

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

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## Abstract

To evaluate protectionism, we propose a comparative advantages model based on monopolistic competition with an endogenous markup, which enables the identification of three policy effects: international competition, productive and allocative efficiency, besides a non-cost competition term. Evidence is based on Brazil's import substitution industrialization, and the foreign economy is a set of (integrated) developed countries, which amplifies both the accuracy to comparative advantages and the access to fixed costs (economies of scale). Only the period under protection is considered, so that some comparative static analyzes draw on counterfactuals.

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# 1 Introduction

From the principle that comparative advantages follow from economic efficiency (Deardorff, 1980), we develop a comprehensive industry-level analysis of trade-policy under imperfect competition, in which the policy effects are identified in the positive analysis. Evidence is based on Brazil's import-substitution industrialization (ISI) from the late 1960s to the late 1980s, which offers a rich history for studying the impacts of protection on trade performance.

Since any bilateral trade pattern is affected by specific trade costs, our foreign economy is 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 (*RCA*; Balassa (1967)). Although this two-country framework turns meaningless the geographic basis of trade (Eaton and Kortum, 2002), it makes ampler room to comparative advantages.

Both 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 (or *RCA*) and countries' characteristics (Deardorff, 1979, 1980). Examining the entire ISI period is one way to avoid misleading statistical inferences, which are more likely to emerge in a one-year cross-sectional analysis. Besides, the long time span 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<sup>1</sup>. Our comparative-static exercises are, instead, based on counterfactuals that also allow simultaneously addressing some related development issues over that ISI period.

At the same time, the pre-1980 years greatly reduced the amount of internationally comparable data. For instance, total employees is the only direct marginal-cost information available for the seven examined countries, which prompted us to expand this information set, working out a latent opportunity-cost variable, based on the impact of the 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

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

counterfactual based on a more accurate (than *RCA*) trade-performance measure: the revealed comparative efficiency in manufacturing, *RCEM*, which provides a more conclusive evidence about the trade-policy effect on allocative-efficiency.

Entailed in the *RCA* index is the possibility of exporting from sectors without comparative advantages, which is here grounded on monopolistic competition. The latter further enables us to build a non-price competition argument (or regressor) of the *RCA*, which rests on product differentiation. Since it is deduced from changes over time in the preferences parameter of the upper-level utility function, it precludes direct evidence on exclusive product by firms - rather challenging for a multi-country analysis<sup>2</sup>.

The spatial monopolistic competition (Lancaster, 1984; Schmitt, 1990) grants the existence of both the scale and the market-power effects from trade policy, which also means that the main contribution of our framework is rather using the efficiency hypothesis of comparative advantages so as to identify those policy effects within a general-equilibrium analysis. Most analyzes around the scale and market power (Harrison, 1994; Tybout et al, 1991; Feenstra, 2003; Head and Ries, 1999) are partial equilibrium development about the production function.

Moreover, following a standard procedure in the empirical industrial-organization literature, we attempt to distinguish both marginal and fixed costs, and the latter is unfold into corporate and plant-level cost, each based on a specific productive factor. The variables standing for corporate fixed cost conveys mostly a factor-intensity information, whereas the plant fixed cost is a composite of firm (establishment) size and technology scale per industry. The integrated foreign economy was crucial for assessing these costs, since relevant data not available for all developed countries was drawn from the United States alone.

By rendering a more accurate measure of economies of scale, this composite variable, meant to identify the impact of inefficiency entry stemming from trade policy (Horstmann and Markusen, 1986), responds to some disputes around true source of such gains, whether related to firm size or to plant type (Tybout, 1993). Further exploratory analyses, together with some re-

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<sup>2</sup>It is worth noticing that the firm-level multi-country analysis by Bernard et al (2003) actually rests on US firms alone.

gression experiments, are done so as to single out the scale (firm size) effect. Recalling that the implied non-constant price elasticity of demand, enables us to ground this productive-efficiency effect on economies of scales rather than on plant selection Melitz (2003); Yeaple (2005).

Likewise, the endogenous markup makes room for the pro-competitive effect of liberalization (Markusen, 1981; Lancaster, 1984), also known as the industry-size effect of protection under imperfect competition (Feenstra, 1995). Empirically this market-power effect is proxied by the effective rate of protection (ERP), whose identification with the edged between prices and marginal cost is corroborate by several statistics experiments.

Three policy effects are then considered: on allocative efficiency, on (scale) productive efficiency, and on (pricing) competition intensity. The non-price (or cost) component has no definite relationship with policy, nor with the varieties effect (Arkolakis et al, 2008) to consumer satisfaction. This comprehensive analysis of trade policy thus encompasses both the traditional marginal cost and imperfect competition, yielding a richer general-equilibrium model<sup>3</sup>. More precisely, a richer comparative-advantage model, whose imperfect competition terms prevent misleading linkages from trade policy. At the same time, the empirical framework enables us to somewhat compensate for the inferior technology accuracy of an industry-level analysis, while maintaining its ability to analyze several distortions<sup>4</sup>.

In fact, the statistics results of both the exploratory and regression analyzes corroborate all those positive basis of economic inefficiency, showing that Brazil's ISI regime not only engendered extreme allocative inefficiency, as already shown in Tyler (1985), but also 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.

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<sup>3</sup>That contrasts with the comprehensive theoretical analysis of international trade by Melitz and Ottaviano (2008), which rests on a Chamberlian quasi-linear utility.

<sup>4</sup>Bernard et al (2003, p. 1271-72) "how little industry explains about exporting and productivity", but their Table 2 shows that, conditional on industry, differences of 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>5</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

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

<sup>5</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 heterogenous firms and non-local competition.

where  $S_i = \xi_i Y$  is the size of industry  $i$ , irrespective of prices, and  $Y$  is the available income of 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, 1984) 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>6</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:

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

<sup>6</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.

where  $c_{iy}(y^i, w)$  stands for marginal cost and  $n_i^T$  for the number of firms with (protected) trade. 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>7</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 neg-

<sup>7</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  $X_i^k = \delta_i^k \xi_i Y^w / \theta_i^k \mathbf{w}_i^k = \delta_i^k \xi_i Y^w / p_i^k$  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.



ative, 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 proportion (or prices) and a certain home-market effect, though their empirical form is such, as explained bellow, 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. Under spatial monopolistic competition, the symmetric distribution of firms across regional markets prevents that this effect be limited to subsidies (see Schmitt, 1990; Lancaster, 1984)<sup>8</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:

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

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),

<sup>8</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.

directly expressed such effect.

We test  $\bar{T}$  with an intrinsic variable (Schmalensee, 1989), replacing the internationally equal  $G_i$  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 *CP-COST* 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>9</sup>. Hence, in the *RCA*,  $x_{it}^* = \Sigma_{it} (X_{it}^j / X_t^j)$ ,  $X_{it}^j$  stands for the  $j$ th foreign country's exports of  $i$  and  $X_t^j$  for its 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  $i$ ,  $Y_t^w = \Sigma_i X_t^w$  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

<sup>9</sup>This multi-country aggregation is an alternative to the multiple regressions made by Golub and Hsieh (2000).

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 Trefler, 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  $RCA$ s 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.

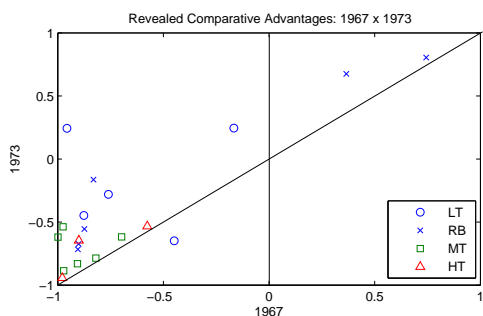


Figure 1

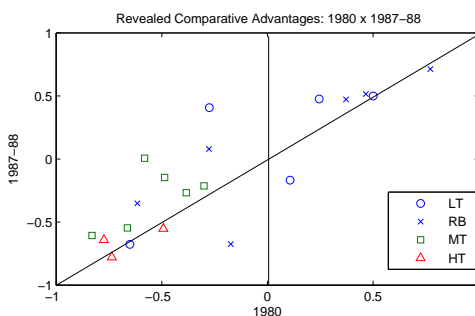


Figure 2

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, hav-

ing 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, *World Development Indicators 1998*.

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). Indirectly: that less bias stems from the absence of traded goods (machineries and components) – see Schaur et al (2008).

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>10</sup>, as given by the negative correlation between comparative cost and trade pattern, a point we take up in the

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<sup>10</sup>Our model rests on weak links as his, though with no reference to autarky prices.

next section.

Recall that the fixed-cost variable *PLANT* stands for an input/output rate, whereas *CORPO* (and *CORPBR*) for a factor intensity. We can then conclude, seeing the regression results, that Brazil's *RCA* partially rested on both plant-level economies of scale and skilled-labor intensive sectors. The positive *CORPBR*, which might have been affected by *PLANT* incorporating only unskilled labor, may reflect Brazil's regional comparative advantages in skilled-labor intensive goods, as happened with Japan's early manufacturing exports (Heller, 1976). In this sense, *CORPO* would be correlated with (unobserved) fixed trade costs, assumed as smaller for neighboring countries.

For all industries and periods,  $CORP_{it} > CORPBR_{it}$ , confirming the theoretical hypothesis,  $F_{it}^h < F_{it}$ , and so that  $CORPBR_{it}$  is the best measure of corporate costs in Brazil.  $CORPO_{it}$  is then only marginally considered in the ensuing investigations.

The negative *FPROT* fits to the *pro-competitive effect* of international trade: higher wedges between prices and cost compete against international sales. Since this negative impact equally fits to the competitive model, driven by opportunity costs alone, additional analysis is necessary, which is carried out in the next section. Nominal tariffs, *TNOM*, a less accurate measure of firm's revenues, had a non-definite impact [columns (v) and (vi)].

What remains to be examined is the "productive effect" from inefficient entry. As noticed before, replacing *PLANT* by *PLANTBR*, the plant-fixed cost adjusted to firm size (or entry) in Brazil, amounts to a counterfactual experiment, in which *PLANT* is an idealization of how the world would be without policy distortions. The proposed sequence is the most logical to our analysis and agrees with most computable general equilibrium analyzes.

We must make sure, firstly, that the differences between *PLANTBR* and *PLANT* can be referred to entry and then to firm size in the corresponding industries. Following a statistical pattern in the industrial organization literature, this is done by an exploratory analysis, plotting the ratio " $PLANTBR_{it}/PLANT_{it}$ " against that of firms per industry  $\frac{N_{it}/\bar{N}_t}{N_{it}^*/N_t^*}$ , in Figure 3. In order to yield a more informative relationship, the values are in logarithm, which avoids the large concentration of points in the [0,1] interval. As can be seen, the cost ratio,  $PLANTBR_{it}/PLANT_{it}$ ,



is positive and highly correlated with  $N_{it}/\bar{N}_{it}$ , which agrees with the hypothesis that (inefficiently) entry, by lowering the economies of scale, increases the average cost. The quite high fitness of the curve indirectly vindicates the “operative labor input” as a scale measure, given the even greater fitness of the “firms/value added” term.

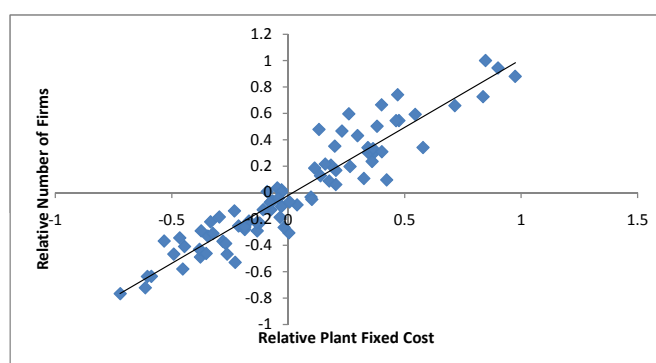


Figure 3: Number of Firms *versus* Plant Fixed Cost

Can we grant that trade protection is behind these inefficient entries? We must bear in mind that our focus is Brazil’s protectionism, which, beyond trade policy (encompassing a wide range of unobserved quantitative restriction), also encompassed industrial-policy instruments, such as the long term credit bank, BNDES, and other taxes and credit incentives. Second, and conclusively, the remaining legal apparatus for entry (and exit) in the Brazilian manufacturing industry, has no sectorial bias within the manufacturing industry, except for two or three sectors in which foreign firms were restricted.

Moving, finally, to the regression results, shown in Table (3), we do observe an expressive fall in the inverse relationship between  $PLANTBR$  and  $RCA$  – in model (iii) it became positive – as compared to corresponding models with  $PLANT$ , expressing a smaller contribution from plant-level economies of scales to relative exports, and corroborating the *productive efficiency effect*: that same-industry plants operated, in Brazil, with lower economies of scale, comparatively to the developed countries<sup>11</sup>.

Comparing this trade-policy analysis with those firm-level analysis, in which the effect goes

<sup>11</sup>This is not a test about the minimum efficiency scale ( $MES$ ), among others because monopolistic competition rules out the  $MES$  hypothesis.

through plant-selection (see Fernandes, 2007; Feenstra, 2003, ch. 5), we must concede that, indeed, firms are not technically homogenous. On the other hand, besides assuming a constant markup<sup>12</sup>, these firm-level analyzes are based on Total Factor Productivity, with no bearing on trade pattern, or on allocative efficiency. The main point is: the *productive efficiency effect*, from either plant selection or plant-size reduction, can coexist, and our analysis sheds some light on how to examine the latter in an industry-level general equilibrium model.

## 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 weaken 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

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

<sup>12</sup>Not present in a new assessment by Feenstra (2009).

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>13</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 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, we need a more definitive evidence that our derived market-structure variable, *FPROT*,

<sup>13</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.

is expressing the pro-competitive effect. In the competitive model, the producers' distortion from *FPROT* goes through opportunity costs, whereas, with imperfect competition, it goes through higher markups that, imparting on sectors' size, hit marginal (opportunity) costs (Markusen, 1981). 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  $x_2$ .

Since *PLANTBR* is related to markup revenues and the wedge between price and marginal (production) cost increases also induces entry, then the above hypothesis about *FPROT* implies that its elimination affects would have a greater impact on the partial coefficient of *PLANTBR* than those of *CPCOST* and *SIZE*, standing for opportunity costs. That is the way different stepwise regressions are applied as robustness analyzes about the true economic nature of *FPROT*.

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  $FIRMSZBr_{it}$  expresses firm size proportionally, unlike  $PLANTBR_{it}$ , 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*.

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 on economic efficiency. 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>14</sup>. Yet, any such normative analysis envisaging to quantify losses from protection, which is often so disputed, is here more compromised by the by the several transformations we had to do in the variables.

## 7 Conclusions

The attempted comparative-advantage model, with an enlarged (integrated) foreign economy, overcame several data difficulties, so common when analyzing both a developing economies and a lasting protectionist experience. The spatial monopolistic competition, on the other hand, amplified the identifiable policy effects: allocative efficiency, productive efficiency and the pro-competitive effects.

In the estimates of the *RCA* model, the *productive (average cost) inefficiency* was manifest in the lower contribution to comparative exports from local plant-level economies of scale, as compared to the international one. To access allocative efficiency, we resorted to a counterfactual: replacing *RCA* by *RCEM*, a more accurate trade-pattern measure as to efficiency in resource allocation. The coefficient of both *CPCOST* and *SIZE* showed a drastic reduction in

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<sup>14</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).

the inverse relationship between comparative cost advantages and relative exports, confirming their weaker link to allocative efficiency, and so that part of their low contribution to *RCA* could be ascribed to microeconomic inefficiency. We also transformed the plant fixed-cost variables, singling out the pure size effect, so as to scrutinize whether or not the negative impact of the *ERP* was correlated with average cost pricing, and so with the *pro-competitive effect*. As revealed by the stepwise regressions, that correlation was strong, supporting the notion of price-driven allocative distortion, as compared to the cost-driven in the competitive analysis.

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 mathematical 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 loose 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).

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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	
CLOSHOE			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				CLOSHOE	-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.

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.

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>-0.076</b>	<b>-0.118</b>	-0.045	-0.036	<b>-0.094</b>
	<b>0.047</b>	<b>0.035</b>	<b>0.036</b>	0.024*	0.025	<b>0.019</b>
CPCOST	-0.031	<b>-0.111</b>		0.049	<b>0.154</b>	
	0.038	<b>0.059</b>		0.054	<b>0.058</b>	
DCPCOST	<b>1.176</b>	<b>0.741</b>		<b>0.907</b>	<b>0.674</b>	
	<b>0.120</b>	<b>0.211</b>		<b>0.091</b>	<b>0.157</b>	
CPROD			<b>0.308</b>			<b>0.284</b>
			<b>0.051</b>			<b>0.038</b>
DCPROD			<b>0.141</b>			0.091
			<b>0.049</b>			0.071
SIZE	-0.031	0.220	<b>0.523</b>	<b>0.251</b>	<b>0.406</b>	<b>0.658</b>
	0.051	0.180	<b>0.188</b>	<b>0.076</b>	<b>0.169</b>	<b>0.158</b>
PLANT	<b>-1.010</b>	<b>-0.473</b>	<b>-0.889</b>			
	<b>0.169</b>	<b>0.305</b>	<b>0.206</b>			
PLANTBR				<b>-0.148</b>	<b>-0.179</b>	<b>-0.158</b>
				<b>0.050</b>	<b>0.047</b>	<b>0.073</b>
CORPO						
CORPBR	<b>0.543</b>	<b>0.384</b>	<b>0.291</b>	<b>0.382</b>	<b>0.441</b>	0.114
	<b>0.051</b>	<b>0.104</b>	<b>0.076</b>	<b>0.056</b>	<b>0.077</b>	0.069*
FPROT	<b>-0.352</b>		<b>-0.286</b>	<b>-0.260</b>		<b>-0.189</b>
	<b>0.023</b>		<b>0.022</b>	<b>0.016</b>		<b>0.015</b>
TNOM		0.081			<b>0.086</b>	
		0.043*			<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.



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.