# Comparative Advantages and Average Costs Under Trade Protection

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**ABSTRACT**

We develop a monopolistic competition model of comparative advantages (RCAs) to evaluate, from trade pattern and its determinants, the impact of trade protection. Evidence is based on Brazil comparatively to a set of developed countries, in a panel data of twenty industries over two decades (late 1960s to late 1980s). Estimates show the firms in the manufacturing industries operated efficiently, regarding marginal cost (in skilled and unskilled labor) minimization, however domestic resources were allocated to industries with the lower productivity, implying higher average costs. The RCAs were also inversely related to market power (tariff revenues) and to the world's most expansive industries – this letter standing for non-price competition.

*JEL* codes: F 120, F130, F140
Key words: Comparative Advantages, Trade Protection, Average Cost.

## I. Introduction

In a small and competitive economy, trade protection can produce gains only with identified imperfection in factor markets or with externalities. With imperfect competition, the possibility of gains is greater (Helpman & Krugman, 1989)[1], but this entails either non-increasing marginal costs or constant markups, otherwise higher marginal social costs or average costs, from firms' entry, will lead to losses (Helpman & Krugman, 1989, Horstmann & Markusen, 1986). In fact, since Harris (1984), empirical general equilibrium studies suggest that trade openness produces larger gains under imperfect competition than under competitive markets.

The problem is that when prices differ from costs and the latter unfold into variable and fixed, the difficulty of empirically evaluating trade policy is amplified. To start with, we cannot count on measures of gains or distortions, such as the "domestic resource cost", as shown in Harrison (1994a). Resorting to panel data analyses, very useful for identifying changes in market power (Harrison, 1994b), only reinforces this difficult. In sum, a general conclusion about empirical analysis of trade-policy with imperfect competition is "estimate don't calculate!" (Feenstra, 1995),

Accordingly, in the present analysis we focus on the equilibrium effect of policies, rather than on calculating welfare gains, although the welfare implications of changes in the equilibrium are almost straightforward. Besides, following a long tradition in the field (Leamer & Levinsohn, 1985; Helpman & Krugman, 1989: ch. 8), we pay special attention to theory so as to derive meaningful empirical models. This modeling is probably the main contribution of our analysis.

In words, we derive a dynamic monopolistic competition model of comparative advantages that are determined by (i) non-constant markups and (ii) marginal costs, characterizing the society's resource cost. The model also has (iii) a dynamic term for non-price competition. Markup revenues are distinguished by (iii) an international technology term so as to separate fixed cost from profits (or tariffs income). Besides, there is (iv) a term capturing the indirect effect of firm's entry on

[1] We are mentioning import protection on purpose, since export tax is the only optimal export policies, under realistic assumptions (see, Helpman & Krugman, 1989: ch. 5), not much suitable to developing countries that concern us here.

average costs. By so doing, we can single out the *international competition* and *the average cost* (*or scale*) *effects*, respectively.

Evidence is based on Brazil comparatively to a set of developed countries, in a panel data covering twenty industries over 1967, 1973, 1980 e 1987-88. We thus analyze Brazil's experience of import substitution, more especially its efficiency as given by the behavior and determinants of its comparative advantages changes.

The paper is thus structured. Theory and empirical specification are developed in Section II, followed by a presentation of the empirical variables. A brief panel of Brazil's experience is shown in Section IV and, in Section, we analyze the models estimates.

## II. Theory and Empirical Modeling

### II.1 Industries Size

Consider an integrated world economy producing a homogenous agricultural goods, *g*, and a set of various differentiated manufactured goods, *m;* the former with unskilled labor and constant returns to scale, the latter with unskilled and skilled labor and under increasing returns to scale. Consumers' preferences over X goods are described by the function:

$$U = \sum_i X_{m,i}^{\pi_i} X_g^{1-\pi_m} \ , \tag{1}$$

where the superscripts $\pi_m = \sum \pi_i$ of each manufactured goods (industry) *i*.

Given budget restrictions, *Y*, the demand for each manufacturing industry *i* is:

$$X_i = S_i \left( \frac{1}{\theta_i c_i} \right), \tag{2}$$

where $S_i = \pi_i Y$ and $\theta c_i = p_i$ is the monopolist optimum price: a markup $\theta_i$ over marginal cost $c_i$ (with unskilled labor). Profits are zero and the factor market is competitive.

Consumer preferences for diversified manufactured goods are expressed by a subutility function of constant elasticity of substitution, σ, which equals the price-elasticity of demand, following the large-group approach (Helpman & Krugman, 1985). However, we departure from this approach, so that the perceived marginal revenue (and thus $\theta_i$) varies with the numbers of firms, $n$ – see Hertel (1994).

Normalizing (2) by total sales $X=\Sigma_i X_i$, which has a fixed proportion $b$ to $Y_i$:

$$x_i = \pi_i b\left[\frac{1}{\theta_i(\mathbf{w_i a_i})}\right], \tag{3}$$

where $x_t=X_i/X$ are the relative sales and $\mathbf{w_i a_i}$ the price and input vectors of marginal costs.

To give (3) a time dimension we add subscript $t$ to its variables and substitute $\pi_i$ by $\eta_{it} = dlogS_{it}/\ dlogY_t$, expressing time changes in preferences[2], which leads to:

$$x_{it} = \eta_{it} b\left[\frac{1}{\theta_{it}(\mathbf{w}_{it}\mathbf{a}_{it})}\right]. \tag{4}$$

**II.2 International production and costs**

Suppose our integrated economy is made up of three countries, home, foreign and the rest of the world, maintaining transportation costs outside. Each country net export will be proportional to the international size of their industries, as given by (4). However, if home introduces barriers to trade then the integrated economy falls apart and so (4) can only help in determining industries' size after accounting for all impacts on prices and costs.

Home is a price taker in its import market and a price maker in its export market. To evaluate the impact of trade policy on the costs of the monopolistic industries, we begin by noticing that homothetic production functions define technology, which assures separable cost functions and so that the average cost of any country $j$ can be written as:

$$\boldsymbol{AC}_i^j(\boldsymbol{w}^j, \boldsymbol{x}_i^j)/\ \boldsymbol{x}_i^j = \frac{\tilde{\boldsymbol{c}}(\boldsymbol{w}^j)}{\bar{\boldsymbol{c}}(\boldsymbol{x}_i^j)}. \tag{5}$$

Thus $\tilde{\boldsymbol{c}}(\boldsymbol{w}^j)$ responds to factor prices while $\bar{\boldsymbol{c}}(.)$, standing for a productivity index, is related to economies of scales. Therefore, the input terms of marginal costs, $\boldsymbol{a}_{li}^j$, are given by:

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[2] Consumers choose in each period, so that the $\pi_{it}$ cannot be associated to non-homothetic preferences.

$$\frac{\partial \boldsymbol{c}_i(\boldsymbol{w},\boldsymbol{x}_i^j)}{\partial \boldsymbol{w}_l} = \boldsymbol{a}_{li}^j(\boldsymbol{w}^j,\boldsymbol{x}_i^j)\,, \tag{6}$$

$c_i(.)$ standing for the unit cost function.

Countries thus differ in both their marginal and average costs, given their unequal ***w***, which together with barriers, is bound to make ***x*** to differ as well. Hence, if home is a developing (scarce in skilled labor) country and foreign a developed country, then home's resources will be mostly oriented to unskilled-labor intensive industries, provided that its fixed costs, *F*, are either neutral or not so intensive in skilled labor.

Nonetheless, evidence for the covered countries and period exists only for two factors of production, skilled and unskilled labor, which means that our marginal and fixed costs do not sufficiently characterize the real-world costs. Yet, the unobserved cost terms can be assessed from the revenue function, $r_i(p,v,x)$, *v* being the factor endowment and *p* the international price, assuming, for the time being, that $\theta$ is proportional to fixed cost.

Inasmuch as *v* and *x* can be incorporated into a cost function, we may work with a new revenue function, $\bar{\boldsymbol{r}}[\boldsymbol{p},\boldsymbol{C}()]$. Accordingly, if home and foreign costs in *i* are $C_i(.)<C_i^*(.)$, for the same revenue, then

$$\frac{\partial \bar{\boldsymbol{r}}_i[(\boldsymbol{p},\boldsymbol{C}()]}{\partial \boldsymbol{p}_i} = \boldsymbol{x}_i > \frac{\partial \bar{\boldsymbol{r}}_i[\boldsymbol{p},\boldsymbol{C}^*()]}{\partial \boldsymbol{p}_i} = \boldsymbol{x}_i^*\,. \tag{7}$$

Hence, the ratio $x_i/x_i^*$ provides an additional and indirect evidence of the unobserved costs. That is, under the considered circumstances, $x_i/x_i^*$ would be positively correlated with a measure of comparative advantages.

Since trade policies affect both prices and costs, we must drop the hypothesis of $\theta_i$ proportional to $F_i$. Regarding the markup $\theta_{i,}$ the impact of home's trade policy on both its profits (or tariffs income) and on fixed costs can be written as:

$$\theta_i^j = \delta.\tilde{F}_i^{\,j}[F_i, n_i^j(\overline{T}_i^{\,j})] + (1-\delta).T_i^j\,, \qquad \delta \in (0,1) \tag{8}$$

where $T_i$, the effective rate of protection, reflects the mentioned income effect and the unobserved $\bar{T}_i^j$, other trade-policy instruments, reflects the second impact of policies: on the unit fixed cost $\tilde{F}_i^j$ through new firms, *n*, thus coined by the *average cost effect* (Horstman & Markusen, 1986).

Actually, the unobserved $\bar{T}_i^j$ affects the expected positive correlation between $x_i/x^*_i$ and home's relative exports under free trade, related to the unobserved cost terms. That is, the incentives within $\bar{T}_i^j$ enlarge the relative size of home's industries too, but its consequent impact on average costs implies a negative correlation between $x_i/x^*_i$ and home's relative exports. These opposite impact of (7) and (8) are worked out below.

## II.3 The International Comparative Industries Size

From the above outlined changes in $\theta_i$, $F_i$ and ***wa*** follows distinct supply function of home and foreign industries, implying two equilibrium vectors giving the international size of their respective according to (4). Therefore, the relative size of each home industry *i* can be given from the ratio (4')/(4'*), the apostrophe standing for the transformed (4) and the asterisk for the foreign economy.

In both (4') and (4'*) we must also adjust $S_i$ to its international size $S_i^w = \delta_i(\pi_i Y_t^w)$, where $\delta$ represents the domestic share in the world sale of industry *i* and $Y^w$ the world income. Finally, total relative sales $x_{it}$ and $x^*_{it}$ are replaced by relative exports from home and foreign to the rest of the world, respectively. Hence, (4')/(4'*) yields:

$$x_{it} / x_{it}^* = \beta_{0i} + (\delta_i - \delta_i^*)\eta_{it} - \beta_2\left(\frac{w_t^u a_{i,t}}{w_t^{u*} a_{i,t}^{u*}}\right) - \beta_3\left(\frac{w_t^s a_{it}^s}{w_t^{s*} a_{it}^{s*}}\right) + \beta_4 F_{it} + \beta_5\left(\frac{Y_{it}}{Y_{it}^*}\right) - \beta_6 T_{it} + \varepsilon_{it}, \qquad (9)$$

where the revealed comparative advantages, $x_{it}/x^*_{it}$, replaces the alternative country's net exports, $\beta_{oi}$ are the industry-specific intercepts and $\varepsilon_{it}$ the random errors. The marginal costs $w^u a^u$ and $w^s a^s$ stand for unskilled and skilled labor, respectively.

The coefficient ($\delta_i$-$\delta_i^*$), related to a non-cost monopolistic competition term, can be referred to home's stride in the world's most demand-dynamic industries, which can be assigned to human capital formation or to effective international learning (Currie *et al.*, 1999, Pasinetti, 1981).

Variable $F_i$ is an international measure of fixed cost, following (8), so the coefficient of home's industries size, $\boldsymbol{Y_{it} / Y_{it}^*}$, gathers the mentioned correlation of both unobserved costs and trade-policy instruments with comparative advantages. Therefore, while $T_{it}$ captures market power, or the *international competition effect* of trade policy, $\boldsymbol{Y_{it} / Y_{it}^*}$ captures both the *average-cost* (*or scale*) *effect* and the unobserved costs.

Notice that $\boldsymbol{Y_{it} / Y_{it}^*}$, controlled for several terms of comparative cost advantages, has a correspondence with total factor productivity (TFP), used by Harrigan (1997) to identify difference in productivity (*i.e.*, comparative advantages)[3]. Here, after fully accounting for comparative costs and market power, this TFP term gain an additional meaning, especially if its coefficient turns out to be negative.

## III. Data and Variables

Let us write our comparative cost model (9) into a named form:

$$VCR_{it} = \beta_{1i} + \beta_2 YEL_{it} - \beta_3 CPCOST_{it} - \beta_4 SCPCOST_{it} + \beta_5 SCALE_{it} + \beta_6 SIZE_{it} - \beta_7 TAR_{it} + \varepsilon_{it} \qquad (10)$$

where $VCR_{it}=x_{it}/x^*_{it}$, $YEL_{it} = \eta_{it}$, $CPCOST_{it} = w_{it}^u a_{it}^u / w_{it}^{u*} a_{it}^{u*}$ and $SCPCOST_{it} = w_t^s a_{it}^s / w_{it}^{s*} a_{it}^{s*}$, $SIZE_{it} = Y_{it} / Y_{it}^*$, $SCALE_{it} = F_{it}$ and $TAR_{it} = T_{it}$, with $i$ spanning over twenty industries (three digits ISIC with some slight adjustment to available evidence) and $t$ over four periods (1967, 1973, 1980 and 1987-88), with a slight deviation for some variables. This *cross-section time series* dimension made the dearth of international compatible data more stringent. Data sources are found in the Data Appendix. Lastly, the foreign economy is a set of five countries (the USA, Japan, Germany, the UK

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[3] See also Maskus & Webster, 1999.

and Italy), taken as an integrated economy and encompassing the then world's six largest countries, except France for lack of detailed data of labor.

Hence *RCA*= $x_{it}/x^*_{it}$ is such that $x^*_{it} = \sum_{ij}(X^j_{it} / X^j_t)$, $X^j_{it}$ standing for each *j* country's exports of industry *i* at *t*, and $X^j_t$ for its total manufacture exports. Variable $YEL_{it}$, standing for worldwide demand dynamism, comes from:

$$\eta_{it} = \frac{X^w_{it} / X^w_{i,t-1}}{Y^w_t / Y^w_{t-1}},$$

where $X_i^w$ is the world's exports of industry *i* and $Y_t^w$ is the world total exports of all industries (i.e., not only manufacturing). The latter could be given by the world *value added* of tradable-goods sectors, but it was not available.

In the marginal comparative costs *CPCOST* and *SCPCOST*, the inputs $a^l_{it}=l_{it}/y_{it}$ and $a^*_{it} = \Sigma_j l^j_{it} / (\Sigma_j y^j_{it})$, "employment/value added", differ from the type of labor: $l^u_{it}$ are the operatives and $l^s_{it}$ office and professionals, corresponding to unskilled and skilled labor, respectively. Three prices for *w* and $w^s$ are considered:

*CPCOST1* and *SCPCOST1*: given by the mean wages of operatives and technical/ professionals of each industry;

*CPCOST2* e *SCPCOST2*: given by the proportion of the population with secondary and tertiary school levels, respectively;

*CPCOST3* e *SCPCOST3*: given by the population with secondary and tertiary school levels, respectively, with respect to land size.

As in Brainard (1997), *SCALE* is given by "*value added/number of employees*" of the integrated foreign economy, standing for plant economies of scale, whereas *SCALBR* is given by the same ratio in the local economy. These variables for economies of scale are, characteristically, nominal variables, so that, to smooth their steady growth over time, they are considered at constant prices and transformed to logarithm. The composite *DSCALE*=*SCALExWSIZE* $= y_{it} / \sum_j l^*_{it,j}$, stands for the economies of scale adjusted to the host-industry size, where $WSIZE_{it} = y_{it} / \sum_j y^*_{it}$ is the relative world size of host-industry *i*. Since it carries comparative advantage information, in the location model we also try the domestic size: *DSIZE*= $y_{it} / \sum_{ij} \bar{y}^{*}_{ij,t}$ ; each domestic industry size $y_{it}$ with respect to the average manufacturing output of the foreign economy.

$TAR_{it}$ is the *effective rate of protection* and $TNOM_{it}$ the nominal tariffs; both for Brazil. Not accounting for tariffs in the foreign economy, due to the lack of corresponding panel data, amounts to assuming that the foreign manufacturing industry operated as if under free trade, as compared to Brazil – a reasonable hypothesis for the period[4].

All revenue and cost variables are considered at the current market costs:

$$R_i=[p_i^*(1+T_i)].x_i, \tag{11}$$

which means not deflating them by $p_i=p_i^*(1+T_i)$ in the local economy, otherwise we would not be able to single out the effect of $\bar{\tau}_i^j$ upon $R_i$, *i.e.*, that part of $T_i$ other then *TAR*.  is a restrict information of trade policy, we remove.

## IV. Trade Policy in Brazil

A previous overview of Brazil's performance and trade policy is useful for understanding the estimates of the model. And we begin with a graphical analysis of the bounded *RCA* (see Benedicts, 2005), given by:

$$b_{it} = \frac{RCA_{it} - 1}{RCA_{it} + 1}, \tag{12}$$

which is limited to the interval $-1 \leq b \leq 1$: positive (negative) values indicating comparative advantages (disadvantages). Industries are further classified by technology groups, according to Lall (2000): resources based (RB), food stuff, beverages, rubber, wood and non-metals; low technology (LT): furniture, leather and furs, clothing & shoes, metals and textiles; medium technology (MT):

[4] International evidence of *TNOM* for several industries and countries are only available for 1980 on.

transport equipments, plastics, printing & publishing, mechanical equipments, chemicals and tobacco[5]; high technology (HT): electrical materials, other chemicals and other sectors.

Two scatter diagrams of these categorized RCA are shown in Figures 1 and 2, where the horizontal and vertical axes stand for the initial and final period, respectively, so that points below the diagonal represent a fall with respect to the initial period.

According to Figure 1, in 1967, more than a decade after the beginning to the classical period of import substitution industrialization (ISI), Brazil had comparative advantages in only two industries belonging to the *RB* group. In 1973, two LT industries attain positive RCA. By the end of this policy experience, 1987-88, three more industries from the RB and LT groups attained RCA. Hence, no MT or HT achieved comparative advantages, in spite of the massive policy incentives to and growth of these industries (Evans, 1980; Tigre & Evans, 1989). In sum, the evidence of artificially enlarged industries is rather blatant, as already shown by systematic empirical analyses around the export subsidies or the effective protection in Brazil (SAVASINI, 1983; Tyler, 1983).

Figure1 RCA'1967x1973

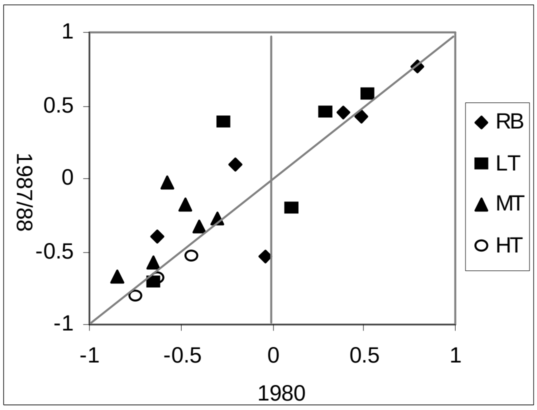
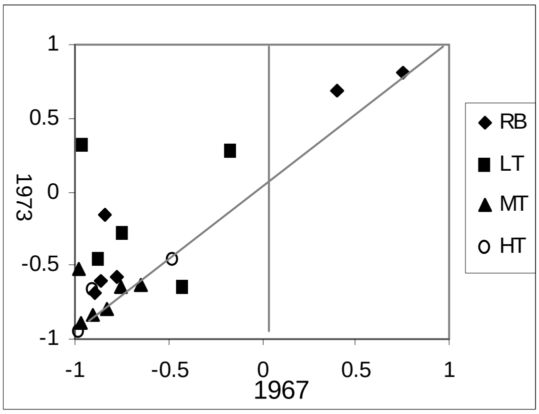



Figure2RCA'1980x1987/88'



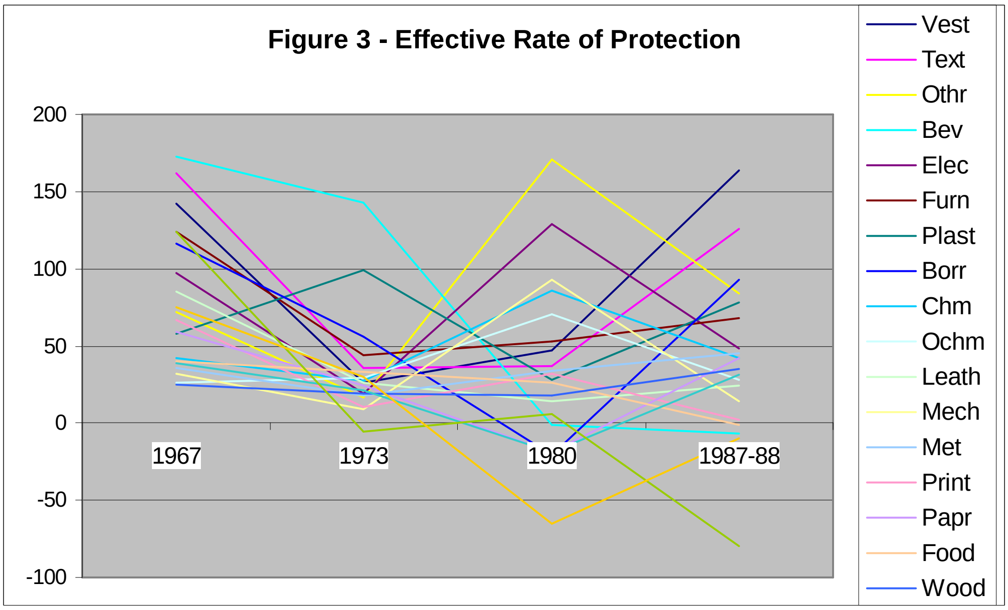

Sources: UN, *International Trade Statistics Yearbook.* New York, various years.

Policy incoherence, very common when trade intervention is strong and pervasive (Paulino, 2002), provides a clue. As shown in Figure 3, the effective rate of protection experienced a very erratic movement. A uniform movement (of fall) happened only in the 1967-73 period, that of the

[5] Unlike Lall (2000), who classified Tobacco as *RB*, we classify it as MT because, in Brazil, the world's two leading firms dominate this industry, with reasonable technology exclusivity.

highest stability and economic growth. Afterwards, the effective protection grew and became quite unsystematic, as shown their *zig-zags*.

One must also notices that Brazil's trade policy was distinguished by huge export subsidies (Bruton, 1989; Moreira, 1999), especially after 1973, aimed at compensating the anti-export bias of the import-protection schema (Fristch & Franco, 1994). And in a context of higher and pervasive policies, their coordination becomes a distant goal, falling prey to political circumstances.




Another reason for those disappointing RCA's changes is economic characteristics. In Table 1 we see that the low "skilled/unskilled labor" proportion in Brazil, relatively to the foreign economy, only reduced from 1/6 to ¼, from 1967 to 1988; quite humble when compared to the Asian Tiger[6]. At the same time, the abundance of Land became even higher along this period. Brazil's persistent disadvantages in the MT and HT's industries then seem rather natural, despite their *GDP* growth.

[6] See World Bank, World Development Indicators (1998) and Freeman & Soete (1997).

| Table 1: Factor Endowments: Brasil x Developed Countries[¥] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Skilled/Unskilled Labor* | | | | Skilled Labor/Land** | | | |
| | 1967 | 1973 | 1980 | 1987-88 | 1967 | 1973 | 1980 | 1987-88 |
| Brasil | 0,016 | 0,050 | 0,055 | 0,051 | 0,001 | 0,004 | 0,006 | 0,006 |
| Desenvolvidos | 0,097 | 0,132 | 0,189 | 0,207 | 0,019 | 0,029 | 0,037 | 0,039 |

UNESCO. Statistical Yearbook, Paris, UNESCO, several years, and FAO in http://faostat.fao.org/site/418/DesktopDefault.aspx?PageID=418 >, accessed in 04/23/2007.
[¥]: the five analyzed countries, taken as an integrated economy. (*) Skilled Labor: number of people 15 to 65 years old having the tertiary-school level.
(**) Unskilled Labor: number of 15 to 65 years old people having the secondary-school level;
(***) Productive Land in Hectares.

## IV. Estimation Results

We estimated the $\beta_{1i}$ of model (10) as *fixed-effects*, that is, as industry-specific, and almost all betas coefficients attained statistical significance. The opposite happened with the *random effects* specification, suggesting that these random $\beta_{1i}$ are correlated with the independent variables (Verbeek, 2000)[7].

Estimates in Tables 2 and 3 are arranged into three groups, according to the distinct measures of marginal comparative costs. In Table 3, we have an additional measure for corporate fixed costs. Parameters in bold letters indicate no statistical significance.

The coefficient sign of *YEL* show that the country did not thrive in the world's most expansive industries. Since this non-price competition term is supposed to be related to skilled-intensive activities (MUSCATELLI, 1995), the result fits to the low evolution of labor qualification in Brazil.

The comparative marginal cost variables – *CPCOST1-SCPCOST1; CPCOST2-SCPCOST; CPCOST3* – are inversely related to *RCA*, as expected. The small sample size and collinearities explain the statistical non-significance of some coefficients. The coefficient of *SCPCOST3* is, contrarily, positive, which makes some sense before Table 1: relatively to Land, the scarcity of skilled labor is enormous, making the use of this factor inherently inefficient in some activities. However, models with the *CPCOST3- SCPCOST3* have the least goodness of fit.

[7] The Hausmann test for fixed against random effects could not be applied because the estimated covariance matrix of its coefficients is not positively definite – a not-so-rare result in small samples (Verbeek, 2000).

*SCALE* and *DSCALE* are both negative, showing that Brazil's comparative advantages did not rest on industries with higher plant-level unit fixed costs, which is possibly related to skilled-labor intensity of these cost, as shown in Antweiler & Trefler (2002).

**Table 2: Estimates of the Comparative Advantages Model**

| Independent Variables | (i) | (ii) | (iii) | (iv) | (v) | (vi) | (vii) | (viii) | (ix) |
|---|---|---|---|---|---|---|---|---|---|
| | Dependent Variable: *RCA* | | | | | | | | |
| C | 4,421 | 4,034 | 4,273 | 4,316 | 3,966 | 4,058 | 4,732 | 4,028 | 4,312 |
| | (0,326) | (0,202) | (0,181) | (0,453) | (0,717) | (0,133) | (0,641) | (0,849) | (0,326) |
| YEL | -0,064 | -0,082 | -0,061 | -0,072 | -0,084 | -0,082 | -0,087 | -0,084 | -0,106 |
| | (0,027) | (0,035) | (0,027) | (0,020) | (0,024) | (0,019) | (0,027) | (0,022) | (0,035) |
| CPCOST1 | **-0,121** | -0,477 | **-0,068** | | | | | | |
| | **(0,126)** | (0,100) | **(0,125)** | | | | | | |
| SCPCOST1 | -0,444 | -0,446 | -0,466 | | | | | | |
| | (0,032) | (0,102) | (0,049) | | | | | | |
| CPCOST2 | | | | -0,385 | -0,432 | -0,385 | | | |
| | | | | (0,036) | (0,049) | (0,028) | | | |
| SCPCOST2 | | | | -0,211 | **-0,223** | **-0,060** | | | |
| | | | | (0,121) | **(0,180)** | **(0,096)** | | | |
| CPCOST3 | | | | | | | -0,444 | -0,683 | -0,516 |
| | | | | | | | (0,097) | (0,083) | (0,127) |
| SCPCOST3 | | | | | | | **-0,020** | 0,170 | 0,105 |
| | | | | | | | **(0,082)** | (0,068) | (0,046) |
| SCALE | -0,213 | -0,126 | | -0,216 | -0,182 | | -0,245 | -0,181 | |
| | (0,028) | (0,012) | | (0,042) | (0,062) | | (0,057) | (0,075) | |
| DSCALE | | | -0,228 | | | -0,224 | | | -0,230 |
| | | | (0,028) | | | (0,020) | | | (0,031) |
| SIZE | -1,786 | -2,297 | -1,696 | -1,551 | -1,635 | -1,352 | -2,002 | -2,004 | -1,888 |
| | (0,205) | (0,183) | (0,159) | (0,146) | (0,164) | (0,088) | (0,206) | (0,203) | (0,221) |
| TAR | -0,236 | | -0,204 | -0,108 | | -0,089 | -0,129 | | -0,094 |
| | (0,011) | | (0,013) | (0,051) | | (0,038) | (0,038) | | (0,028) |
| TNOM | | -0,255 | | | **0,049** | | | **0,068** | |
| | | (0,046) | | | **(0,039)** | | | **(0,045)** | |
| N. Obs. | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 |
| Adjusted $R^2$ | 0,812 | 0,871 | 0,797 | 0,669 | 0,674 | 0,704 | 0,658 | 0,650 | 0,673 |
| *F*-statistics | 14,101 | 21,479 | 12,905 | 7,148 | 7,291 | 8,232 | 6,837 | 6,638 | 7,263 |
| F (*P-value*) | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |

Coefficients in bold letter are statistically insignificant: *P-value* > 10%.

The negative coefficient of *TAR* shows, in accordance with the *international competition effect*, that the consequent higher markup reduces international competitiveness. The causation may be thought in the other way around, as in the competitive analysis: the least competitive sectors demanded the highest protection, but the structure of protection in Brazil had not such a coherence (Terra et al, 2006; Tyler, 1983), as otherwise corroborated by the (dominant) positive coefficients of *TNOM*. Hence, considering the market structure, we cannot avoid the *markup effect* on the RCA, underlying the *TAR*'s coefficient.

Finally, *SIZE* is inversely related to revealed comparative advantages, the opposite of the free-trade prediction under limited information of marginal costs: that largest industries would present the highest *RCA.* However, this negative correlation fits to the predicted effect of the unobserved trade-policy variables, when favoring industries without comparative advantages. This means that these industries where operating with higher average costs, as reinforced by the negative coefficient.

In Table 3 we show the estimates of the previous model amplified by corporate scale, *CSCALE* (or *DCSCALE*), expected to be more skilled-labor intensive than *SCALE* (*DSCALE*). One central goal of this richer technology characterization is to attain more accurate results about the true content of *SIZE.*

The coefficient sign of the variables are equal to the previous model, except the plant-level returns to scale, in some cases, meaning that the correlation between trade pattern and fixed costs changes once we consider corporate fixed cost. As expected, from the nature of these new variables, higher collinerity caused an increase in the bold coefficients, concentrated in the variables for marginal and fixed costs. Lastly, the models with the greatest goodness of fit are those with the most realist marginal costs, *CPCOST1* and *SCPCOST1*, as before.

**Table 3 – Estimates of the Amplified Comparative Advantages Model**

| Independent Variables | Dependent Variable: *RCA* (i) | (ii) | (iii) | (iv) | (v) | (vi) | (vii) | (viii) | (ix) |
|---|---|---|---|---|---|---|---|---|---|
| C | 5,191 | 5,050 | 5,021 | 4,864 | 5,404 | 4,048 | 5,143 | 4,485 | 3,861 |
| | (0,529) | (0,409) | (0,225) | (0,583) | (0,414) | (0,416) | (0,627) | (0,825) | (0,610) |
| YEL | -0,064 | -0,089 | -0,086 | -0,076 | -0,107 | -0,072 | -0,093 | -0,081 | -0,100 |
| | (0,022) | (0,046) | (0,029) | (0,024) | (0,023) | (0,024) | (0,036) | (0,028) | (0,037) |
| CPCOST1 | **-0,198** | -0,402 | **-0,108** | | | | | | |
| | **(0,170)** | (0,112) | **(0,099)** | | | | | | |
| SCPCOST1 | -0,288 | -0,400 | -0,405 | | | | | | |
| | (0,088) | (0,150) | (0,038) | | | | | | |
| CPCOST2 | | | | -0,405 | -0,498 | -0,408 | | | |
| | | | | (0,040) | (0,067) | (0,049) | | | |
| SCPCOST2 | | | | -0,238 | -0,349 | **-0,027** | | | |
| | | | | (0,123) | (0,174) | **(0,082)** | | | |
| CPCOST3 | | | | | | | -0,445 | -0,642 | -0,410 |
| | | | | | | | (0,122) | (0,240) | (0,142) |
| SCPCOST3 | | | | | | | **-0,095** | **0,052** | **0,051** |
| | | | | | | | **(0,087)** | **(0,102)** | **(0,084)** |
| SCALE | **-0,034** | **-0,027** | | **-0,102** | **0,025** | | **-0,128** | **-0,087** | |
| | **(0,105)** | **(0,109)** | | **(0,091)** | **(0,135)** | | **(0,141)** | **(0,232)** | |
| DSCALE | | | 0,073 | | | -0,182 | | | -0,221 |
| | | | (0,030) | | | (0,090) | | | (0,123) |
| CSCALE | -0,237 | **-0,189** | | **-0,149** | -0,300 | | **-0,138** | **-0,115** | |
| | (0,130) | **(0,127)** | | **(0,094)** | (0,117) | | **(0,115)** | **(0,218)** | |
| CDSCAL | | | -0,339 | | | **-0,041** | | | **0,025** |
| | | | (0,023) | | | **(0,102)** | | | **(0,119)** |
| SIZE | -1,720 | -2,278 | -1,652 | -1,499 | -1,704 | -1,257 | -2,014 | -2,156 | -1,737 |
| | (0,388) | (0,349) | (0,167) | (0,098) | (0,118) | (0,062) | (0,169) | (0,192) | (0,205) |
| TAR | -0,131 | | -0,188 | -0,109 | | -0,082 | -0,136 | | -0,098 |
| | (0,050) | | (0,051) | (0,045) | | (0,038) | (0,041 | | (0,045) |
| TNOM | | -0,153 | | | **0,063** | | | **0,018** | |
| | | (0,082) | | | **(0,045)** | | | **(0,112)** | |
| N. Observations | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 |
| Adjusted $R^2$ | 0,704 | 0,739 | 0,767 | 0,668 | 0,699 | 0,733 | 0,658 | 0,668 | 0,682 |
| *F*-statistics | 7,968 | 9,291 | 10,648 | 6,882 | 7,788 | 9,044 | 6,629 | 6,893 | 7,257 |
| *F* (P-value) | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |

Coefficients in bold letter are statistically insignificant: *P-value* > 1.0%.

Regarding plant-level economies of scale, only *DSCALE*, adjusted to domestic market sizes, exhibits statistical significance. Differently, for corporate cost one such adjustment reduces the significance, as if these inputs were less sensitive to domestic market size. We should warn that, unlike *SCALE*, higher values of *CSCALE* or *CDSCALE* stand out for industries less intensive in these firm-specific inputs. Therefore, the negative coefficients of corporate fixed cost, except for the last column of Table 3, mean that Brazil's comparative advantages in the manufacturing industry do rest in these exclusive inputs.

All these results are conditional to an international (common) technology, based on the foreign economy, which represented about 2/3 of the world production or trade of these activities at the covered period, as the best measure of fixed costs at both plant level and research & management-level. Indeed, such a technology ordering of the twenty analyzed sectors, regardless of the Brazilian economy, especially with respect to *CSCALE* (*DSCALE*), best translates our theoretical modeling. However, this might not be true, especially for plant-level economies of scale.

Accordingly, as a last try, we allow for technology adjustments from both domestic scale and factor prices, that is: *SCALBR*=[(value added/employees) in Brazil] and *CSCALBR*=[(value added/office and technical) in Brazil]. Estimates of this model are shown in the below Table 4.

The goodness of fit of this model is superior to the previous one, and no important change in the coefficient signs occurs, except in *SCALBR*, which becomes always negative, including column (i), in which it attains statistical significance. Inasmuch as these variables are more comprehensive, we cannot rule out the inverse correlation between plant-scale economies and comparative advantages. Besides, *CSCALBR* attains statistical significance in all variations of the baseline model, meaning that this fixed-cost measure is more meaningful for explaining Brazil's comparative cost advantages.

**Table 4 – Estimates of the Comparative Advantages Model with Domestic Fixed Cost**

| Independent Variables | Dependent Variable: RCA (i) | (ii) | (iii) | (iv) | (v) | (vi) |
|---|---|---|---|---|---|---|
| C | 5,924 | 6,617 | 5,732 | 6,209 | 5,764 | 5,702 |
| | (0,511) | (0,643) | (0,941) | (0,516) | (1,084) | (1,078) |
| YEL | -0,146 | -0,201 | -0,131 | -0,158 | -0,192 | -0,139 |
| | (0,025) | (0,076) | (0,066) | (0,036) | (0,059) | (0,041) |
| CPCOST1 | -0,185 | -0,436 | | | | |
| | (0,106) | (0,092) | | | | |
| SCPCOST1 | -0,422 | -0,446 | | | | |
| | (0,061) | (0,111) | | | | |
| CPCOST2 | | | -0,448 | -0,578 | | |
| | | | (0,054) | (0,079) | | |
| SCPCOST2 | | | **-0,105** | **-0,036** | | |
| | | | **(0,121)** | **(0,197)** | | |
| CPCOST3 | | | | | -0,447 | -0,765 |
| | | | | | (0,129) | (0,188) |
| SCPCOST3 | | | | | **0,010** | 0,248 |
| | | | | | **(0,102)** | (0,104) |
| SCALBR | -0,052 | **-0,013** | **-0,072** | **-0,025** | **-0,074** | **-0,071** |
| | (0,028) | **(0,084)** | **(0,063)** | **(0,081)** | **(0,067)** | **(0,089)** |
| CSCLBR | -0,277 | -0,325 | -0,260 | -0,344 | -0,247 | -0,250 |
| | (0,047) | (0,046) | (0,095) | (0,080) | (0,093) | (0,088) |
| SIZE | -1,940 | -2,822 | -1,667 | -1,791 | -2,129 | -2,178 |
| | (0,184) | (0,292) | (0,049) | (0,066) | (0,223) | (0,306) |
| TAR | -0,213 | | **-0,100** | | -0,121 | |
| | (0,031) | | **(0,079)** | | (0,054) | |
| TNOM | | **-0,062** | | 0,152 | | **0,106** |
| | | **(0,063)** | | (0,048) | | **(0,081)** |
| N. Obs. | 77 | 77 | 77 | 77 | 77 | 77 |
| Adjusted $R^2$ | 0,807 | 0,836 | 0,756 | 0,790 | 0,754 | 0,778 |
| $F$-statistics | 13,245 | 15,851 | 10,037 | 12,006 | 9,981 | 11,223 |
| $F$ ($P$-value) | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |

Coefficients in bold letter are statistically insignificant: *P-value* > 10%.

Regarding *SIZE*, which was the main goal of all these variations in the empirical specification, we observe that its sign did not change both in Tables 3 and 4. In the former it shifted to even higher negative values, so that the previous conclusions remains the same. Once more, the negative correlation of that this productivity-like variable, resembling the total factor productivity in Harrigan (1997), with industries' relative exports in an imperfectly competitive economy implies, following Horstmann & Markusen (1986), higher average costs.

In reality, we only know that the higher industry-specific productivity in activities having comparative advantages, and rather expressing the unobserved cost variables, was outweighed by the higher comparative average costs, from unobserved trade-policy variables. On the other hand, domestic firms were operating in the efficiency border regarding the marginal costs. The question is to each point the higher average cost, from the first relationship; add up, given the efficiency in the marginal costs? Can we have a unique measure, close to the domestic resource cost in competitive economies, which would work as an indicator of productive inefficiency?

One possible response, towards such a more concise measure of efficiency gains (or losses), is eliminating both *SIZE* and all fixed-cost variables, so that the remaining *CPCOST* and *SCPCOST* will stand out as total comparative costs and thus of comparative average costs. Both *YEL* and *TAR* are maintained, though, for not being related to fixed costs. The estimates of this model are shown in Table 5, below.

**Table 5. The Restricted Comparative Export Model**

| Independent Variables | Dependent Variable: RCA (i) | (ii) | (iii) | (iv) | (v) | (vi) |
|---|---|---|---|---|---|---|
| C | 0.962 | 0.899 | 1.041 | 1.017 | 0.978 | 1.033 |
| | 0.118 | 0.130 | 0.129 | 0.113 | 0.075 | 0.075 |
| YEL | -0.047 | -0.115 | **-0.060** | **-0.054** | -0.098 | -0.135 |
| | 0.043 | 0.075 | **0.048** | **0.049** | 0.054 | 0.069 |
| CPCOST1 | 0.510 | 0.718 | | | | |
| | 0.161 | 0.240 | | | | |
| SCPCOST1 | -0.214 | -0.237 | | | | |
| | 0.117 | 0.136 | | | | |
| CPCOST2 | | | **-0.120** | -0.345 | | |
| | | | **0.096** | 0.142 | | |
| SCPCOST2 | | | 0.595 | 0.555 | | |
| | | | 0.266 | 0.229 | | |
| CPCOST3 | | | | | **-0.035** | **-0.191** |
| | | | | | **0.120** | **0.154** |
| SCPCOST3 | | | | | 0.866 | 0.860 |
| | | | | | 0.126 | 0.138 |
| TAR | -0.175 | | **-0.064** | | **-0.043** | |
| | 0.063 | | **0.066** | | **0.055** | |
| TNOM | | **-0.107** | | 0.231 | | **0.072** |
| | | **0.081** | | 0.109 | | **0.073** |
| N. Observations | 77 | 77 | 77 | 77 | 77 | 77 |
| Adjusted R2 | 0.718 | 0.764 | 0.743 | 0.737 | 0.757 | 0.723 |
| F-statistics | 9.412 | 11.678 | 10.547 | 10.255 | 11.292 | 9.644 |
| P-value (of F) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Coefficients in bold letter are statistically insignificant: *P-value* above 10%.

Regardless of either *TAR* or *TNOM*, the coefficients of marginal comparative costs shift to positive in half of the cases, and always with statistical significance, unlike the negative ones. Therefore, inefficiency in resource allocation, thanks to myriad of (unobserved) policy instruments, went to a point that home's (Brazil) relative exports in the manufacturing industry were the greatest in sectors with the higher comparative costs. Two income losses may underline such an allocation of resources towards sectors with higher comparative costs: lower economies of scale and higher marginal cost (see Harris, 1984), though our previous analysis showed that only the former actually happened.

## V. Conclusions

The monopolistic competition model of comparative advantages, conceived to also handle some limited evidence of policies and costs, provided good evidence about static and dynamic impact of trade policy on productive efficiency. The main result is that the economy operated efficiently regarding marginal cost, but that domestic resources were not efficiently allocated among the manufacturing industries, as revealed by the negative correlation of the index of comparative productivity to RCA, implying production with higher average costs.

Analyzed over the last two decades of Brazil's ISI, the model also showed that the economy did not succeed to attain comparative advantages in the most demand-expansive international industries, as sought by import substitution. Moreover, the effective rate of protection remained inversely related to RCA, meaning that the negative *international competition effect* dominated.

Finally, restricting our model so as to attain a more concise measure of productive efficiency, we obtained that, controlling for the market power, the allocation of resources, as expressed by relative exports (RCA) went to sectors with higher comparative costs.

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## Data Appendix: Variables and Sources.

***RCA***: UNCTAD, *Handbook of International Trade and Development Statistics*, *International Trade Statistics Yearbook*, and IBGE, *Anuário Estatístico do Brasil.* All in current US dollars.

***YEL*****:** the same as *RCA* and also UN's *Commodity Trade Statistics Database.*
***CPROD, CPCOST, GSCALE***, ***GSIZE*** and ***SIZE***: UNIDO, *Industrial Statistics Database.* UN, *Yearbook of Industrial Statistics,* and *The Growth of the World Industry*, all over several volumes. IBGE (idem). As explained, the valued-added underlying ***GSCALE***, ***GSIZE*** were deflated, and by the US and Brazil's GDP deflator, respectively.
***TAR*** and ***TNOM***: Bergsman & Malan (1971); Neuhauss & Lobato (1978); Tyler (1983), and Kume (1989).