical coefficients than the same industry in a developed country, because they have a different content as well.

As explained below, both marginal cost variables capture somewhat part of the effect of price distortions stemming from trade-policy barriers, assumed to act upon the product markets alone. If that is so and home is a small country, then a isolated variable for trade policy (import tariffs and subsidies),  $T_i^k$ , can be exclusively related to positive profits in the form of trade-policy revenues. This makes  $\theta_i^k(T_i^k)$  higher than the measure of economies of scale,  $\psi_i$ , that is:

$$\theta_i(T_i) = \left(1 - \frac{1}{\sigma_i(n_i^T)}\right)^{-1} > \frac{c_i(w, y_i)}{c_{iy}(y_i, w)} = \psi \quad (8)$$

where  $c_{iy}(y_i, w)$  stands for marginal cost and  $n_i^T$  for the number of firms with (protected) trade.

<sup>5</sup>In our two-country analysis, for which countries' endowment are of little statistical use, evidence of technology difference is directly provided by the industries' marginal costs in each country, whereas in Harrigan (1997) comes from his total factor productivity.

These higher markup permitted by trade barriers (or subsidies) express the pro-competitive effect from trade-policy barriers (Markusen, 1981).

We must then substitute (5)-(8) into (4), defined by each country's world supply (exports),  $x_{it}^T$  and  $x_{it}^{T*}$ , representing their relative exports to the rest of the world, which thus introduces ROW as a third country. In such an international context,  $S_{it}$  (and  $S_{it}^*$ ) must be replaced by its international size:  $S_{it} = \delta_i(Y_t^w)Y_t^{w(\eta_{it})}$ , where  $\delta_i$  stands for the home economy's share in the world sales of  $i$  (there is a similar share for foreign) and  $Y^w$  for the world income. Lastly, the transformed (4) is rewritten as comparative exports and then linearized into the following stochastic form:

$$x_{it}^T/x_{it}^{T*} = \alpha_i + (\delta - \delta^*)\eta_{it} - \beta_2 \left( \frac{w_t a_{it}}{w_t^* a_{it}^*} \right) + \beta_3 \left( \frac{Y_{it}}{Y_{it}^*} \right) - \beta_4 \tilde{G}_{it} - \beta_5 \tilde{F}_{it} - \beta_6 T_{it} + \mu_{it}, \quad (9)$$

where  $\alpha_i$  stands for unmeasured industry-specific characteristics,  $\mu_{it}$  for the random error, and the subscript of  $\delta$  were dropped since coefficients are mean values.

We thus have a comparative cost and pricing model, where  $\beta_1 = (\delta - \delta^*)$ , expressing the relative increase in home's exports as world preferences change over time (ranked as the most internationally expansive industries), stands for a non-price competition term. It just takes relating those preferences to differentiated products to eventually reach an international product-differentiation race<sup>6</sup>. Should  $\eta_{it}$  be proportional to skilled-labor intensive activities, which is relative scarce in home, then  $\beta_1 > 0$  also stands for a technology *catch up* (see Currie et al., 1999).

The coefficient  $\beta_2$  captures the marginal comparative cost advantages and should be negative, while  $\beta_3$  captures the latent opportunity cost attempted in (14) and should be positive. Price distortions weaken these linkages, but a definite identification of such allocative effect is postponed to Section 6. Next, the fixed-cost  $G_{it}(= G_{it}w^k/y_{it})$  and  $F_{it}(= F_{it}w_s^k/y_{it})$  are affected by both factor

<sup>6</sup>Suppose firms are identical in size,  $z$ , so  $X_i^k = n_i^k z_i$ , where  $k$  refers to either home or foreign. we can then rearrange  $X_i^k = \delta_i^k \xi_i Y^w / \theta_i^k \mathbf{w} \mathbf{a}_i^k = \delta_i^k \xi_i Y^w / p_i^k$  to

$$\delta_i^k = p_i^k n_i^k z_i (\xi_i Y^w)^{-1},$$

making clear the association between  $\delta_i^k$  and  $n_i^k$ , once  $p_i^k$  has already been accounted for. Consider now the international form of the normalized temporal equation (4):

$$x_{it}^k = \delta_i^k \eta_{it} (p_i^k)^{-1}.$$

If the inter-period changes in varieties are internationally uneven (e.g., Grossman and Helpman, 1991, ch. 9), then  $\dot{n}_i \geq \dot{n}_i^* \Rightarrow \delta_i^k(\eta_{it})$ , and so  $\delta - \delta^* \leq 0$  reflects countries' relative positions in this non-price competition.



proportion (or prices) and a certain home-market effect, though their empirical form is such, as explained below, to measure only cross-industry differences. Lastly, the more adverse is the impact of  $T$  on price and thus on trade performance, the lower is  $\beta_6$ .

### 2.3 Protection and Productive Efficiency

By inducing inefficient firm entry, protection can also affect the righthand side of (8), raising average cost  $c_i(w, y)$  and thus push (8) toward the equality. This firm-size scale effect (Horstmann and Markusen, 1986) must then be singled out from the above pro-competitive effect. Unlike Markusen and Venables (1988), the symmetric distribution of firms across regional markets, under spatial monopolistic competition, prevents that this effect be limited to subsidies (see Schmitt, 1990; Lancaster, 1984)<sup>7</sup>.

Given the myriad of trade-policy instruments (*e.g.*, export subsidies, quotas, and domestic content requirements) in Brazil, similarly to most developing countries in the period we study (Santos-Paulino, 2002), one refers this additional policy effect to unobservable,  $\bar{T}$ . Therefore,  $T$  would be only proxying the effects of diminished competition.

Plant fixed cost,  $G_{it}$ , is the natural index of economies of scale, since its technology coefficient does not change internationally, unlike  $F_{it}$ . Using the separability in factor content in (7), the whole imperfectly trade-policy effect on each  $G_i$  and  $\theta_i$  can be thus decomposed:

$$\Theta_i(T, \bar{T}) = \delta \cdot G_i / x_i [n_i(\bar{T}_i)] + (1 - \delta) \cdot \sigma [N_i(T_i)], \quad \delta \in (0, 1), \quad (10)$$

where  $N_i = n_i + n_i^*$  stands for the numbers of firms (varieties) in  $i$ . Under the hypothesis of free entry, the economies of scale (or average costs) effect upon  $G_{it}$  is adjusted by number of local firms,  $n_i$ , given unobserved instruments,  $\bar{T}_i$ , whereas market power,  $\sigma_i$ , adjusts to the number of varieties in the market,  $N_i$ , given  $T_i$  that would, as a derived variable (Schmalensee, 1989), directly expressed such effect.

We test  $\bar{T}$  with an intrinsic variable (Schmalensee, 1989), replacing the internationally equal  $G_i$

---

<sup>7</sup>Similar reasons are multinational firms, with regional plants, and that domestic sales represented 85%, at least, in most Brazilian manufacturing industries at that time.

by the local  $G_i^n$ , which transforms (9) to:

$$x_{it}^T/x_{it}^{T*} = \alpha'_i + (\delta - \delta^*)'\eta_{it} - \beta'_2 \left( \frac{w_t a_{it}}{w_t^* a_{it}^*} \right) + \beta'_3 \left( \frac{Y_{it}}{Y_{it}^*} \right) - \beta'_4 G_{it}^n - \beta'_5 F_{it} - \beta'_6 T_{it} + \varepsilon_{it}. \quad (11)$$

In this counterfactual to (9), the inefficient entry, causing  $G_{it}^n > G_{it}$ , is identified by the weakening linkage of fixed-plant cost with  $RCA$ . More to the point, using the true, local-adjusted fixed cost, causes  $\beta'_4 > \beta_4$ . Since the comparative cost relationship does not rely on autarky prices, the non-homothetic cost function (7) does not affect the entailed productive-efficiency effect. Yet, we make an exploratory analysis about  $G_{it}^n > G_{it}$  to identify if they are really related with firm size.

### 3 Variables and Data

To discuss the empirical specification, let us transform (9) and (11) to a nominal form:

$$\begin{aligned} RCA_{it} = & \alpha_i + \beta_1 WYEL_{it} - \beta_2 CPCOST_{it} + \beta_3 SIZE_{it} - \beta_4 PLANT_{it} - \beta_5 CORPO_{it} \\ & - \beta_6 FPROT_{it} + \epsilon_{it}, \quad i = 1, \dots, 20 \quad \text{and} \quad t = 1, \dots, 4 \end{aligned} \quad (12)$$

where  $RCA_{it}$  (revealed comparative advantages) =  $x_{it}/x_{it}^*$ ,  $WYEL_{it} = \eta_{it}$ ,  $CPCOST_{it} = (w_t a_{it})/(w_t^* a_{it}^*)$ ,  $SIZE_{it} = y_{it}/y_{it}^*$ ,  $PLANT_{it} = G_{it}$ ,  $CORPO_{it} = F_{it}$  and  $FPROT_{it} = T_{it}$ . Alternative to  $CPCOST$  is  $CPROD = (a/a^*)$  and to  $PLANT$  is  $PLANTBR = G^n$ . The three-digits twenty manufacturing industries – with some adjustments to available data – are described below, while the four years are 1967, 1973, 1980, and 1987-88 (average, due to the extreme disturbances of these two years), with slight deviations for some variables. Pre-1980 years made the dearth of international compatible data more stringent, the sources of which are described in the Data Appendix.

The then six largest industrialized economies (USA, Japan, Germany, UK, France, and Italy) make up the foreign economy, which assures less-biased  $RCA_{it}$  and comparative costs than one built on a single developed country, given their large differences in size and factor endowments<sup>8</sup>. Hence, in the  $RCA$ ,  $x_{it}^* = \sum_{it} (X_{it}^j / X_t^j)$ ,  $X_{it}^j$  stands for the  $j$ th foreign country's exports of  $i$  and  $X_t^j$  for its

<sup>8</sup>This multi-country aggregation is an alternative to the multiple regressions made by Golub and Hsieh (2000).

total manufactured exports at  $t$ .

Variation in  $i$ 's world-market demand,  $WYEL_{it}$ , is given by:

$$\eta_{it} = \frac{X_{it}^w / X_{i,t-1}^w}{Y_t^w / Y_{t-1}^w},$$

where  $X_i^w$  is the world's exports of  $i$ ,  $Y_t^w = \sum_i X_t^w$  the world total exports of all products (i.e., not only manufactured), the  $t - 1$  obliges us to take 1963 data.  $Y_t^w$  can be thought as proxying the world output (income) of tradable-goods sectors.

Marginal and fixed costs, which are not directly observable – as most inter-industry studies (Bersnahan, 1989) – are taken as distinct components of total labor input. Accordingly, marginal comparative labor costs is given by:

$$CPCOST_{it} = \frac{a_{it}w_t}{a_{it}^*w_{it}^*} = \frac{(l_{it}/y_{it}) \cdot w_t}{\left(\sum_j l_{it}^j / \sum_j y_{it}^j\right) \cdot w_{it}^*},$$

where  $l/y$  stands for “total employees/value added”, and  $w$  and  $w^*$  are the manufacturing wages in constant US dollars of Brazil and foreign. A pure productive measure,  $CPROD_{it}$ , is obtained by dropping  $w_t/w_{it}^*$ . The social opportunity cost,  $SIZE_{it} = y_{it}/y_{it}^*$ , makes room for some cross-time scale (or home-market) effects.

Corporate fixed cost is proxied by the ratio “office labor/total employees”, whereas plant fixed cost by two proxies of economies of scale: operative labor input and average firm size. Previous studies (Brainard, 1997; Head and Ries, 1999; Tybout et al, 1991; Feenstra, 2003) use either one only, sometimes coupled with regression estimation, which are questioned by Schmalensee (1989).

In sum,

$$PLANT_{it} = \frac{\left(\sum_j l_{it}^{u*} / y_{it}^*\right) \cdot N_{it}^*}{\bar{G}_t}$$

where  $l_{it}^{u*}$  and  $y_{it}^*$  stand, respectively, for operative workers employment and output in the corresponding US industries,  $N_{it}^*$  for the number of firms therein, and  $\bar{G}_t$  is the yearly average of the numerator. In sum, operative labor input is further modulated by average firm size. The normalization by  $\bar{G}_t^*$ , equally applied to the similarly calculated plant fixed cost in Brazil,  $PLANTBR_{it}$ , removes

a likely general higher size of foreign firms, so that this regional difference is limited to a relative cross-industry difference. It also removes, by transforming them in stationary panel data, a temporal home-market (size) effect, which in fact does not underline either  $CORPO_{it}$  (and  $CORPBR_{it}$ ) or the difference of  $PLANT_{it}$  from  $PLANTBR_{it}$ .

Although the intensity of skilled (office) labor is expressive of fixed cost (see Antweiler and Treffer, 2002), it comes from a source other than plant size. That is then the role of the corporate fixed cost variable: to assure separability of technology difference from firm-size, and so to reinforce the attempted meaning underlying the comparative impact of  $PLANT_{it}$  and  $PLANTBR_{it}$ . This differentiation in the fixed cost is absent in the empirical studies on trade policy and inefficient entry commented above, which also lacks a variable-cost variable, as widely applied in the empirical IO literature (Berry and Reiss, 2007; Bersnahan, 1989).

A derived market-structure variable proxies market power,  $FPROT_{it}$ , underlying tariff (and subsidies) revenues: the effective rate of protection (ERP) in Brazil. The reason is straightforward: the literature makes a direct association between protection and market power in non-competitive industries. Further regression experiments are performed, in Section 6, to prove that ERP, based on local prices higher than the free-trade ones, stands for prices rather costs distortions alone. Disregarding the foreign economy, whose corresponding panel data was not available, amounts to assuming it as operating under free trade as compared to Brazil – quite reasonable for that period. Nominal tariffs in Brazil,  $TNOM_{it}$ , are also tested for robustness.

Policy endogeneity is dismissed in (11) on the ground that protection in Brazil was unrelated to sectors' comparative advantages (Gonzaga et al., 2006).

## 4 Trade Policy in Brazil

A brief overview of Brazil's policy experience is useful and enables us to better grasp of some of our variables. We begin it with a graphical analysis of a centered  $RCA$ , as in Benedictis (2005) :

$$b_{it} = \frac{RCA_{it} - 1}{RCA_{it} + 1},$$

with  $-1 \leq b \leq 1$ , where positive (negative) values, from  $RCA > 1$  ( $< 1$ ), indicate comparative advantages (disadvantages). These  $b_{it}$  are further classified into the four technology groups (Lall, 2000): **RB (resources-based)**: food products, beverages, paper & paperboard, rubber, non-metallic minerals, wood & cork; **LT (low technology)**: furniture, leather & furs, clothing & shoes, metals and textiles; **MT (medium technology)**: transport equipment, plastics, printing & publishing, mechanical equipment, chemicals and tobacco; **HT (high technology)**: other chemicals, electrical material and other sectors.

The  $b_{it}$  are plotted in the below diagrams, each having the original and final periods on the horizontal and the vertical axes, respectively, so that points below the diagonal indicate industries whose final RCAs were smaller than the original ones. In 1967, Brazil had comparative advantages in only two manufacturing industries, although the concentration of points above the diagonal, in both figures, shows a steady upward movement. However, all seven sectors having comparative advantages by 1987-88 belonged to either the *RB* or the *LT* groups.

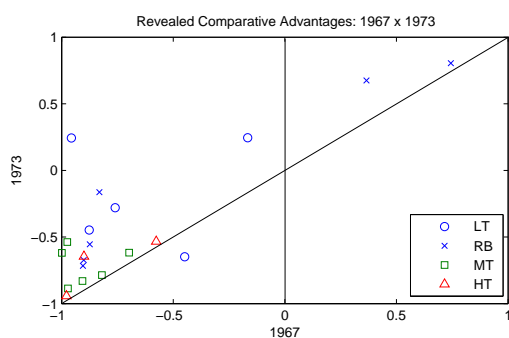


Figure 1

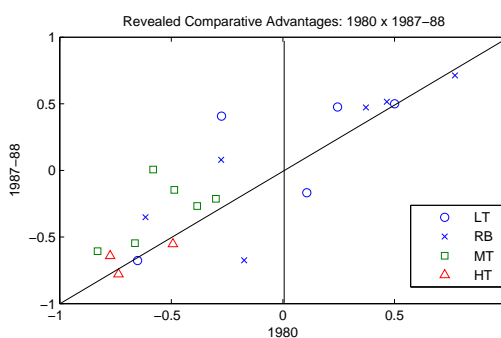


Figure 2

Considering the additional fact that many of the Brazilian *HT* and *MT* industries were among those with the highest output growth, then the allocative inefficiency of this inward-growth experience becomes rather patent. The whole picture becomes clearer once we consider the evolution of factor endowments. Table 1 below shows that Brazil's proportion of skilled to unskilled labor, relatively to the developed countries, did not change from 1967 to 1980, having even increased relative to arable land. This slow pace of human capital formation is a key difference between this industrialization strategy and that of the Asian NICs – see UN, *Human Development Report 1999* and World Bank,

Table 1: Factor Endowments: Brazil/Developed Countries

Countries	Skilled/Unskilled Labor*		Skilled Labor/Land**	
	1967	1980	1967	1980
Brazil	0.07	0.12	57.2	59.8
Developed Countries	0.15	0.26	96.8	297

Source: for 1967: Bowen et al (1987); for 1980: The World Institute Resource (1998) and World Bank, *World Development Report* 1982.

\*Skilled Labor: 1967, percentage of clerical and management in the economically active population; 1980, complete secondary education as % of relevant age group.

\*\*Land: Arable in hectares.

Trade protection is other factor to consider, starting with the average (and standard deviation) of the *ERP*: 79.7 (45.2) in 1967; 34.1 (32.4) in 1973; 36.0 (53.4) in 1980; and 41.4 (51.6) in 1987-88. It is worth noticing that Brazil's GDP and relative (to the world) total export grew the most in the only period of steady and general fall in the *ERP*, 1967-73. Protectionism resumed afterwards, strongly, though the slight increase in the average *FPROT* must be combined with the sharp increase in the standard deviation, from 32.4 to 53.4, characterizing its new features: a time and sectoral erratic path, in zig-zags, that includes negative protection in some industries (see also Tyler, 1985; Savasini, 1983) and typifies the uncontrolled consequences (and lack of policy coordination) of expanding trade barriers. In the present case, huge export subsidies, in many cases aimed at compensating the anti-export bias of the import-substitution policy, was the main trait of this new policy (Bruton, 1989; Moreira, 1995).

## 5 Estimation Results

The main goal of the ensuing regression analysis is estimating the qualitative effects of trade policy, even when making some counterfactual, where the focus will be the parameters shifts. Accordingly, we work with centered variables:  $z_i - \bar{z}_i$ , where the "within" mean is  $\bar{z}_i = \sum_t z_{it} / \sum_i$ , which further avoids the scale nature of some variables, and apply a WGLS-White estimator to models (9) and (11), as justified in the Statistical Appendix.

As shown in Table 2, all variables are statistically significant in most of model specifications,

in spite of some having low  $\bar{R}^2$  which can be assigned to both the small sample and high number of regressors. Average values of the fixed effects, for models (i)-(vi), without the dummies, and (vii)-(ix), respectively, clearly characterize industries' components of the  $RCA_{it}$ , as reinforced by the slight change in their ordering with the dummies.

The negative *WYEL* confirms that the country did not thrive in the world's most expansive markets, which, given the empirical form of *WYEL* and all cost and pricing controls, this result can be referred to non-price competition. Assuming that these demand-expansive sectors were high-tech intensive, the failure in this dear target of the import substitution (ISI) can be explained by Brazil's sluggish human-capital formation (Bruton, 1989, see). That technology assumption is not granted, though.

The coefficient of *CPCOST* is lower than *CPROD*, confirming the role of factor prices, whose sizeable relative fall in 1987-88, explains, in turn, the lower significance of *CPCOST*. However, in models (i) to (vi), the positive partial correlation between comparative cost and relative exports stands for an extreme "allocative inefficiency" as to comparative advantages. To some degree, this inverted relationship confirms the "extreme microeconomic inefficiency" of Brazil's ISI (Tyler, 1985; Savasini, 1983; Bruton, 1989), but a closer look at resource-based sectors, such as Food and Wood, having high *CPCOST*, suggest a misrepresentation of comparative cost advantages because of the unobserved price advantage of this non-tradable factors (resources).

With a cost-dummy variable for both Food and Wood, in models (vii)-(ix), *CPCOST* and *CPROD* then become negative. In sum, the world is not Ricardian: comparative advantages only show up when other productive factors are somewhat considered. Yet, we cannot rule out that resources misallocation, not sufficiently controlled by either *FPROT* or *TNOM*, may have also attenuated the weak linkages of comparative advantages (Deardorff, 1979)<sup>9</sup>, as given by the negative correlation between comparative cost and trade pattern, a point we take up in the next section.

Since the fixed-cost variable *PLANT* stands for an input/output rate, whereas *CORPO* (and *CORPBR*) for a factor intensity, their coefficient show Brazil's *RCA* partially rested on both plant-level economies

---

<sup>9</sup>Our model rests on weak links as his, though with no reference to autarky prices.

Table 2: Estimates of the Comparative Advantages Model

Independent Variables	Dependent Variable: RCA								
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
YEL	<b>-0.266</b>	<b>-0.208</b>	<b>-0.041</b>	<b>-0.072</b>	<b>-0.050</b>	<b>-0.057</b>	<b>-0.221</b>	<b>-0.051</b>	<b>-0.068</b>
	<b>0.024</b>	<b>0.013</b>	<b>0.017</b>	<b>0.013</b>	<b>0.022</b>	<b>0.013</b>	<b>0.021</b>	<b>0.018</b>	<b>0.014</b>
CPCOST	<b>0.289</b>		-0.042		-0.003		<b>-0.169</b>	<b>-0.196</b>	
	<b>0.065</b>		0.105		0.094		<b>0.080</b>	<b>0.099</b>	
CPROD		<b>0.207</b>		<b>0.253</b>		<b>0.282</b>			<b>0.236</b>
		<b>0.024</b>		<b>0.027</b>		<b>0.020</b>			<b>0.030</b>
DCPCOST							<b>0.773</b>	<b>0.897</b>	
							<b>0.211</b>	<b>0.184</b>	
DCPROD									<b>0.126</b>
									<b>0.038</b>
SIZE	<b>2.257</b>	<b>2.245</b>	<b>2.963</b>	<b>3.231</b>	<b>2.730</b>	<b>3.166</b>	<b>1.632</b>	<b>2.847</b>	<b>3.175</b>
	<b>0.375</b>	<b>0.359</b>	<b>0.386</b>	<b>0.323</b>	<b>0.446</b>	<b>0.448</b>	<b>0.406</b>	<b>0.390</b>	<b>0.311</b>
PLANT	<b>-1.283</b>	<b>-1.295</b>	<b>-1.051</b>	<b>-1.115</b>	<b>-0.845</b>	<b>-1.071</b>	<b>-1.745</b>	<b>-1.246</b>	<b>-1.328</b>
	<b>0.186</b>	<b>0.151</b>	<b>0.324</b>	<b>0.216</b>	<b>0.391</b>	<b>0.250</b>	<b>0.220</b>	<b>0.280</b>	<b>0.228</b>
CORPO	<b>3.405</b>	<b>1.975</b>					<b>2.476</b>		
	<b>0.268</b>	<b>0.164</b>					<b>0.215</b>		
CORPBR			<b>0.276</b>	<b>0.101</b>	<b>0.292</b>	0.007		<b>0.244</b>	<b>0.122</b>
			<b>0.042</b>	<b>0.029</b>	<b>0.060</b>	0.062		<b>0.038</b>	<b>0.029</b>
FPROT	<b>-0.183</b>	<b>-0.195</b>	<b>-0.231</b>	<b>-0.205</b>			<b>-0.328</b>	<b>-0.277</b>	<b>-0.238</b>
	<b>0.020</b>	<b>0.011</b>	<b>0.027</b>	<b>0.018</b>			<b>0.023</b>	<b>0.028</b>	<b>0.022</b>
TNOM					0.021	<b>-0.162</b>			
					0.044	<b>0.036</b>			
N. Observations	77	77	77	77	77	77	77	74	74
Adjusted R2	0.739	0.845	0.641	0.687	0.550	0.593	0.806	0.693	0.722
F statistics	48.04	87.74	32.13	38.30	23.62	27.17	57.12	32.99	37.27
Ordered Fixed Effects									
FOOD			7.275				FOOD	0.415	
WOOD			5.21				PAPER	6.252	
CLOTHSHOE			4.169				EQTRANS	5.586	
METAL			2.034				MECH	3.055	
MECH			1.692				PRNTNG	2.469	
LEATFUR			1.358				PLAST	2.364	
PRNTNG			1.286				CHEM	1.765	
PAPER			0.886				FURN	1.261	
DIVERSES			0.488				BEVER	1.236	
FURN			0.457				DIVERSES	1.225	
TEXT			0.439				METAL	1.04	
RUBB			0.302				TEXT	0.812	
ELETR			0.173				LEATFUR	0.755	
NONM			0.087				OTHCHM	0.707	
EQTRANS			-0.097				TOBAC	0.313	
PLAST			-0.427				NONM	-0.093	
TOBAC			-0.908				CLOTHSHOE	-0.593	
OTHCHM			-1.103				ELETR	-0.674	
CHEM			-1.169				RUBB	-0.787	
BEVER			-1.297				WOOD	-0.788	

Heteroskedasticity corrected models (cross-section weights and White covariance matrix). Number in brackets are standard errors.

Statistical significance: bold letter stands for statistical significance of 5% or higher, whereas \* stands for 10% significance.

†: Three industry observations for WYEL were not available for 1967, reducing the total to 77.

Description of Variables in Section 3. Data Source: Appendix I.



of scale and skilled-labor intensive sectors. The positive *CORPBR* may reflect Brazil's regional comparative advantages in skilled-labor intensive goods, as happened with Japan's early manufacturing exports (Heller, 1976), which simultaneously means that this variable contains (or is correlated with) unobserved fixed trade costs, which are smaller for neighbor country's exports.

Another possibility for this unexpected positive impact is that it was just weakly controlled by *PLANT*, which incorporates only unskilled labor. At the same time, it must be stressed that  $CORP_{it} > CORPBR_{it}$  for all industries and periods, confirming the theoretical hypothesis and so that *CORPBR<sub>it</sub>* is the best measure of corporate costs in Brazil.

Regarding plant fixed cost, *PLANTBR* gives the plant-fixed cost adjusted to firm size in Brazil, whereas *PLANT* is an idealization closer to a world without policy distortions, which amounts to a counterfactual experiment aimed at assessing the "productive effect" from inefficient entry, underlying the former.

We must, however, make sure that the differences between *PLANTBR* and *PLANT* can be referred to firm size in the corresponding industries. Following a canon in the industrial organization literature, this is done by an exploratory statistical analysis, plotting the ratio "*PLANTBR<sub>it</sub>/PLANT<sub>it</sub>*" against that of firms per industry  $\frac{N_{it}/\bar{N}_t}{N_{it}^*/\bar{N}_t^*}$ , in Figure 3, where the values are in logarithm so as to avoid a large concentration of points around "0", or else to better visualize the relationship. As shown, the cost ratio *PLANTBR<sub>it</sub>/PLANT<sub>it</sub>* is positive and highly correlated with  $N_{it}/\bar{N}_t$ , which agrees with the hypothesis that (inefficiently) entry decreases (increases) the economies of scale (average cost). The quite high fitness of the curve indirectly vindicates the "operative labor input" as an scale measure, given the even greater fitness of the "firms/value added" term.

Can we grant that protectionism is behind these inefficient entries? The first thing to consider is that Brazil's protectionism goes beyond trade policy (encompassing a wide range of unobserved quantitative restriction), encompassing industrial-policy instruments, such as the long term credit bank, BNDES, and other taxes and credit incentives. Finally, what drives us to a positive conclusion is that Brazil's legal apparatus for entry (and exit) has no sectorial bias, except for two or three manufacturing sectors, in which foreign firms were restricted.

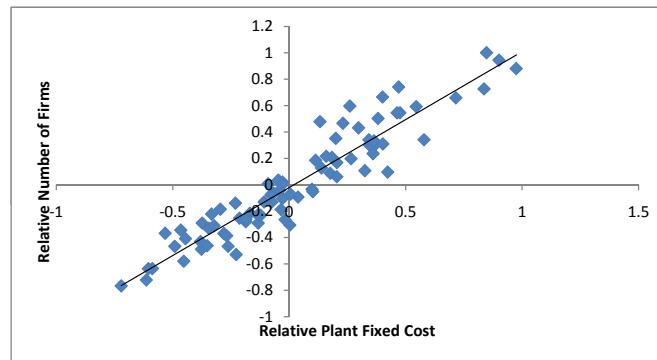


Figure 3: Number of Firms *versus* Plant Fixed Cost

We can now move to the regression analysis, whose results (Table 3) show an expressive fall in the inverse relationship between *PLANTBR* and *RCA* – in model (iii) it became positive – as compared to corresponding models with *PLANT*. This smaller contribution from *PLANTBR* to relative exports corroborates the *productive efficiency effect*: that same-industry plants operated, in Brazil, with lower economies of scale, comparatively to the developed countries<sup>10</sup>.

Disappointing evidence about trade policy and firms size have been obtained in firm-level analyses (Head and Ries, 1999; Tybout, 1993; Feenstra, 2003, ch. 5), also based on unobserved cost types, which suggest instead the plant-selection effect. However, these studies make no distinction on fixed costs, nor have a marginal cost term, departing from most empirical IO studies. Last but not the least, the observed firm-size effect is supported by a more comprehensive variable of economies of scale, combining an input and a firm-size terms.

Lastly, the negative coefficient of *FPROT* fits to the *pro-competitive effect* of international trade: higher wedges between prices and cost compete against international sales. The same negative impact can, however, express the competitive hypothesis: misallocation towards sectors with higher opportunity costs, so that an additional analysis will be carried to single them out. Nominal tariffs, *TNOM*, a less accurate measure of firm's revenues, had a non-definite impact [columns (v) and (vi)].

<sup>10</sup>This is not a test about the minimum efficiency scale (*MES*), among others because monopolistic competition rules out the *MES* hypothesis.

Table 3: Estimates of the Comparative Advantages with Local Scale

Dependent Variable: RCA				
Independent Variables	(i)	(ii)	(iii)	(iv)
YEL	<b>-0.024</b>	<b>-0.071</b>	<b>-0.028</b>	<b>-0.021</b>
	<b>0.007</b>	<b>0.012</b>	<b>0.009</b>	<b>0.010</b>
CPCOST	-0.060	0.020	-0.048	-0.040
	0.057	0.069	0.063	0.076
DCPCOST	0.502	<b>0.444</b>		0.382
	0.300*	<b>0.488</b>		0.345
SIZE	<b>2.605</b>	<b>2.312</b>	<b>2.701</b>	<b>2.663</b>
	<b>0.341</b>	<b>0.479</b>	<b>0.322</b>	<b>0.402</b>
PLANTBR	<b>-0.036</b>	-0.095	0.059	-0.014
	<b>0.123</b>	0.136	0.098	0.110
CORPO		<b>0.891</b>		
		<b>0.160</b>		
CORPBR	<b>0.163</b>		<b>0.209</b>	<b>0.191</b>
	<b>0.048</b>		<b>0.046</b>	<b>0.041</b>
FPROT	<b>-0.143</b>	<b>-0.126</b>	<b>-0.116</b>	
	<b>0.015</b>	<b>0.023</b>	<b>0.013</b>	
TNOM				0.024
				0.026
N. Observations	77	77	77	77
Adjusted R2	0.604	0.580	0.551	0.544
F statistics	23.64	21.79	23.65	19.44

Idem Table 2.

## 6 The Allocative and the Competitive Effects

No definitive evidence about both allocative and the pro-competitive effects have been provided yet. Regarding the former, the efficient relationship between comparative cost and trade patterns showed that microeconomic inefficiency of this protectionist experience, observed elsewhere, had not gone to the point of inverting the weak linkages of comparative advantages. What remains unanswered, though, is whether or not unobserved-policy instruments had weakened the negative partial correlation between *CPCOST* (*CPROD*) and the *RCA*.

One possible answer is using a germane measure of trade performance that captures allocative efficiency more accurately than *RCA*, other than the empirically more costly net export, and then check the new coefficient of comparative marginal costs. Bernard et al (2003) employ akin theoretical-

driven statistical experiment to obtain indirect evidence of trade cost.

In countries whose manufacturing industries heavily rely on trade and industrial-policy instruments, one can predict that a given export share of the  $N$  benefited industries  $i$  draws, on average, higher input requirement comparatively to same-industry exports from a country closer to free trade. Hence, if  $\tilde{E} = RCA$  and  $E$  is the alternative vector of trade pattern, then their respective correlation to the vector of comparative opportunity cost (controlled for fixed cost and markup revenues),  $\mathbf{c}^p$ , are

$$E = -b\mathbf{c}^p, \quad \tilde{E} = -b'\mathbf{c}^p \quad \Rightarrow \quad b' < b, \quad (13)$$

where  $b' < b$  expresses the weaker links of comparative advantages, which can be referred to the higher trade-policy barrier in Brazil, inasmuch as natural and cultural trade barriers are closely symmetric across countries. Extreme microeconomic inefficiency can actually make  $b' < 0$ , since  $b \simeq 0$  with  $RCA$ .

A germane (to  $RCA$ ) and more accurate measure of allocative efficiency is the *revealed comparative efficiency in the manufacturing industry*:

$$RCEM_{it} = \frac{(x_{it}^T/x_t^T) / (x_{it}/x_t)}{(x_{it}^{*T}/x_t^{*T}) / (x_{it}^*/x_t^*)}$$

where  $x_i^T$  and  $x_i$  stand for the exported and total output of  $i$  in an economy, respectively. Notice that the  $RCEM$  index combines information of both production and goods market, and in a way that resembles the efficient partition of the traded and produced output in Deardorff (1980)<sup>11</sup>. On this regard,  $RCEM$  is superior to *net export* in two senses: imports ( $M$ ) would increase the UN's problem of sectoral aggregation for production (ISIC) and goods (SITC), and Brazil's  $M$  is as distorted by trade policy as its exports.

As argued, the goal of the new regression of model (12), with  $RCEM_{it}$ , is seeing if Brazil's comparative exports entailed higher cost than revealed in a standard trade-performance measure. Indeed, as shown in the below Table 4 the coefficient of  $CPCOST$  moved significantly upward, as compared to similar models in Tables (2) and (3). Hence, this weaker link of comparative advantages under a

<sup>11</sup>Though comparative costs dispense autarky prices. Cinquetti and Silva (2008) apply a similar variable to access the relative efficiency of manufacturing industry in a set of developing countries prior to the 1980s debt crisis.

Table 4: Estimates of the Comparative Efficiency Model

Independent Variables	Dependent Variable: RCEM					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
YEL	<b>-0.136</b> <b>0.047</b>	<b>-0.076</b> <b>0.035</b>	<b>-0.118</b> <b>0.036</b>	-0.045 0.024*	-0.036 0.025	<b>-0.094</b> <b>0.019</b>
CPCOST	-0.031 0.038	<b>-0.111</b> <b>0.059</b>		0.049 0.054	<b>0.154</b> <b>0.058</b>	
DCPCOST	<b>1.176</b> <b>0.120</b>	<b>0.741</b> <b>0.211</b>		<b>0.907</b> <b>0.091</b>	<b>0.674</b> <b>0.157</b>	
CPROD			<b>0.308</b> <b>0.051</b>			<b>0.284</b> <b>0.038</b>
DCPROD			<b>0.141</b> <b>0.049</b>			0.091 0.071
SIZE	-0.031 0.051	0.220 0.180	<b>0.523</b> <b>0.188</b>	<b>0.251</b> <b>0.076</b>	<b>0.406</b> <b>0.169</b>	<b>0.658</b> <b>0.158</b>
PLANT	<b>-1.010</b> <b>0.169</b>	<b>-0.473</b> <b>0.305</b>	<b>-0.889</b> <b>0.206</b>			
PLANTBR				<b>-0.148</b> <b>0.050</b>	<b>-0.179</b> <b>0.047</b>	<b>-0.158</b> <b>0.073</b>
CORPO						
CORPBR	<b>0.543</b> <b>0.051</b>	<b>0.384</b> <b>0.104</b>	<b>0.291</b> <b>0.076</b>	<b>0.382</b> <b>0.056</b>	<b>0.441</b> <b>0.077</b>	0.114 0.069*
FPROT	<b>-0.352</b> <b>0.023</b>		<b>-0.286</b> <b>0.022</b>	<b>-0.260</b> <b>0.016</b>		<b>-0.189</b> <b>0.015</b>
TNOM		0.081 0.043*			<b>0.086</b> <b>0.036</b>	
N. Observations	77	77	77	77		77
Adjusted R2	0.786	0.371	0.646	0.492	0.424	0.556
F statistics	50.78	11.82	27.46	16.60	13.64	20.21

Idem Table 2.

trade pattern measure adjusted for efficiency, clearer identifies artificial (costly) export achievements. In columns (iii)-(vi), the coefficients of comparative costs (and productivity) are positive, which can be coined an extreme microeconomic inefficiency. The drastic fall in the coefficient of *SIZE*, up to a negative value in (i), corroborates the weaker relationship between comparative industries sizes and their relative comparative efficiency.

The relative coefficients of *PLANT* and *PLANTBR* remained as before, corroborating the productive efficiency effect, although their values shifted down as if these cost variables reduce their explanatory power with a trade-pattern variable more accurate to allocative efficiency.

Lastly, the *FPROT*. In the competitive model, the producers' distortion from *FPROT* goes through opportunity costs, whereas in the imperfectly-competitive model it goes through higher markups – the pro-competitive effect – that, imparting on sectors' size, hits marginal (opportunity) costs. Analytically, the latter resembles an implicit-function relationship, which might be statistically accessed by means of stepwise regressions (Greene, 2000): observing how the elimination of *FPROT* changes the remaining partial correlation with *RCA*. More to the point, if  $b_1$  and  $b_{1,2}$  are the partial correlation of  $x_1$  in the restricted and in the unrestricted (with  $x_2 = FPROT$ ) models, respectively, then  $E[b_1]/E[b_{1,2}] \sim Bias[b_1]$  is the implicit relationship between  $x_1$  and  $x_2$ .

Inasmuch as the wedge between price and marginal (production) cost increases induces entry, then the elimination of *FPROT* would have a great impact on the partial coefficient of *PLANTBR*, at least as great as those of *CPCOST* and *SIZE*, standing for opportunity costs. That is the way different stepwise regressions are here applied as robustness analyzes about the true economic nature of *FPROT*. And since our attention around *PLANTBR* is here mainly directed towards its firm-size component, we could gain accuracy by disregarding its technology component, the "operative labor/value added" ratio, working instead with

$$FIRMSZBr_{it} = \frac{(y_{it} / N_{it})}{\bar{Z}_t} \quad (14)$$

where  $\bar{Z}_t$ , the year-average of the numerator, is a normalization factor. Not only *FIRMSZBr<sub>it</sub>* expresses firm size proportionally, unlike *PLANTBR<sub>it</sub>*, but also it is less of plant-fixed costs measure than the latter. We also test  $DIFIRMSZ_{it} = \log(FIRMSZBr_{it}) - \log(USFIRMSZ_{it})$ , to further access the variation with respect to the free-trade reference, likewise calculated.

Each pair of equations, in Table (5), stands for a particular stepwise regression, beginning with the elimination of *FPROT* in (ii). As shown, the coefficient of the most relevant variables changed in the predicted direction: more positive for *FIRMSZBr* and *SIZE*, and more negative for *CPCOST*, meaning that the productive and allocative efficiency are magnified in the absence of *FPROT*. In (iii)-(iv), we make an alternative experience with *TNOM*, so as to better single out the component of protection causing a wedge from price to cost, more consistently expressed by *FPROT*. Now the result shifts: the impact on *FIRMSZBr* is far greater than in the set *CPCOST* and *SIZE*. Finally,

replacing *FIRMSZBr* by *DIFIRMSZ*, in columns (v)-(vi), we observe that the statistical significance of this new scale variable is maintained only in the restricted model, confirming differently its strong correlation with *FPROT*.

Table 5: Stepwise Estimates of the Comparative Efficiency Model

Independent Variables	Dependent Variable: RCEM					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
YEL	<b>-0.070</b>	<b>-0.083</b>	<b>-0.043</b>	<b>-0.062</b>	-0.018	-0.031
	<b>0.027</b>	<b>0.030</b>	<b>0.021</b>	<b>0.025</b>	0.015	0.017*
CPCOST	<b>0.081</b>	-0.049	-0.089	-0.076	-0.138	-0.087
	<b>0.025</b>	0.035	0.046*	0.054	0.089	0.079
DCPCOST	<b>0.846</b>	<b>0.620</b>	<b>0.862</b>	<b>0.627</b>	<b>0.738</b>	<b>0.510</b>
	<b>0.076</b>	<b>0.140</b>	<b>0.082</b>	<b>0.150</b>	<b>0.196</b>	<b>0.263</b>
SIZE	<b>0.179</b>	0.218	<b>0.167</b>	<b>0.187</b>	<b>0.501</b>	<b>0.726</b>
	<b>0.036</b>	0.123*	<b>0.053</b>	<b>0.146</b>	<b>0.095</b>	<b>0.168</b>
FIRMSZBr	<b>-0.156</b>	0.026	-0.099	0.029		
	<b>0.050</b>	0.057	0.077	0.076		
DIFIRMSIZE					<b>0.307</b>	<b>0.471</b>
					<b>0.076</b>	<b>0.092</b>
CORPBR	<b>0.422</b>	<b>0.350</b>	<b>0.364</b>	<b>0.396</b>	<b>0.467</b>	<b>0.516</b>
	<b>0.045</b>	<b>0.079</b>	<b>0.059</b>	<b>0.083</b>	<b>0.071</b>	<b>0.077</b>
TNOM			<b>-0.304</b>	0.043	<b>0.159</b>	<b>0.078</b>
			<b>0.028</b>	0.042	<b>0.025</b>	<b>0.037</b>
FPROT	<b>-0.297</b>		<b>0.083</b>		<b>-0.269</b>	
	<b>0.018</b>		<b>0.035</b>		<b>0.020</b>	
N. Observations	77	77	77	77	77	77
Adjusted $R^2$	0.621	0.328	0.467	0.359	0.618	0.399
F statistics	25.11	12.42	13.36	11.43	21.41	12.74

Idem Table 2.

Therefore, the weaker correlation of *FPROT* with marginal cost variables, as compared to that one related to both fixed cost and markup revenues, corroborates the pro-competitive effect underlying *FPROT*; that it goes beyond the allocative efficiency.

A final remark. The three main policy effects of our positive trade-pattern analysis can be summed up to lower income, and so to lower consumer expenditure that can also be translated into an indirect utility function (see Feenstra, 1995)<sup>12</sup>. Yet, any such often disputed normative analysis, envisaging

<sup>12</sup>The same applies to the ignored analysis of demand for varieties, inasmuch as their number do not increase with protection and that the possibility of income gains depends on either no-entry or a constant markup (Helpman and Krugman, 1989).

to quantify losses from protection, is here more compromised by the by the several transformations we had to do in the variables.

## 7 Conclusions

While the spatial monopolistic competition amplified the identifiable policy effects in an industry-level analysis, the comparative-advantages model with an enlarged (integrated) foreign economy overcame several data difficulties, so common when analyzing a lasting protectionist in a developing economy.

The *productive (average cost) inefficiency* was manifest both by the exploratory graphical analysis and by the weaker partial linkages to the Revealed Comparative Advantages (RCA) of the *PLANTBR* as compared to the counterfactual *PLANT*. Equally, the allocative inefficiency was uncovered when replacing *RCA* by a more accurate trade-pattern measure as to efficiency in resource allocation, *RCEM*, which drastically weakened the linkages with marginal costs, *CPCOST* and *SIZE*. Lastly, evidence of the *anti-competitive effect* was attested by the negative impact of the *ERP* on *RCA* and corroborated by the stronger correlation of this partial coefficient with average cost terms, supporting the notion of a price-driven allocative distortion.

The non-cost competition term showed that the country did not thrive in the most expanding industry, which manifests a failure in a key dynamic target of this ISI, despite it having no definite efficiency effect in the model.

## A Data Appendix: Sources

$RCA_{it}$ : UNCTAD, Handbook of International Trade and Development Statistics; United Nations, International Trade Statistics Yearbook; IBGE, Anuário Estatístico do Brasil. All in current US dollars.

$WYEL_{it}$ : the same as  $RCA_{it}$  and also United Nations, *Commodity Trade Statistics Database*.



$CPROD_{it}$ ,  $CPCOST_{it}$ ,  $PLANT_{it}$ ,  $PLANT_{it}$ ,  $PLANTBR_{it}$  and  $SIZE_{it}$ ,  $CORP_{it}$ ,  $CORPBR_{it}$ : UNIDO, *Industrial Statistics Database*; UN, *Yearbook of Industrial Statistics*; IBGE (idem), with valued added deflated by the US and Brazil's GDP deflator, respectively. Industries average wages were based on UN, *Statistical Yearbook* and ILO, *LABORSTA Labour Statistics Database*, IBGE, *Estatísticas Históricas do Século XX*, and FIESP (São Paulo State Industry Federation), for Brazil in 1980. Lastly, number of firms in industries: *Country Business Patterns for the USA*, and IBGE *Estatísticas Históricas for Brazil*.

Brazil's series of employment and number of establishments was interrupted in 1985, at the beginning of the democratic government, and the level of the new series shifted dramatically, so that their values in 1987-1988 were interpolated according to Cinquetti and Silva (2010). Briefly, the employment data was interpolated from IBGE's special series for 1985-88, together with those ones of 1984 and 1988 (in *Estatísticas Históricas*), while the establishments, whose new data started only in 1986 (In "www.sidra.ibge.gov.br/bda/cempre/", collected in 11/03/2009), was interpolated from a mix of statistical forecast (up to 1986) and mathematica interpolation (from the yearly sample variation from 1986 to 1988). To forecast, we estimate a class of first-order autoregressive model, adding the actual and one-period lagged GDP as covariate, the specification of which was oriented by the structural shift (with high instability) of the Brazilian economy during the 1980s.

$FPROT_{it}$  and  $TNOM_{it}$ : Bergsman and Malan (1971); Neuhauss and Lobato (1978); Tyler (1985); Kume (1989).

## **B Statistical Appendix**

In the regression models, the unexplained constant term  $\alpha_i$  can be either group-specific constants (fixed effects, FE), or group-specific disturbances (random effects, RE). The former is tailored to the dimension of our panel data (Greene, 2000, p. 615), but our choice was further based on evidence (in Table 2) that the parametric differences between cross-sections were associated with industry characteristics (*i.e.*, fixed effects), and with the regressors as well. Another indication in this direction

is that the variance of the  $\beta$ s increase tremendously – most of them lose statistical significance – when running the baseline models either as RE. A Hausmann test yielded  $\chi^2 = 4.79$  ( $p$ -value = 0.571), which does not reject the null hypothesis of the RE model, but this test is inadequate for small samples (Hsiao, 2003) like ours, so that we further applied the test of redundancy of the fixed effects, yielding  $\chi^2 = 174.55$  ( $p$ -value = 0.000) that strongly rejects the null hypothesis of redundant FE. Hence, under this set of evidence and constraint, the FE arises as the most efficient estimator.

Lastly, the sample size and the heterogeneity of the sources, both between and within periods (internationally), dictated a WLS-White estimator, which corrects contemporaneous cross-equation correlation as well as different error variances in each cross-section (Arellano, 1987).

## References

- Antweiler, Werner, Trefler, Daniel. 2002. Increasing Returns and All That: A View From Trade. *American Economic Review* 92 (1), 93-119.
- Arkolakis, C., Demidova, S., Klenow, P. J., and Rodríguez-Clare, A., 2008. Firm Heterogeneity and the Gains from Trade. *American Economic Review* 98 2, 444-450.
- Arellano, M., 1987. Computing robust standard errors for within-groups estimators. *Oxford Bulletin of Economics and Statistics* 49, 431–434.
- Balassa, B., 1967. Trade Liberalisation and Revealed Comparative Advantage. *Manchester School of Economics and Social Studies*, 32 (2), 99-123.
- Benedictis, L., 2005. Three decades of Italian comparative advantages. *The World Economy* 28 (1), 1679–1709.
- Bergsman, J., Malan, P., 1971. The structure of protection in Brazil. In: Balassa, B. (Ed.), *The Structure of Protection in Developing Countries*. The Johns Hopkins Press, Baltimore, pp. 239–277.

- Bernard, Andrew, Eaton, Jonathan, Jensen, J. Bradford, and Kortum, Samuel. 2003. Plants and Productivity in International Trade. *American Economic Review*, 93 (4), 1268–1290.
- Berry, Steven, Reiss, Peter. 2007. Empirical Models of entry and Market Structure, in: Armstrong, M. and Porter, R. (ed.), *Hand of Industrial Organization*, vol. 3. Holland: Elsevier, pp. 1845–1886.
- Brainard, S. L., 1997. An empirical assessment of the proximity-concentration trade-off between multinational sales and trade. *The American Economic Review* 87 (4), 520–544.
- Bresnahan, Timothy. 1989. Empirical Studies of Industries with market Power, in: Schmalensee, R. and Willig, R. D. (ed.), *Handbook of Industrial Organization*, Vol. 2. Holland: Elsevier, 1011–1057.
- Bruton, H., 1989. *Handbook of Development Economics*. Vol. II. Amsterdam: North-Holland, pp. 1601–1644.
- Calabi, A., Reiss, G. D., Levy, P. M., 1981. *Geração de Poupança e Estrutura de Capital das Empresas no Brasil*. Instituto de Pesquisas Econômicas, São Paulo.
- Cinqueti, C. A., Silva, R., 2008. Delays in Stabilization or in Reforms? The Debt Crisis. *Developing Economies*, v.46, p.290 - 305.
- Cinqueti, C. A., Balistreri, Edward. 2010. A Comprehensive Industry-Level Model of Trade Policy with Monopolistic Competition. *Brazilian Workshop of the Game Theory Society in honor of John Nash – 2010*. Sao Paulo, FEA-USP.
- Cinqueti, C. A., Silva, R., 2010. Number of Firms in Brazil: fullfilling the series with an economic analysis. Working paper. 9 pages.
- Currie, D., Levine, P., Pearlman, J., Chui, M., 1999. Phase of imitation and innovation in a north-south endogenous growth model. *Oxford Economic Papers*, 51, 60–88.
- Deardorff, A. V., 1979. Weak Links in the Chain of Comparative Advantage. *Journal of International Economics*, 9: 197-209.

- Deardorff, A. V., 1980. The General Validity of the Law of Comparative Advantage. *Journal of Political Economy*, 88 (5), 941–957.
- Eaton, J., Kortum, S., 2002. Technology, geography and trade. *Econometrica* 70 (5), 1741–1779.
- Feenstra, R., 1995 Estimating the effects of trade policy. In: Grossman, G., Rogoff, K. (Eds.), *Handbook of International Economics*. Vol. 3. North-Holland, Amsterdam, pp. 1553–1593.
- Feenstra, R. C., 2003. *Advanced International Trade: Theory and Evidence*. Princeton University Press.
- Feenstra, Robert. Measuring the Gains from Trade under Monopolistic competition. *Canadian Economics Association, 2009 Meeting*, 1-38.
- Fernandes, A. M., 2007. Trade policy, trade volumes and plant-level productivity in Colombian manufacturing industries. *Journal of International Economics* 71, 52 – 71.
- Golub, S. S., Hsieh, C.-T., 2000. Classical ricardian theory of comparative advantage revisited. *Review of International Economics* 8 (2), 221–234.
- Gonzaga, G., Menezes Filho, N., and Terra, M. C., 2006. Trade liberalization and the evolution of the skill earnings differentials in Brazil. *Journal of International Economics*, 68, 345 – 367.
- Greene, W. H., 2000. *Econometric Analysis*. Prentice-Hall, New Jersey.
- Grossman, G., Helpman, E., 1991. *Innovation and Growth in the World Economy*. The MIT Press, Cambridge, MA.
- Harrigan, J., 1997. Technology, factor supplies and international specialization: Estimating the neo-classical model. *American Economic Review* 87 (4), 475–494.
- Harrison, A. E., 1994b. Productivity, imperfect competition and trade reform - theory and evidence. *Journal of International Economics* 36, 53–73.

- Head, Keith, Ries, John. 1999. Rationalization effects of tariff reductions. *Journal of International economics*, 47: 295-320.
- Heller, Peter. 1976. Factor Endowment Change and Comparative Advantage: The Case of Japan, 1956-1969. *The Review of Economics and Statistics* 58 (3), pp. 283-292.
- Helpman, E. 1981. International Trade in the Presence of Product Differentiation, economies of scale, and monopolistic competition: a chaberlin-Heckscher-Ohlin Approach. *Journal of International Economics*, 11: 305–340.
- Helpman, E., Krugman, P. R., 1985. *Market Structure and Foreign Trade*. The MIT Press, Cambridge, MA.
- Helpman, E., Krugman, P. R., 1989. *Trade Policy and Market Structure*. The MIT Press, Cambridge, MA.
- Horstmann, I. J., Markusen, J. R., 1986. Up the average cost curve: Inefficient entry and the new protectionism. *Journal of International Economics* 20, 225–247.
- Hsiao, C., 2003. *Analisis of Panel Data*, 2nd Edition. Cambridge University Press, Cambridge: MA.
- Kume, H., 1989. A proteção efetiva proposta na reforma tarifária de 1988. Texto para Discussão Interna 21, Funcex, Rio de Janeiro.
- Lall, S., 2000. The technology structure and performance of developing country manufactured exports, 1985-98. QEH Working Paper, University of Oxford (44).
- Lancaster, K. 1979. *Variety, Equity, and Efficiency*. New York: Columbia University Press.
- Lancaster, K., 1980. Intra-industry trade under perfect monopolistic competition. *Journal of International Economics* , 10: 151-175.
- Lancaster, K., 1984 Protection and product differentiation, In: KIERZKOWSKI, H. (ed), *Monopolistic competition and international trade*. Oxford: Claredon Press. 1984.

- Markusen, James R., 1981. Trade and the gains from trade with imperfect Competition. *Journal of International Economics*, 11, 531-551.
- Markusen, J. R., Venables, A. J., 1988. Trade policy with increasing returns and imperfect competition: contradictory results from competing assumptions. *Journal of International Economics* 24(May): 299-316.
- Markusen, J. R., Venables, A. J., 2000. The theory of endowment, intra-industry and multinational trade. *Journal of International Trade* 52, 209–235.
- Melitz, M. J., 2003. The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica* 71 (6), 1695–1725.
- Melitz, Marc J., and Gianmarco I. P. Ottaviano. 2008. Market size, trade, and productivity. *Review of Economic Studies* 75 (1), 295-316.
- Moreira, M. M., 1995. *Industrialization, Trade and Market Failures: the Role of Government Intervention in Brazil and South Korea*. Macmillan Press, London.
- Neuhaus, P., Lobato, H., 1978. *Proteção efetiva da Indústria no Brasil, 1973-75*. mimeo, Rio de Janeiro.
- Santos-Paulino, A. U., 2002. Trade liberalisation and export performance in selected developing countries. *Journal of Development Studies* 39 (1), 140–164.
- Savasini, J. A., 1983. Análise da Política de Promoção das Exportações. In: e Ibraim Eris, C. E. (Ed.), *Finanças Públicas*. FIPE:Pioneira, São Paulo, pp. 69–94.
- Schmalensee, Richard. 1989. Inter-Industry Studies of Structure and Performance, in: Schmalensee, R. and Willig, R. D. (ed.), *Handbook of Industrial Organization*, Vol. II. Holland: Elsevier.
- Schmitt, Nicholas. 1990. Two-country trade liberalization in an address model of product differentiation. *Canadian Journal of Economics* 23 3: 654-675.

- Tybout, James. 1993. Internal returns to scale as a source of comparative advantage: the evidence. *The American Economic Review*, 83 (2), 440-44.
- Tybout, James, de Melo, Jamie and Corbo, Vittorio. 1991. The effects of trade reforms on scale and technical efficiency. *Journal of International Economics*, 31: 231–250.
- Tyler, W. G., 1985. Effective incentives for domestic market sales and exports. *Journal of Development Economics* 18, 219–242.
- Tyler, William P., Gurgel, Angelo C . 2008. Brazilian Trade Policies: Some Observed and Estimated Effects of the 1990s Liberalization. *Estudos Econômicos*, 39 (1), 59–88.
- Vogel, Jonathan. 2008. Spatial Competition with Heterogenous Firms. *Journal of Political Economy*. *Journal of Political Economy* 116 3, 423-466.
- Yeaple, Stephen. 2005. A Simple Model of Firm Heterogeneity, International Trade and Wages. *Journal of International Economics*, 65 1: 1-20.