Technology Service and Factor Intensity:

The Export Impact From Multinationals

Carlos A. Cinquetti
São Paulo State University – UNESP
cinquett@fclar.unesp.br

Abstract

We develop an industry-level model to examine the impact of multinational firms (MNFs) on revealed comparative advantages (RCA), predicting that it stems from firms' *technology service* and *factor-intensity*. Based on Brazilian manufacturing industries during the import-substitution period, compared to a set of developed countries, the panel data estimates show that *FORGN* (multinationals' share in industries) negatively affected *RCA*, due to *location advantages* in industries intensive in skilled labor; or else to horizontally integrated MNFs, shown by the estimates of firms' location model. In order to control the errors stemming from unobserved variables, we estimate a structural RCA model, where the latent distribution of FORGN is given from the production regime model, which shifts its coefficient to positive.

Key words: multinationals, exports, host-country, tecnologia.

Resumo

Desenvolvemos um modelo à nível de indústria para examinar o impacto das empresas multinacionais (EMNs) nas vantagens comparativas reveladas (VCR), o qual decorreria dos efeitos "serviços tecnológicos" e "intensidade de fator" subjacentes à atividade destas firmas. Baseado em evidências da indústria brasileira durante o período da substituição de importações, as estimativas dos dados em painel mostram que *FORGN* (fração das multinacionais nas indústrias) afeta negativamente as *VCR*, devido ao tipo horizontalmente integrado das EMNs, ou à vantagens de localização em indústrias intensivas em trabalho qualificado. Afim de controlar o efeito de variáveis políticas não observadas, estimamos um modelo estrutural das VCRs, onde a latente distribuição de FORGN é dada pelo modelo "regime de produção", o que leva à mudança para positivo no coeficiente daquela variável.

Palavras chaves: Multinacionais, Exportações, país-hóspede, tecnologia

JEL classification: F13, F23, 014

Área 6 – Economia Internacional

1. Introduction

Theoretical models of international trade with multinational firms (MNFs), fully developed by the middle 1990s[1], inspired a wave of empirical tests about the emergence and location of these firms (Brainard 1997; Norback, 2000; Hanson *et al.*, 2005). These applied general-equilibrium studies have not investigated, however, the impact of foreign affiliates upon country's trade volume, excepting Sleuwaegen & Backer's (2001) whose analysis does not theoretically develop the relationships between MNFs' activities and host country's outcome.

Lack of data is part of the difficulties. Any analysis around MNFs and trade volume must be connected to some sort of industry-level data, turning the collection of firm-level data in a multi-country framework, as the above commented, too difficult. Modeling is another source: the two-sector theoretical models – multinationals operating in one industry alone – give a poor setting about the impact of MNFs activities on domestic resources allocation in a *N-industries* economy. One must recall that distinct reasons may underline the MNFs presence across industries – market proximity or factor prices – each one having a particular industry orientation and thus trade impact.

In the present paper, we attempt an industry-level model to empirically analyze the impact of multinational firms on host country's trade (exports), which greatly draws on Markusen &Venables (1998 – M&V henceforth) and Zhang & Markusen (1999), regarding the impact of industries' production regimes (multinationals' share in industry output) on trade volume. In fact, our model encompasses both types of MNFs (vertically or horizontally integrated), any of each is to be revelaed by the location pattern of the production regime.

The modeling is set up for a monopolistic competition structure, from which we obtain that the host economy revealed comparative advantages (*RCA*) is determined by *world income elasticity, comparative marginal cost,* and *international competition.* As fixed costs are detailed, in the form of firm-specific technology (F) and plant cost (G), the endogenous emergence of multinational firms follows immediately, as developed in a location model, expressed by industries production regime. This model helps us both to empirically characterize the MNFs' type and to theoretically deduce the amplified export model in which F, associated with skilled labor, is particularized by firm type. In this latest step, we obtain that the impact of MNFs on *RCA* stems from (i) technology service and (ii) the factor-intensity of their activity.

Estimates of the production regime model and, secondly, a descriptive statistical analyses around the location pattern of foreign affiliates in Brazil are used as further evidence of these two impacts, namely of (ii). However, they cannot solve the problem of obtaining the true value of each of these effects in the presence of unobserved policy variables. We tackle this last problem by re-estimating the *RCA* model with an endogenous regressor for MNFs, expressing the latent distribution of foreign affiliates, as given by some variations of the production regime model. This endogenous (or latent) variable is meant to control the policy-induced orientation of MFNs towards anti-trade activities. Indeed, estimates show that the coefficient sign of predicted MNFs upon *RCA* is distinct, as compared to the observed one.

The panel data is based on Brazil, a large and protected less developed countries (LDCs), whose market size and abundant unskilled labor attract both *horizontal and vertical* MNFs. More to the point, we take Brazil during its import-substitution industrialization – the

[1] Including distance (transport-cost). See Markusen (1984), Helpman (1984), Ethier (1986), Brainard (1993), Markusen & Venables (1998), Ethier & Markusen (1996), and Zhang & Markusen (1999).

leading FDI's (Foreign Direct Investment) receptor among LDCs in that period[2] - with respect to a set of six developed countries, covering twenty manufacturing industries over four years from the late 1960s to the late 1980s.

The paper is structured as follows: models are worked out in Section 2. In Section 3, we describe the variables and, in Section 4, we show and interpret the estimations. Estimation of the Structural RCA model is exposed in Section 5. Conclusions follow.

2. Export Contribution by Multinationals: Theory and Empirical Specification

2.1 Trade Model

Consider an integrated world economy producing homogenous agricultural goods, *g,* with unskilled labor and under constant return to scale, and various differentiated manufactured goods, *m,* with both unskilled and skilled labor and under increasing returns.

Consumers' preferences follow the function:

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

where X stands for the consumption (sales) of each product and the superscripts for their respective share in total consumption, with $\pi_m = \sum \pi_i$ of each manufactured goods (industry) *i.*

Given budget restrictions, *Y,* the demand for each manufacturing industry will be:

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

where $S_i = \pi_i Y$ is the price-independent component of industry size and $p_i = \theta c_i$ is the monopolist optimum price: a markup θ_i over marginal cost c_i (with unskilled labor). Profits are zero, so that θ covers only the fixed costs.

Consumers' preferences for varieties of manufactured goods *i* follow a subutility CES (constant elasticity of substitution) function for *love of variety,* so that the price-elasticity of demand $\sigma = (1/1-\theta)$ equals the elasticity of substitution among varieties, when firms have a negligible effect on the marginal utility of income (Helpman & Krugman, 1985, ch. 6).

For empirically analyzing (2) over time, a subscript *t* is added to each variable, and to linearize it, we normalize (2) by total sales $X_t = \Sigma X_{it}$, which have a fixed proportion to total income, Y_t, yielding the following stochastic equation:

$$x_{it} = \alpha_0 + \alpha_1 \pi_{it} - \alpha_2 (w_t a_{it}) - \alpha_3 \theta_{it} + \upsilon_{it} . \tag{3}$$

The $x_{it} = X_{it}/X_t$ stands the relative sales of manufactured goods *i* at time *t,* υ_{it} is the random error and $w_t a_{it} = c_{it,}$ since marginal cost. The term π_{it} can be referred to changes in preferences over time, but, most importantly, it stands to a price-independent term of demand over time[3].

To shift to international market equilibrium with unequal factor rewards we, firstly, assume identical preferences worldwide, which refers us to a corresponding equation (3*) for the foreign economy. Secondly, let x_{it} and x^*_{it} stand for Brazil (home) and the foreign economy sales to the world – a three-country model. Finally, replace S_i by $Y_t^{\eta_{it}}$, from $dlogS_{it} = \eta_{it}\, dlogY_t$, and substitute it by its international size, $S_i^w = \delta_i (Y_t^w)^{\eta_{it}}$, where δ_i is the local economy share in the world sale of *i* and Y^w is the world income. Dividing (3)/(3*), yields the international

---

[2] Hosting 11.3% of all inward FDI stock in developing economies in 1967, and 16.4% in 1983 (Jenkins, 1987; Appy, 1987. Net FDI inflow, for 1968-82, was: US$ 14 billion to Brazil, US$ 7 billion to Mexico, US$ 3 billion to Hong Kong, and US$ 648 million to Korea (Bruton: 1989). Thanks *inter allia* to a strategy combining strong trade protectionism with fair liberalism to international companies (Fritsch & Franco, 1994).

[3] Consumer's choice is defined for each period, so that the varying π_{it} cannot be associated with non-homothetic preferences.

equilibrium, in which x_{it}/x^*_{it}, the *revealed comparative advantages* (RCA), according to Balassa (1965), are determined by comparative exporting conditions:

$$x_{it} / x_{it}^* = \beta_{1i} + (\delta_i - \delta_i^*)\eta_{it} - \beta_3 \left(\frac{w_t a_{i,t}}{w_t^* a_{i,t}^*} \right) - \beta_4 \theta_{it} + \mu_{it} \,. \tag{4}$$

β_{1i} is a specific-industry intercept and μ_{it} the random error. A set of developed countries, taken as an integrated economy, represents the foreign economy and, given local trade restrictions, θ_{it} now carries positive profits, or tariff revenue (Sen, 2005). Variable η_{it} stands for changes in the world market demand in each i industry, so $(\delta_i - \delta_i^*)>0$ would stands for Brazil's stride in the world's most demand-dynamic industries, something that can be assigned to *human capital* formation (Currie *et al.,* 1999), or else to effective international learning (Passinetti, 1993).

2.2. Multinationals Firms

The fixed costs include plant cost, *G,* and firm-specific cost, *F,* engendering the opportunity to international multiplant firms. Two issues then immediately arise for the international equilibrium: (a) in which countries and industries will MNFs emerge mostly? and (b) what are their effects on host-country international trade pattern and volume?

MNFs mainly arise in industries intensive in non-rival inputs (*F),* related to research activities, that can be used in new plants with no additional costs, or just a marginal fraction related to technology transfer. The integration between parent and affiliate units are in turn related to plant costs: horizontal integration arises in large foreign markets that lower the fixed cost G of subsidiaries as compared to export cost from a local plant [$G+\tau$ (transportation-cost)], whereas vertical integration in countries whose differences in factor prices push the marginal plant costs significantly down.

Accordingly, for a given industry *X,* the production regime X_f^{hm}/X^n (the mix of foreign multinationals and national firms' output) for horizontal integration is determined by this slightly modified equation from Brainard (1997):

$$\frac{X_f^{hm}}{X^n} = \frac{w^s F}{w^s G.e^{-S(1+T)(1+\tau)}} \tag{5H}$$

The fixed-cost ratio F/G_h is the *industry effect,* making X more or less intensive in multinationals, whereas the remaining variables stand for the *location effect* (Hwang & Mai, 2002): host market size S in reducing the G cost, whereas the import barriers, *T,* and the transport-cost (from source-country), τ*,* increase the relative cost of exporting from the source country. Skilled labor price, w^s, fulfills the list of the location effect, conventionally called *location advantages* (Dunning, 1981).

For vertically integrated plants, T and τ have an opposite result: they increase the overseas processing costs, while S helps to reduce the cost of product shipped back to parent firm (Zang & Markusen, 1999). The F/G ratio still gives an edge to multinationals, but foreign plants are no longer intensive in F and the G cost is based on unskilled labor. Hence, the production regime of vertically integrated foreign firms, X_f^{vm}/X^n, is driven by:

$$\frac{X_f^{vm}}{X^n} = \frac{w^s F_v}{w.G_v.e^{(1+T)(1+\tau)-S}} \tag{5V}$$

Since X_f^{vm} is related to another production phase, $G_v \neq G$ (of the parent firm), whereas $F_v<F$, translating the low intensity in skilled labor and referring to technology transfers to foreign plants.

As implied, $X^{mf}/X^n = \phi(X_f^{hm}/X^n) + (1-\phi)(X_f^{vm}/X^n)$; $\phi \in [0,1]$. Hence, the weights of each MNFs-type in the aggregate production regime, X^{mf}/X^n, condition their effect on host country trade (export) volume, as further developed next.

The chosen period of our panel data prevented full information on technologies and factor prices. Yet, the below data on Brazil relative to the then six major developed countries (the USA, Japan, Germany, the UK, France and Italy)[4], taken as the foreign economy, gives a good picture about w and w^s. As shown in Table 1, Brazil's relative abundance of both unskilled labor and land was maintained from 1967 to 1980, favoring vertical MNFs. However, the high τ and T, by increasing the local processing cost, act otherwise. In fact, exports by foreign affiliates in Brazil amounted to only 7.9% of their total sales in 1973, and to 10.1% in 1980 (Doellinger & Cavalcanti, 1979; Cepal, 1983)[5]. The clue to that is that Brazil's size (among the then world's ten largest economies), import barriers and large distance represent strong *location advantages* to horizontal foreign affiliates.

Table 1: Factors Endowments – Brazil/Developed Countries

	Skilled/Non-Skilled Labor*		Skilled Labor/Land **	
Countries	1967	1980	1967	1980
Brazil	0.05	0.08	0.08	0.21
Developed Countries	0.11	0.17	0.41	0.44

Sources. Labor for Developed Countries: 1967: Bowen et al (1987); 1980: Trefler's (1995) database (http://www.nber.org/ftp/trefler/HOV). Labor for Brazil: IBGE, *Anuário Estatístico do Brasil*
Land: 1967: Bowen et al. (1987) and World Institute Resource (1998), World Resources 1998-99.
* Technical & Professional/Remaining economic occupation. ** Land: cropland and pastures in hectares.

Relying on (5*H*) for a general stochastic specification of (5) yields the following linear equation, after adjustments to available data:

$$\frac{X_{it}^{mf}}{X_{it}^{n}} = \alpha_{1t} - \alpha_2\eta_{it} - \alpha_3\bar{G}_{it} + \alpha_4 S_{it} + \alpha_5 T_{it} + \alpha_6\frac{w_t a_{it}}{w_{it}^{*} a_{it}^{*}} + \varepsilon_{it}\,, \tag{6}$$

where ε_{it} stands for the stochastic errors, $\bar{G}_{it}$ for plant-based economies of scale, S_{it} for domestic industry size, and T_{it} for the import barriers.

The knowledge capital F identifying horizontal MNFs is proxied by η_{it}, given their negative on world trade volume (M&V). For vertical integration, α_2 may instead take positive value on the ground that it would facilitate international market access (UNCTAD, 2002; Zhang & Marksuen, 1999), although F is fixed in (5*V*). The comparative marginal cost, $w_i a_{it}/w_i^{*} a_{it}^{*}$, captures the search for marginal (comparative) costs in the case of vertical integration, although a two-factors technology would be more accurate.

Local market size (Y_{it}/Y_{it}^{*}) attracts both vertical and horizontal integration, but economies of scale at plant size ($\bar{G}_{it}$) is negative for X_f^{hm}/X^n, given that G_h=G, and undetermined for X_f^{vm}/X^n.

[4] They accounted for 71.6% of the inward FDI stock in Brazil in 1977 (Cepal, 1983).
[5] Although inward-orientation dominated the Brazilian manufacturing industry: 8.1% export propensity in 1979 (Cepal, 1983).

2.3. Multinationals and Exports

To examine the impact of the X_{it}^{mf} / X_{it}^{n} on trade volume, we start by taking both F and G in aggregated form – *i.e.*, disregarding their composition as to multinational and national firms. The equilibrium price in industry X then becomes:

$$p_x = \frac{w^s F}{X} + w\left(\frac{G}{X} + a\right), \tag{7}$$

with zero profits due to free entry.

Substituting (7) into the Marshallian demand (2), as done before to reach (6), we obtain the relative international sale of domestic industry X:

$$x / x^* = \beta_{0i} + (\delta - \delta^*)\eta - \beta_2\left(\frac{w\ a}{wa^*}\right) + \beta_3(S_{it} / S_{it}^*) + \beta_4\theta + \beta_5\overline{G} - \beta'_6\ F + \upsilon\ , \tag{8}$$

where the unit fixed costs of plant and the knowledge-capita are given by $\overline{G}$ and F respectively, while θ was introduced by relaxing the assumption of zero profits. Given the scarcity of skilled labor at home, β'_6 is supposed negative in this the technology-intensive industry, relatively to the agricultural sector. Lastly, we added home-industry relative size, (S_{it}/S_{it}^*), as a means to expand the limited technology information of our one-factor model, with (S_{it}/S_{it}^*) expressing a sort of neutral (Ricardian) technology difference as in Harrighan (1997).

Multinational and national firms are distinguished by the assumption that $F^m<F^n$, underlying (5), expressing the former ownership advantages: from MNFs being able to spare much of the F cost in subsidiaries. Hence, in the equation (8):

$$\frac{dF}{d(X_f^m / X^n)} < 0 = \beta_6\,, \tag{9}$$

so that higher X_f^m/X^n have impact on relative export (x/x^*), reducing β_6. This stands for MNFs' technology services, which holds true for both X_f^{hm}/X^n and X_f^{vm}/X^n.

Nonetheless, once comparative exports in (8) are defined over n industries, then the export impact of X^m/X^n will also depend on cross-industry orientation of multinationals, or else on their type. From (5*H*), the share X_f^{hm}/X^n rises as we move to F intensive activities, whereas from (5*V*) the relationships is either null or negative:

$$\frac{dF_i}{d(X_f^{hm} / X_i^n)} > 0 = \beta_7 \quad (10.1); \qquad \frac{dF_i}{d(X_f^{vm} / X_i^n)} \leq 0 = \beta_7 \quad (10.2)$$

That is, the value of intangible asset F (R&D, marketing and management) increases as we move towards industries intensive in horizontally integrated multinationals – a *stylized microeconomic fact* (Markusen, 1995) – thus leading to a negative impact on comparative advantages, given Brazil's endowments of skilled labor. On the other hand, as shown in (10.2), F is non-increasing in X_f^{vm}/X^n, which leads to either a null or positive impact on host-country's relative exports[6].

Therefore (10.1)-(10.2) indicate how *location advantages* linked to either *market proximity* or *factor proportions* affect relative exports in a large and unskilled-labor economy. Taking (10.1) as a benchmark, the now n industries export model with multinationals becomes:

$$x_it/x_{it}^* = \beta_{0i} + (\delta_i - \delta^*)\eta - \beta_2\left(\frac{w_t a_{it}}{w_t^* a_{it}^*}\right) + \beta_3 T + \beta_4 \bar{G}_{it} + \beta_5 \frac{S_{it}}{S_{it}^*} + (\beta_6 - \beta_7)[X_{it}^{mf}/X_{it}^n] + \mu_{it} \tag{11}$$

Once both G and F of the markup $\theta = \theta\,(n, G, F)$ have been accounted, the remaining n (number of firms) term, standing for the market power, is proxyied by T, import barriers. Hence, T bears

[6] Its export impact is unrelated to the omitted transport cost τ, in (6), since τ can be bad for exports to source countries, but not to third countries (Kumar, 1998).

a correspondence with the *competition effect* of international trade (Helpman & Krugman, 1985).

That (6) and (11) share some common determinants is rather expected, since they describe the international location of specific firms and industries (expressed by their comparative trade volume), respectively. Notice, though, that F is proxied by distinct variables in each of these equations.

Even though the qualitative impact of multinationals on exports, given by $(\beta_6\text{-}\beta_7) \gtrless 0$, is conditioned to the dominant MNFs' type[7], its unique parameter does not provide a definite statistical proof about the firm's type. The difficulty is related to the industry-level variable of our analysis. Nonetheless, sufficient evidence can be achieved from the estimates of the production regime model (6) and, lastly, from a descriptive analysis about its cross-industry variation, regarding their technology profile and export orientation.

Yet, the value of parameters β_6 and β_7 are subject to errors, once we recognize that variable T is far from characterizing all policy instruments dictating the observed X_i^{mf}/X_i^n used in (11). We attempt to solve it by using a latent X^{mf}/X^n from their theoretical model (6). Several specification of it are tried, from a reduced to a complete form, which can only be clarified after the original estimation of (6). What is envisioned, here, is to control the unobserved policy-component in the host-country effect as a way to approach the true values of β_6 and β_7, reflecting mostly the endogenous values of X^{mf}/X^n under free-trade.

With the thus given $\widehat{X_{it}^{mf}/X_{it}^{n}}$, (11) can be re-written as:

$$x_it/x_{it}^* = \beta_{0i} + (\delta_i - \delta^*)\eta - \beta_2\left(\frac{w_t a_{it}}{w_t^* a_{it}^*}\right) + \beta_3 T + \beta_4 \bar{G}it + \beta_5 S_{it} + (\beta_6' - \beta_7')[\widehat{X_{it}^{mf}/X_{it}^{n}}] + \mu_{it} \quad (12)$$

From the above explanation, we should have $(\beta_6' - \beta_7') > (\beta_6 - \beta_7)$. Estimation of (12) is done by two stage estimations – $\mathrm{E}\{y_2 \mid x_2[E(y_1 \mid x_{1,}\theta_1)\}$– as shown below.

3. Data and Variables

Transforming (11) to a named form, we have:

$$RCA_{it} = \beta_{0i} + \beta_1 YEL_{it} - \beta_2 CPCOST + \beta_3 SCALE_{it} + \beta_4 SIZE - \beta_5 TAR_{it} + (\beta_6 - \beta_7)FORGN_{it} + \mu_{it} \quad (13),$$

where the revealed comparative advantages $RCA_{it}=x_{it}/x_{it}^*$, $YEL=\eta_{it}$, $TAR_{it}=T_{it}$, $SCALE=G$, and $FORGN_{it}=X_{it}^{mf}/X_{it}^{n}$. Since w_t/w_t* is unique in each period t, not altering the ordering and variation of cross-industry $CPCOST_{it}=w_i a_{it}/w_i^* a_i$, one can also test the alternative comparative productivity, $CPROD_{it}=a_{it}/a_{it}^*$, for reasons exposed below.

The panel data covers twenty industries – three digits ISIC, adjusted to standard classification for $FORGN_{it}$ – and four periods (1967, 1973, 1980 and 1987-88), with slight deviation in time for some variables. Regarding their sources, see Data Appendix. The then six largest industrialized economies (the USA, Japan, Germany, the UK, France, and Italy), taken as an integrated economy, represent the foreign economy. This *cross-section time series* analysis turns the dearth of international data even more stringent, namely for technologies and factor endowments (or prices) of all countries, industries and periods simultaneously.

[7] Noticing that, in (6), F is empirically represented by a distinct variable, aiming to identify each type of MNFs was dominant.

Variable $RCA=x_{it}/x^*_{it}$ is such that $x^*_{it} = \sum_{ij} (X^j_{it} / X^j_t)$, where X^j_{it} stands for each j country's exports of industry and X^j_t for its total manufacture exports.

Variable $\eta_{it} = YEL_{it}$, standing for worldwide demand dynamism, is given by:

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

where X^w_i is the world's exports of industry i and Y^w_t is the world total exports of all industries (i.e., not only manufacturing). Y^w_t could be proxied by the world *value added* of tradable goods sectors, but it was not available, so we used the output of tradable sectors sold internationally. Since data of X_i contains production input, so that η_i may express both the income-elasticity of demand and biased technology changes.

Regarding *CPCOST*, the productivity term is $a_{it}=l_{it}/y_{it}$: "*total employees* (except working proprietors, active business partners, unpaid family workers and homeworkers)*/value added"*, whereas $a^*_{it} = \Sigma_j l^j_{it} / (\Sigma_j y^j_{it})$. Given that manufacturing industry wages were not available in comparable form in the six countries over all periods, then *per capita GDP* represents both w and w^*, as in the Ricardian *n goods* model (Dornbusch *et al.*, 1977), with w_t^* standing for the weighed average *per capita* GDP of the six developed countries.

The unobserved factor endowments among countries may influence the technology (a_{it}/a^*_{it}), given that labor directly engaged in production (mostly unskilled) dominates total labor employees. However, from Helpman & Krugman (1985: 24-28), one can draw that the bias would be closely symmetric over the n industries; the industry ordering (a_{it}/a^*_{it}) is not strongly affected.

SCALE is the log of "*value added/number of employees*" of the integrated foreign economy, standing for plant economies of scale, close to Brainard (1997), while the same expression based on the local economy gives *SCALBR*. Taking $WSIZE_{it} = y_{it} / \sum_j y^*_{it}$ as the relative host-industry size, we also compose $GSIZE = SCALExWSIZE = y_{it} / \sum_j l^*_{it,j}$, a proxy for the achieved economies of scale in the host country size.

TAR_{it} is the *effective rate of protection* in Brazil and $TNOM_{it}$ are the nominal tariffs. Not accounting for tariffs in the foreign economy, due to lack of corresponding panel data, is tantamount to assuming that the manufacturing industry in this region operated as if under free trade, compared to Brazil – a reasonable hypothesis for the period. Finally, $FORGN_{it}$ stands for foreign affiliates' output share in industry i at t.

4. Empirical Results

All beta coefficients of the *fixed effects* (FE) estimators of (6) and (11) are statistically significant, against only one in the RE model, indicating that the α_i are not randomly distributed; *i.e.*, that they inform industries' particular characteristics[8]. We also applied the Weighted Least Squares estimators with the robust covariance – White test rejected the homoscedasticity of residuals at 1.0% of significance.

Table 2, below, reports the estimates of the location model (6) thus organized: models in columns (i)-(v) use *SCALE*, substituted in columns (vi)-(vii) by *SCALBR*. Lastly, *TNOM* replaces *TAR* in columns (vii)-(viii).

At first, the negative and statistically significant coefficient of *CPCOST* corroborates the hypothesis of vertically integrated foreign affiliates, however the estimates of the RCA

[8] 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).

model will give an opposite view. Its dubious meanings, reinforced by the positive sign of *CPROD* [columns (i) and (vii)], might be assigned to the fact that both *CPCOST* and *CPROD* are not good indicators of *factor proportions,* as well as to the extreme microeconomic inefficiency of industry in Brazil, as shown by the next model estimates.

The negative and statistically significant coefficient of *SCALE* [columns (i)] reinforces the opposite hypothesis of *market proximity*; that economies of scale at plant do not favor foreign production as compared to exporting cost – see also Brainard (1997).

Table 2 - Estimates of the Production Regime Equation

Independent Variables	World Scale				Scales in Brazil		Nominal Tariffs	
	(ii)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
YEL	-0.025	-0.024	-0.023	-0.024	-0.022	-0.027	-0.028	-0.028
	(0.005)	(0.003)	(0.003)	(0.003)	(0.006)	(0.004)	(0.006)	(0.005)
CPCOST		-0.069	-0.072	-0.069		-0.098		-0.067
		(0.022)	(0.023)	(0.022)		(0.031)		(0.040)
CPROD	0.010				-0.010		0.003	
	(0.004)				(0.005)		(0.008)	
SCALE	-0.080	-0.029	-0.058	-0.018			-0.002	-0.037
	(0.014)	(0.036)	(0.010)	(0.018)			(0.022)	(0.012)
SCALBR					-0.054	-0.034		
					(0.015)	(-1.254)		
WSIZE		-1.609.						
		(0.397)						
DSIZE			0.129		0.254			0.108
			(0.089)		(0.118)			(0.110)
GSIZE				-0.03245		-0.025	-0.036	
				(0.014)		(0.0126)	(0.015)	
TAR	-0.045	-0.048	-0.047	-0.048	-0.043	-0.046		
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)		
TNOM							-0.026	-0.017
							(0.011)	(0.011)
N. Obs.	77	77	77	77	77	77	77	77
Adjusted R^2	0.979	0.985	0.984	0.993	0.966	0.982	0.970	0.976
F-statistics	1594.3	1275.6	1212.3	1275.6	549.0	1055.6	628.8	774.6

Dependent Variable is *FORGN*. Numbers in parentheses are *t statistics*.
The simbols (***), (**) and (*) indicate statistical significance at 10%, 5% and 1%, respectively

The negative coefficient of *WSIZE,* the international relative size of home industry, a further indication of industries' comparative advantages, gives another indication against the hypothesis of vertical integration. In fact this sign and statistical significance of this variable has been maintained in several other specification.

However, domestic industries size, S_{it} in the production regime equation (6), is given by $DSIZE_{it} = S_{it}/Y^f_{it}$; Y^f_{it} standing for the total GDP of the foreign economy. And, as seen in columns (iii), (v) and (viii), *DSIZE* is positive – though statistically significant only in (v) – corroborating once more the market proximity hypothesis of (5*H*).

Other measures of economies of scale at plant level are tried with composite *GSIZE* and *SCALBR,* both capturing the impact of host-economy size upon local plants fixed costs. Both give the same negative sign as *SCALE,* reinforcing the preceding conclusions. However

GSIZE, when used together with *SCALE* or *SCALBR* eliminates their statistical significance – see columns (iv), (vi) and (vii) – which is explained by their high correlation.

Recall, from (5), that the effects of *WSIZE, DSIZE* and SCALE cannot be divorced from the unobserved transport-costs (distance)[9]: the larger is τ, the more relevant are those variables.

TAR and *TNOM* are both statistically significant, but their negative signs, slightly greater for *TAR,* contradict the *tariff-jumping* hypothesis of horizontal integration. Its rejection, suitable in a multi-country analysis, is however at odds with the noticed tiny exports of MNFs in Brazil. The most tenable is that, in a large and highly protected economy, horizontal multinationals do not necessarily operate in the most protected sectors (tariffs concerned); that levels above 60% – the average, in the present case – are not in their interest[10]. There are also the effects of other (unobserved) barriers to foreign firms (e.g., the local content requirement).

Lastly, the negative coefficient of *YEL,* in all equations of Table 2, shows that multinationals concentrated in industries having the least international market sale dynamism, which matches predictions of horizontal multinationals on world trade, related to trade substitution. However, it contradicts other analyses relating export dynamism in LDCs to multinationals (UNCTAD, 2002), more suitable to vertical integration, as noticed before. Hence, country's size, distance, and trade regime condition the subsidiary types and thus their trade impact. In fact, some of the activities horizontally integrated in Brazil were vertically integrated elsewhere, especially from the 1990s onwards (see Hanson et al, 2005).

To examine the export consequence of this location of foreign affiliates we now estimate model (11) with the exogenous *FORGN,* since the residuals of (6) and (11) are not correlated (see Green, 2000) at 10% of statistical significance.

Table 3 presents the most relevant results. The negative sign of YEL_{it} shows that the country did not throve in industries in the most sale-expansive world market, as if the country failed in comparative international learning (Pasinetti, 1981) – predictable from its poor formation of skilled labor.

The most striking result is the positive coefficient of both *CPCOST* ($w_t a_{it}/w_t a_{it}^*$) and *CPROD* (a_{it}/a_{it}^*) in all pairs of equations, as if higher comparative costs (and labor input) lead to greater comparative exports, expressing a sort of *inverted markets* (i.e, extreme inefficiency). Inasmuch as *TAR* controls only part of Brazil's trade policy, this result can be attributed to remaining instruments (quantity controls and the huge export subsidies) that pushed resources towards the less efficient industries (Moreira, 1995; Savasini, 1983)[11].

The positive coefficient of *SCALE* shows that Brazil's *RCAs* were proportional to economies of scale, though at a very small level. At the same time, the largely positive *WSIZE,* shows that the relatively largest industries exports the most, corroborating the prediction of the variable meant to capture further indication of technology difference, only displayed by the comparative marginal cost of labor.

[9] In Belgium, small size and low transportation cost (short distance and good railroads), led to vertical-MNFs and thus to their positive impact on *RCA* (see Sleuwaegen & Backer, 2001).

[10] So MNFs would not be the main actors behind the highest tariffs – distinct from the USA (Blonigen & Fligio, 1998); compatible with the model's causality, where firms are *tariffs takers*.

[11] In a forthcoming pure trade analysis, we demonstrate that these coefficients of *CPCOST CPROD* indeed reflect *inverted markets.* A graphical analysis, which can be ordered to the authors, also shows a positive time correlation between the average values of panels RCA agains *CPCOST* and *CPROD,* corroborating the extreme microeconomic inefficiency of this industrization (see Bruton, 1989).

Table 3 - Estimates of the RCA Equations

Variables	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(x)
YEL	-0.065	-0.137	-0.069	-0.101	-0.067	-0.076	-0.179	-0.146	-0.163
	(0.019)	(0.015)	(0.009)	(0.009)	(0.030)	(0.026)	(0.021)	(0.020)	(0.023)
CPCOST	0.378		0.267		0.772	1.111			
	(0.145)		(0.121)		(0.140)	(0.150)			
CPROD		0.197		0.104			0.193	0.174	0.198
		(0.038)		(0.023)			(0.012)	(0.037)	(0.018)
SCALE	0.193	-0.041	0.271	0.205		0.118		0.065	
	(0.036)	(0.064)	(0.032)	(0.029)		(0.025)		0.063	
SCALBR					0.263		0.046		0.214
					(0.098)		(0.061)		(0.064)
WSIZE	7.050	10.743			5.558	4.528	8.279	9.019	6.468
	(2.444)	(2.602)			(3.428)	(2.110)	(2.441)	(2.991)	(2.565)
GSIZE			0.000	0.000					
			(0.000)**	(0.000)**					
TAR	-0.142	-0.184	-0.115	-0.120	-0.115				
	(0.029)	(0.026)	(0.024)	(0.016)	(0.033)				
TNOM						-0.330	-0.200		
						(0.025)	(0.026)		
FORGN	-0.490	-0.265	-0.740	-0.608	-0.583	-1.023	-0.858	-0.378	-0.549
	(0.269)	(0.183)	0.207***	(0.143)	(0.305)*	(0.128)	(0.128)	(0.183)**	(0.182)
N. Obs.	77	77	77	77	77	77	77	77	77
Adjusted R2	0.546	0.566	0.517	0.549	0.545	0.681	0.726	0.549	0.578
F-Statistic	23.27	24.79	21.26	23.52	23.20	37.44	45.35	29.17	32.05

Note: Dependent Variable is RCA
Numbers in parentheses are standard errors. When the three-decimals number do not allow identification, we added (*), (**) and (***) indicating statistical significance at 10%, 5% and 1%, respectively

The coefficient of effective rate of protection, *TAR,* confirms the *competition effect*: protection refrains export competitiveness. The same happens with TNOM. Noticing that the former variable is the best measure of income incentives (from protection) to firms.

Lastly, the negative sign of *FORGN* shows the singular effect of MNFs-intensive industries on exports. From our model, this means that (β_6-β_7)<0: affiliates *ownership advantages* were outweighed by *location advantages* opposed to the country's comparative advantages. From another standpoint: despite the impressive growth of MNFs exports in Brazil, from the 1960s to the 1980s (Blomstrom, 1990), the expansion of these technology-superior firms drew resources towards the least exporting industries. Noticing that the negative (β_5-β_6) does not carry a corresponding welfare impact to host-country, for unlike the competitive model under protection by Brecher & Diáz-Alejandro's (1977), β_7 is now endogenous to the economy – *TAR* is also controlling for trade policy[12].

Additional evidence are provided in the below contingence Table 4 of the time average of $FORGN_{it}$ against their RCA_{it} and technology pattern (from Lall, 2000). The industries are placed in decreasing order as to their *RCAs,* the values of which are repeated in column (i),

[12] Entry of MNFs, even if oriented towards industries under comparative disadvantages, can cause large reduction in imports, as expound in M&V.

whereas (ii) and (iii) give the ordinal and cardinal values of *FORGN*. As can be seen, foreign affiliates' shares are very low in the seven first exporting industries, as well as quite high in the three worst exporting industries. Moreover, from column (i), we also see that the exporting levels of first industries, namely the first four, are far ahead of the remaining ones.

Table 4: Export Performance, Multinationals Shares and Technology

	RCA Value	MNFS Share* Rank	Value - %	Technology[¥] Classification
	(i)	(ii)	(iii)	(iv)
1. Food Products	6.41	14th	19.1	RB
2. Wood & Cork	3.02	17th	5.1	RB
3. Leather & Furs	1.72	13th	19.6	LT
4. Clothing & Shoes	1.23	18th	4.3	LT
5. Pulp & Paper	1.16	12th	20.4	RB
6. Metals	0.71	10th	26.9	LT
7.Textiles	0.65	15th	15.9	LT
8. Rubber	0.40	2nd	75	RB
9.Chemicals	0.30	6th	46.4	MT
10.Plastics	0.28	8th	34.6	MT
11.Other Chemicals(a)	0.28	4th	68	HT
12.Transport Equipment	0.27	3rd	68.5	MT
13.Mechanical Equipment	0.25	7th	40.7	MT
14.Beverages	0.23	16th	12.1	RB
15.Non metallic mineral	0.22	11th	25.4	RB
16.Furniture	0.18	19th	2.4	LT
17.Printing & Publishing	0.16	20th	1.9	MT
18. Tobacco(b)	0.15	1st	87.5	MT
19.Electrical Materials	0.13	5th	54	HT
20.Other Sectors	0.07	9th	33	HT

[¥]Resource Based (RB), Low Technology (LT), Medium Technology (MT), High Technology (HT).

(a) Given that, in Lall (2000), Pharmaceutical is classified as HT-2 and Cosmetics as MT-2.

(b) Different from Lall, who classified manufactured Tobacco as RB, since the world's two leading international firms run this industry, whose products present high level of technology exclusivity.

In short, *factor proportions* were not the dominant reason for incoming multinationals, but rather *market proximity*. Column (iv) gives more incisive evidence: the best exporting industries (Food Products, Wood, Tobacco, Leather & Furs, Clothing, Pulp & Paper, Metals, and Textile) are intensive in either resources or in unskilled labor (LT), whereas MNFs operate in either Medium or High-Technology industries (Tobacco, Electrical Materials, Transport Equipment, Other Chemicals, Chemicals, Non-Electric Machinery, Others). In sum, their anti-export pattern in Brazil witnesses horizontally integrated affiliates that, at the same time, are skilled-labor intensive. As the estimates of model (6) showed, the *location advantages* for these foreign affiliates can be assigned to both economies of scale and market size, the effects of which are amplified by distance (transport-cost). Legal restrictions against MNFs in mineral-related sectors cannot be disregarded, nor the smaller advantages of foreign production therein.

By eliminating the controls *TAR* or *TNOM,* as in the last two columns of Table 3, we can reach their singular effect upon MNFs' export impact. As expected, *FORGN* becomes more negative as compared to the original model in columns (ii)-(vii), meaning that import protection harms the comparative export contribution of foreign subsidiaries. The relative impact of TNOM is greater, which can be attributed to the fact that export subsidies (within *TAR*) benefited foreign affiliates mostly (Willmore, 1985). One must notice, though, that protection in Brazil included instruments other than both *TAR* and *TNOM*.

5. The RCA Model With an Endogenous Regressor.

There still remain some doubts regarding the true value of (β_6 -β_7), once we recognize that the observed variable *FORGN* (X^{mf}/X^{n}) is also affected by unobserved policy variables, such as the minimum domestic content in production, and some legal restrictions against foreign firms in resource based activities. As proposed in Section 2, we try to solve this problem by estimating a latent $X^{mf}/X^{n,}$ from equation (6), which is used in lieu of the observed one in the RCA model. This methodology has been used by Maskus & Webster (1999) for obtaining the true technology parameter in a HOV model and by Fuentes & Morales (2006) to obtain the true TFP – Total Factor Productivity.

Having seen that (6) fits good to predict the production regime, then this equation can be used to generate $\widehat{X_{it}^{mf}/X_{it}^{n}}$, the latent $FORGN_{\mathrm{it}}$ that controls for the effect of unobserved policy variables. A first specification aims to obtain endogenous emergence of horizontal MNFs under free trade, given by a reduced version of (6): without trade protection and comparative cost (productivity). In a second round, we expand the endogenous determination of $FORGN_{\mathrm{it}}$, by incorporating either one or other of the eliminated variables. Lastly, a complete version of (6) is tried as a conclusive comparison to the observed X_{it}^{mf}/X_{it}^{n}.

We applied the *Feasible TSLS* (Two-Stage Least Squares), correcting the heteroskedasticity in each stage[13], to obtain this new (structural) *RCA* model, which boils down to obtain $\widehat{X_{it}^{mf}/X_{it}^{n}}$ from the commented (6), then used as regressor in (12) – see Green (2000). The main estimation results are displayed in Table 5 below, where $PREDICT_F$ stands for the latent $FORGN_{it}$, and the models are thus organized: the first four columns are based on the above commented reduced (6), while the two following $PREDICT_F$ are given by the expanded and complete version of (6). The exact specification of each one is explained at the footnotes of Table 5.

Since some variables were utilized both for generating $\widehat{X_{it}^{mf}/X_{it}^{n}}$ and for estimating the *RCA,* this latter model bears a quite higher degree of correlation among its regressors. To ease it, we specify the trade model in such a way as to avoid repeating this variable. That is, having used *SCALE*, *DSIZE* and *CPCOST* for obtaining the $PREDICT_F$, then *SCALBR, WSIZE*, and *CPROD* were preferred for estimating the *RCA*. The only variable we did not have a substitute was YEL.

At first, the smaller number of regressors for the $PREDICT_F$ from the reduced (6) may discredit it, although the bias of their coefficients will tend to reinforce the latent horizontal operation of the MNFs, as intended with this variable. And, as shown in the first three columns of Table 5, the impact of MNFs upon RCA shifts to positive. All the remaining variables maintain their sign, as compared to the original (non-structural) *RCA* model, except for YEL in columns (i) – statistically non significant – (ii) and (x). Since this variable is also a regressor in (6), this can be attributed to the nature of its correlation with $PREDICT_F$. However, $PREDICT_F$ shifts to negative when GSIZE is used as a regressor, although we are rather suspect of the

---

[13] By the variance of each group: $\sigma_i^2 = \sum (y_{it} - \hat{y}_{it})^2 / T_i$, where T_i is the number of observations in each group and $\hat{y}_{it}$ are the OLS fitted values.

relevance of this variable, from reasons discussed before and because this composite variable, highly correlated to other regressor, brings in a triplication (or more) of regressors in each stage.

$PREDICT_F$ remains less anti-trade oriented than *FORGN* when either trade protection or comparative marginal costs are added to the location model (6), as shown in columns (v) and (vi), in both of which with positive and statistically significant sign. In short, even with the latent distribution of MNFs given with additional variables expressing host-country's anti-export bias, the positive impact of foreign affiliates remains. Once more, all that shifts when *GSIZE* is used as a regressor [column (vii)].

Table 5 - Estimates of the Structural Export Equations (Dependent Variable: RCA)

	$Predict_F$-I				***$Predict_F$-II$^{¥}$***			***$Predict_F$-III$^{¥}$***		
Variables	(i)^a	(ii)^b	(iii)^b	(iv)^c	(v)^c	(vi)^a	(vii)^a	(viii)^b	(ix)^c	(x)^d
YEL	0.054	0.112	-0.146	-0.3397	-0.147	-0.141	-0.244	-0.161	-0.147	0.063
	(0.114)	(0.051)	(0.035)	(0.036)	(0.018)	(0.021)	(0.033)	(0.018)	(0.019)	(0.035)*
CPCOST		1.221								1.859
		(0.213)								(0.220)
CPROD	0.265		0.222	0.189	0.255	0.2795	0.191	0.285	0.275	
	(0.046)		(0.009)	(0.017)	(0.018)	(0.014)	(0.027)	(0.015)	(0.023)	
SCALE			0.166	0.201	0.037				-0.089	0.167
			(0.036)	(0.025)	(0.039)				(0.042)	(0.040)
SCALBR	0.190	0.298				0.097	0.251	0.064		
	(0.112)*	(0.122)				(0.063)	(0.101)	(0.054)		
WSIZE	27.989	14.307	11.845		12.069	13.346		13.105	17.468	13.007
	(9.763)	(2.705)	(1.911)		(1.588)	(1.540)		(1.605)	(2.540)	(2.316)
GSIZE				0.000			0.00			
				(0.000)***			(0.000)**			
TAR	-0.157	-0.147			-0.134		-0.141			
	(0.017)	(0.023)			(0.014)		(0.036)			
TNOM			-0.147	-0.223		-0.08		-0.064	-0.115	-0.282
			(0.015)	(0.030)		(0.022)		(0.021)	(0.020)	(0.030)
$PREDICT_F$	9.813	4.288	2.688	-6.720	2.099	2.2557	-4.344	1.842	2.331	3.403
	(5.044)	(0.993)	(0.892)	(0.976)	(0.609)	(0.431)	(1.032)	(0.305)	(0.433)	(0.734)
N. Obs.	77	77	77	77	77	77	77	77	77	77
Adj. R2	0.581	0.651	0.895	0.654	0.669	0.754	0.612	0.662	0.625	0.647
F-statistics	26.07	33.36	86.87	33.67	35.79	51.55	29.01	34.83	30.376	32.905

Numbers in parentheses are standard errors. When the three-decimals numbers do not allow identification, we added (*), (**) and (***) indicating statistical significance at 10%, 5% and 1%, respectively.

¥:

$PREDICT_F$-I = E[*FORGN*| *c,Yel,SCALE(SCALBR), SIZE (SIZEBR*];

$PREDICT_F$-II = E[*FORGN*| *c,YEL,SCAL(SCALBR), SIZE (SIZEBR), TAR(CPCOST*];

$PREDICT_F$-III = E[*FORGN*| *YEL, CPCOST, SCAL(SCALBR),SIZE(SIZEBR), TAR*]

Most importantly, the same happens using *PREDICT* the closest the possible to the observed *FORGN*, as shown by the last three columns of Table 5. Noticing that its coefficient goes closer to zero, as expected. Therefore, we can conclude that if we try to magnify the effects of the determinants of the endogenous emergence of MNFs, as given by their theoretical model (6), as a way to reduce the impact of unobserved policy variable acting upon the observed *FORGN*, then the positive technology service effect from these upon relative exports overcomes its negative sign from their operating in skill intensive industries.

6. Conclusions

According to the production regime model, the location of foreign affiliates in Brazil, during the import substitution industrialization period, was dictated by *market proximity* – as signed by both local industry's domestic and international relative size – rather than *factor proportions*. The dominant horizontal integration of these MNFs was reinforced by the negative effects of both returns to scale from production and the international sale expansion of the industries.

In the sequence, we saw that the singular impact of this production regime (*FORGN*) on country's relative export, stemming MNFs' technology services and the factor-content of their activity: marginal and fixed costs, is negative – controlled for a set of industry's variables. As theoretically predicted, and corroborated by a descriptive statistical analysis, the negative impact of *FORGN* on *RCA* is explained by foreign affiliates concentration in technology-intensive activities in a country scarcely endowed by skilled labor.

This last result is, however, subject to estimation errors, namely from unobserved policy variables that would reinforce the anti-export bias of foreign affiliates, a problem that we attempted to remedy by means of a latent *FORGN*. Indeed, the TSLS estimates showed that, in this structural RCA model, the impact of foreign affiliates shifts to positive in a variety of specifications in both the first and the second stages of the modeling estimation. The only exception occurs when GSIZE is used as a regressor, which is related to its strong correlation with the remaining regressor. Yet, further studies about the method of latent variable and of those correlations are required for clearer-cut conclusions.

References

Aitken, Brian, Gordon H. Hansen and Ann E. Harrison, Spillovers, Foreign Investment, and Export Behavior. *Journal of International Economics* 43(1997): 103-32.

Appy, Roberto, *Capital Estrangeiro no Brasil - Um Dossiê,* Rio de Janeiro: José Olympio, 1987.

Bergsman, Joel and Paulo S. Malan,. The Structure of Protection in Brazil, in Bela Balassa (ed.), *The Structure of Protection in Developing Countries.* Baltimore: The Johns Hopkins Press, 1971.

Balassa, Bela, Trade Liberalisation and Revealed Comparative Advantage. *Manchester School of Economics and Social Studies* 32(1965): 99-123.

Bielschowsky, Ricardo, Two Studies on TNCs in the Brazilian Manufacturing Sector: the 1980s and early 1990s. *Desarrollo Productivo* N. 18(1994), Chile: ECLAC.

Blomstrom, Magnus, *Transnational Corporations and Manufacturing Exports from Developing Countries,* New York: United Nations, 1990.

Blomstrom, Magnus, Irving B. Kravis and Robert E. Lipsey, Multinational Firms and Manufacturing Exports from Developing Countries, *NBER Working Paper* 2493(1988), Cambridge, MA.

Bowen, Harry P, Edward E. Leamer and Leo Sveikaukas, Multicountry, Multifactor tests of the Factor Abundance Theory. *American Economic Review* 77(1987): 791-809.

Blonigen, Bruce A. and David N. Figlio, Voting for protection: does direct foreign investment influence legislator behavior? *American Economic Review,* 88(1998): 1002-14

Brainard, S. Lael, An Empirical Assessment of the Proximity-Concentration Trade-off Between Multinational Sales and Trade. *American Economic Review* 87(1997): 520-44.

Brecher, Richard A. and Carlos Díaz-Alejandro, Tariffs, Foreign Capital and Immiserizing Growth. *Journal of International Economics* 7 (1977): 317-322.

Bruton, Henry, Import Substitution, in Chenery,H. and T.N. Srinivasan (eds.), *Handbook of Development Economics* Vol. II, North-Holland: Amsterdam, 1989.

Calabi, Andrea S., Gerald D. Reiss and Paulo M. Levy, *Geração de Poupanças e Estrutura de Capital das Empresas no Brasil,* São Paulo: Instituto de Pesquisas Econômicas, 1981.

Cepal (ECLAC), *Dos Estudios Sobre Empresas Transnacionales en Brasil.* Chile: Naciones Unidas, 1983.

Currie, David, Paul Levine, Joseph Pearlman and Michel Chui, Phase of Imitation and Innovation in a North-South Endogenous Growth Model. *Oxford Economic Papers* 51(1999): 60-88.

Doellinger, Carlos and Luis Cavalcanti, *Empresas Multinacionais na Indústria Brasileira.* Rio de Janeiro: IPEA/INPES, (1975).

Dunning, John H., *International Production and the Multinational Enterprise.* London: George Allen & Unwin, 1981.

Dornbusch, Rudiger, Stanley Fischer and Paul A. Samuelson, Comparative Advantage, Trade, and Payments in a Ricardian Model with a Continuum of Goods, *American Economic Review* 67(1977): 823-39.

Ethier, Wilfredo J., The Multinational Firm. *Quarterly Journal of Economics* 101(1986): 805-34.

Ethier, Wilfredo J. and James R. Markusen, Multinational Firms, Technology Diffusion and Trade, *Journal of International Economics* 41(1996): 1-28.

Feenstra, Robert, Integration of Trade, and Disintegration of Production in the Global Economy. *Journal of Economic Perspective* Fall(1998): 31-50.

Fritsch, Wiston and Gustavo H.B. Franco, Import Compression, Productivity Slowdown, and Manufactured Export Dynamics - Brazil, 1975-90, in Helleiner, G. K (ed.), *Trade Policy and Industrialization in Turbulent Times*. London: Routledge, 1994.

Fuentes, Rodrigo and Marco Morales, On the Measurement of TFP: A Latent Variable Approach, *Encuentro 2007 de la Sociedad de Economía de Chile*, 2006. Obtido em 06/2007 no http://sechi.facea.uchile.cl/prog_detalle_pdf.html.

Greene, William H., *Econometric Analysis.* New Jersey: Prentice Hall, 2000.

Hanson, Gordon, Raymond J. Mataloni and Mattew J. Slaughter, Vertical Production Network in Multinational Firms. *Review of Economics and Statistics,* 87(2005): 664-78.

Harrighan, J., Technology, factor supplies, and international specialization: estimating the neoclassical model, American Econ. Review*,* 87 (1997.): 475-94.

Hwang, Hong and Chao-Cheng M., The Tariff-Jumping Argument and Location Theory. *Review of International Economics,* 10(2002): 361-68.

Helpman, Elhanan, A Simple Theory of International Trade with Multinational Corporations. *Journal of Political Economy* 92(1984): 451-71.

Helpman, Elhanan and Paul R. Krugman, *Market Structure and Foreign Trade.* USA: The MIT Press, 1985.

Jenkins, Rhys, *Transnational Corporations and Uneven Development: the Internationalization of Capital and the Third World.* London: Meuthen, 1987.

Kojima, Kiyosh, Japanese and American Direct Investment in Asia: a comparative analysis. *Hitotsubashi Journal of Economics* 26(1985): 1-35.

Kume, Honório, A Proteção Efetiva Proposta na Reforma Tarifária de 1988, FUNCEX - Texto para Discussão Interna, No. 21(1989). Rio de Janeiro: manuscript.

Kumar, Nagesh, Multinational Enterprises, Regional Economic Integration, and Export-Platform Production in the Host Countries: an Empirical Analysis for the US and Japanese Corporations. *Weltwirtschaftliches Archiv* 134(1998): 451-83.

Lall, Sanjaya, The Technology Structure and Performance of Developing Country Manufactured Exports, 1985-98. QEH Working Paper N. 44(2000), University of Oxford, Oxford.

Markusen, James R., Multinationals, Multi-plant Economies, and the Gains form Trade. *Journal of International Economics* 16(1984): 205-24.

________, The boundaries of Multinational Enterprises and the Theory of International Trade. *Journal of Economic Perspectives* 9(1995): 169-90.

Markusen, James R., James R. Melvin, William H. Kaempfer and Keith E. Maskus, *International Trade: Theory and Evidence*. New York: McGraw-Hill, 1992.

Markusen, James and Anthony J. Venables, Multinational Firms and the New Trade Theory. *Journal of International Economics* 46(1998): 183-203.

Maskus, Keith E. and Allan Webster, Estimating the HOV Model with Technology Difference Using Disaggregated Labour Skills for the United States and the United Kingdom, *Review of International Economics* 7(1999): 8-19.

Moreira, Maurício M., *Industrialization, Trade and Market Failures: the Role of Government Intervention in Brazil and South Korea.* London: Macmillan Press, 1995.

Neuhauss, Paulo and Helenamaria Lobato, *Proteção Efetiva à Indústria no Brasil, 1973-75*. Rio de Janeiro: FUNCEX, manuscript, 1978

Norbäck, Peter-J., Multinational Firms, Technology and Location. *Journal of International Economics* 54(2000): 449-69.

Pasinetti, Luigi L., *Structural Change and Economic Growth*. Cambridge UK: Cambridge U. Press, 1981.

______, *Structural Economic Dynamics - a Theory of Economic Consequences of Human Learning*. Cambridge, UK: Cambridge University Press, 1993.

Savasini, José A., Análise da Política de Promoção às Exportações, In Eris, Claudia *et al.* (eds.), *Finanças Públicas.* São Paulo: FIPE/Pioneira, 1983.

Sleuwaegen, Leo and Koen Backer, Multinational Firms, Market Integration and Trade Structure: What Remains of the Standard-Goods Hypothesis? *Weltwirtschaftliches Archiv,* 137(2001): 379-403.

Tyler William G., Incentivos às Exportações e às Vendas no Mercado Interno: Análise da Política Comercial e da Discriminação contra as Exportações - 1980/81. *Pesquisa e Planejamento Econômico* 13 (1983): 543-74.

_______, Effective Incentives for Domestic Market Sales and Exports. *Journal of Development Economics* 18(1985): 219-42.

UNCTAD, *Trade and Development Report,* 2002. Geneva: United Nations, 2002.

Verbeek, Marno, *A Guide to Modern Econometrics.* New York: John Willey & Sons, 2000.

Willmore, Larry N., *Market Structure, Firm Size, and Brazilian Exports*. Brasília: Estudios e Informes de la CEPAL 44, 1985. [original author: ECLAC].

_______, Controle Estrangeiro e Concentração na Indústria Brasileira. *Pesquisa e Planejamento Econômico* 17(1987): 161-90.

_______, Transnational and Foreign Trade: Evidence from Brazil, *Journal of Development Studies* 28(1992): 314-35.

Zhang, Kevin H. and James R. Markusen, Vertical Multinationals and Host-Country Characteristics. *Journal of Development Economics* 59(1999): 233-52.

Data Appendix.

Variables and their 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.* IBGE (idem). Valued-added deflated by the US and Brazil's GDP deflator, respectively.
TAR and ***TNOM***: Bergsman & Malan (1971); Neuhauss & Lobato (1978); Tyler (1983), and Kume (1989).
$\boldsymbol{FORGN_{it}}$: Calabi *et al.* (1981), for 1967 and 1973, covering a total of 3,167 firms; Willmore (1987) for 1980, covering a total of 49,760 firms; and Bielschowsky (1994) for 1987-88, covering 3,310 firms. Their selection, among the several examined sampling, followed criteria of: (a) sample size, (b) compatibility of industry classification with the remaining variables; (c) classification of foreign firms, preferring the criteria of 25% or more of firm equity, and (d) proximity with the reference years (1967, 1973, 1980, 1987-88). Although Calabi *et al.* (idem) measure market share by capital value – the remaining ones are by the industry's sale – we chose it because: (i) alternative sampling for 1967 and 1973 do not present data on several industries, except Doellinger & Cavalcanti (1975), whose sample is too small (318 firms); (ii) there are no significant differences in the firms' market share by either measures. Further information can be ordered from the author.