The Comparative Performance of Foreign and Domestic Firms in Brazil

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Summary. — This paper analyzes data for 282 pairs of foreign-owned and private Brazilian firms which are matched by sales and by four-digit manufacturing industry. Differences between the two types of firms are surprisingly large and highly significant. Compared to their local counterparts, foreign firms operate fewer plants, have higher ratios of value-added to output, higher levels of advertising and royalty payments, greater exports, higher labor productivity, higher wages and greater capital intensity.

1. INTRODUCTION

No author can hope to attract readers to yet another study of transnational firms unless some justification for the paper is provided at the outset. In this case, the inspiration arises from the fact that existing studies of the comparative performance of transnational firms in Brazil and elsewhere tend to be very aggregate and fail to control for differences in size or type of product. Studies based on data for individual firms or plants do exist, but they have few observations, cover very few industries, refer to only a few aspects of performance, or fail to control for size differences as well as industry (product mix) differences.

The present study represents an attempt to be both disaggregate and comprehensive. Detail and breadth are both necessary if we are to reach conclusions concerning the typical differences between local firms and their foreign counterparts operating in Brazil. The analysis is based on data for 282 pairs of foreign-owned and private Brazilian firms drawn from 80 manufacturing industries in the year 1978. The firms are matched by volume of sales, and in no case does the difference in sales exceed 10%. Average differences between the two sets of firms are measured, and their significance is tested, using various measures of size, value-added to output ratios, advertising expenditure, royalty payments, export performances, productivity, skill intensity and capital intensity.

An important caveat should be noted at this point: the paired firms in our sample interact in the same market, so it is possible that the

behavior of local firms has been altered, through competitive and demonstration effects, by the very presence of foreign rivals. Foreign firms in developing countries are thought to introduce "inappropriate" (capital-intensive) technology and consumer goods that fail to meet the needs of the vast majority of the population (Stewart, 1979, pp. 78–100, and the references cited therein). If foreign firms, through advertising, create a demand for "inappropriate" products, this may induce local firms to satisfy the changed preferences of the population by producing the same type of products. Moreover, local firms may choose to follow the example of foreign firms and adopt the same "inappropriate" production techniques.[1] In short, our control group, which consists of local firms that survive and thrive in the face of foreign competition, may conceivably act as a mirror, reflecting characteristics of the comparison group of foreign firms.

The plan of the paper is as follows. The second section presents a brief review of the literature. Section 3 reports the results of tests for significant differences between matched pairs of firms in our data base. A concluding section summarizes the main empirical findings.

2. REVIEW OF THE LITERATURE

The pnrpose of this section is to provide a concise survey of previous studies of the comparative performance of transnational firms in Brazil's manufacturing sector. Selected references to studies of other countries are included to illustrate alternative methods of analysis. For a broad survey of the literature, see Lall (1978) and Caves (1982, Chapter 9).

Comprehensive data are not available, but foreign-eontrolled firms are believed to account for approximately a quarter of manufacturing employment, a third of the output, and more than a third of the sector's exports (Bonelli, 1980, p. 871; ECLAC, 1983, pp. 65–67; and ECLAC, 1985). Published estimates tend to vary not by year, but rather by sample size. Foreign-owned subsidiaries are much larger on average than local firms, so exclusion of small firms increases the foreign share. Von Doellinger and Cavalvanti (1975), for example, found foreign-controlled firms to aeeount for 55% of the total sales in their sample of 318 large manufacturing enterprises.

Foreign direct investment is concentrated in the technologically "dynamic" industries which have shown rapid rates of growth. Nonetheless, despite fears of "denationalization," local firms and publicly-owned firms have grown at a faster pace than foreign subsidiaries in recent years. Moreover, there is little difference in the reported profitability of foreign compared to local private firms, but foreign firms are believed to remit profits by under-invoicing exports and over-invoicing imports despite the existence of a licensing system designed to prevent such practices (see Zini, 1984; Tyler, 1978, p. 361). Numerous studies have shown foreign firms to be charaeterized by higher export-sales ratios, greater labor productivity, greater capital intensity and higher wage levels compared to local firms in Brazil (von Doellinger and Cavalvanti, 1975; Meller and Mizala, 1982; Goncalves, 1982; Meller, 1984). These studies are quite aggregate, however, with disaggregation proceeding only to 21 subsectors — the two-digit level. The observed differences between foreign and local firms could be due to the fact that foreign firms are larger and operate in different industries rather than to the existence or nonexistence of foreign ownership in itself.

Case studies are a potentially rich source of information on differences betweecn foreign and local firms, as well as their interaction over time. The collection of such data tends to be costly, however, and requires the cooperation of firms that are studied. As a result, researchers who analyze case studies find it difficult to control for differenees in size and prodnct mix, are tempted to generalize from an insufficient number of observations, and seldom report statistical tests of significance. The ambitious research program directed by Jorge Katz in Buenos Aires, for example, covers fewer than 60 firms drawn from a variety of industries in Brazil and five other countries of Latin America. Katz himself (1984, p. 15) notes that the case studies "make no claim to statistical representativeness"; the reader should bear this in mind when evaluating the research findings that he reports.[2]

Industry studies can also be used to investigate differences in the performance of local and foreign enterprise, with the advantage that researeh effort is concentrated on firms that produce similar products and compete in the same market. A number of studies of Brazilian industries do exist, of which a few outstanding examples are Evans (1979, Chapter 3) on textiles and pharmaceuticals and Newfarmer (1977 and 1979) on the electrieal industry. These studies provide valuable analyses of changes in market structure, particularly concentration, foreign ownership and state participation, but they neglect the topic that is the subject of this paper, namely the comparative performance of foreign and domestic firms. Evans (pp. 136–138) does, however, make the interesting point that the nature of technological change may explain why foreign firms were much more successful in their penetration of the pharmaceutical industry than they were in competing with local firms in textiles. Textile technology tends to be embodied in capital goods which are available to all firms, domestic or foreign, for the price of new machinery, whereas pharmaceutical technology generally takes the form of patented products. New pharmaceutical products are developed by transnational corporations in developed countries, and produced by subsidiaries or licensees in developing countries. Locally-owned pharmaceutical firms, with no research facilities in advanced countries and a small volume of sales over which to amortize research and development costs, have a competitive disadvantage in new product development.[3]

In statistical analyses of the effect of foreign ownership and management on industrial performance, two basic approaches have been used. One approach is to collect information for pairs of firms — one foreign and one local — earefully matched by industry and size. Any observed difference between the two types of firms is then ascribed to the effect of ownership rather than the effect of industry or scale of production. This has the advantages of simplicity and weak assumptions. The difficulty is that the method

does not make fnll nse of available data; in many industries local firms comparable in size to foreign firms do not even exist. A second approach is to specify and estimate a regression model in which ownership characteristics are included as one of the explanatory variables. This makes better use of existing information — observations are not "wasted" for lack of a comparable local firm — bnt the method is quite demanding in terms of strong assumptions underlying a complicated theoretical model. If two categories of firms (foreign and local) are poorly matched by size or by industry, fitting a common regression model to the sample amounts to extrapolation beyond the range of the available data, with all the pitfalls inherent in such a procedure.

(a) Matched pairs of firms

The "matched pairs" approach to control for size and industry mix, due to a dearth of adequate data, has been used very little in comparative studies of foreigu and domestic firms. The few studies that do exist are based on a very small number of observations, which makes it difficult to reject the null hypothesis of no difference between the two types of firms at any reasonable level of statistical significance. Mason's (1973) data, for example, consist of 14 pairs of firms: five from Mexico and nine from the Philippines. The present author (1976) obtained information for a sample of 33 matched pairs of foreign and local firms operating in Costa Rica, while Chung and Lee (1980) were able to assemble data for only 17 matched pairs in South Korea.

In Brazil, ECLAC (1983, pp. 35–38) reports that for 65 matched pairs, foreign firms show lower export ratios than local firms, but the differences were not statistically signifieant. It is not clear, however, whether the firms were matched by size as well as by industry. If foreign firms are larger than local firms in the sample, this might account for the unexpected results since, among exporters, a very strong inverse relationship exists between firm size and export performance (see ECLAC, 1985, Chapters 3 and 5). In another study, Gonealves (1983a and b) analyzed 77 pairs of firms matched by four-digit industry and was unable to find significant differences in profit or growth rates in the 1968–80 period. This study suffers, however, from a failure to control for scale differences; the foreign firms are three times as large as the loeal firms in terms of average sales (see Goncalves, 1983a, Table 2 or 1983b, Table 2).

The best example of an application of the "matched pairs" approach to Brazilian data is Morley and Smith (1977, pp. 283–286), who test for significant differenees between foreign establishments of differing national origin as well as differences between these establishments and their locally-owned counterparts. They argue that if the lack of competitive pressures allows foreign establishments to produce profitably without adapting their techniques of production to local conditions, then one should observe both (i) foreign plants utilizing more capital-intensive techniques of produetion than local piants and (ii) techniques of production varying by nationality among otherwise comparable foreign establishments. Matching esfablishments by scale (value-added) and by five-digit industry, they assembled a sample of 29 US–Brazilian pairs, 19 Western Europe–Brazil pairs, 29 US–West Germany pairs, and 24 US–other Western Europe pairs. Value-added per production. worker was significantly higher for both groups of foreign establishments compared to their local counterparts, and the productivity of US plants was significantly higher than those owned by companies from West Germany or other countries of Western Europe. These results are consistent with the existence of differences in techniques of production; nonetheless, a proxy measure of capital intensity — the value of electricity consumed per production worker — was significantly different only for the US–West Germany pairings, so their evidence on choice of technique is not conclusive.

(b) Regression models

The "regression" approach to the control of size, industry and other variables has been utilized quite widely in recent years by researchers in Brazil. Braga (1979), in a careful analysis of data for 267 local and foreign firms, regressed profit rates on firm size, market share, advertising, debt, a foreign ownership dummy and other variables. The foreign dummy has a positive coefficient in the regression equation, indicating that foreign firms are more profitable than local firms once the effect of other variables on profitability is accounted for, but the coefficient is significant only at the 20% level in a two-tailed test. Newfarmer and Marsh (1981, pp. 66–72) also failed to find a significant coefficient for an ownership dummy in a similar model estimated with data for over 150 electrical firms.

ECLAC (1985) estimated a nonlinear model of the probability of exporting with data for more than 12,000 firms and found thc odds of export-

ing for a foreign firm to be double or triple that of a local firm once the effects of size, capital intensity, wage levels, product differentiation and other variables were accounted for. Among the subset of over 3,000 exporters, foreign firms had twice the export volume of local firms, holding constant the effect of differences in size, capital intensity, market structure and commercial policy.

No researcher has yet included a foreign ownership variable in a model of wage determination in Brazil. Lim, however, in a study of 141 local establishments and 159 foreign and "mixed" establishments in Malaysia found wages of the second group to be 3% higher on average than those of the first group after controlling for the effects of capital intensity, the proportion of employees paid with a fixed monthly salary, export/sales ratios and import competition. Surprisingly, variables for scale, trade unions and plant location were not significant. A shortcoming of the study is the incomplete control for inter-industry, as opposed to inter-firm, differences in wage levels. In any case, average wage differences, though statistically significant, were very small. Moreover, the absence of a variable for skill levels makes it impossible to conclude that foreign firms pay higher wages for labor of the same quality.

Small firms typically use less skilled labor, pay lower wages, use more labor-intensive techniques of production, operate fewer shifts and produce an output that is quite distinct from that of larger firms in the "same" industry. This dualism means that it is difficult to interpret the results of production functions estimated with cross-section data, especially in developing countries. Nonetheless, regression models are popular in cross-section analyses of productivity, and there have been several attempts in Brazil to measure the performance of foreign firms relative to local firms by including dummy variables in regression equations.

Tyler (1978) estimated an aggregate Cobb–Douglas production function for the entire manufacturing sector based on published fiscal 1971 balance sheet data for 850 local and foreign firms. He measured output by sales, the capital input by the inflation-adjusted book value of plant and equipment, and labor by the total number of employees. A foreign ownership dummy was positive and significant for the aggregate function, but when the same equation was fitted to each of the 21 two-digit subsectors, the foreign dummy was significantly greater than zero in only three equations. When Tyler estimated a more general Constant Elasticity of Substitution (CES) production function with the

complete set of observations, the higher productivity of foreign firms appeared as greater returns to scale and a higher elasticity of substitution, but not as greater technical efficiency. Mascolo and Braga (1984) confirmed this result by estimating Variable Elasticity of Substitution (VES) production functions for 3,243 exporters at the three-digit industry level, dividing the sample into local and foreign-owned firms.

In another study Tyler (1979) assembled similar data for the years 1971–75 and estimated Cobb–Douglas production functions for two broadly defined industries: electrical machinery (75 firms) and domestic appliances and communication equipment (56 firms). A time variable captured Hicksian neutral technological change and a dummy variable for each firm captured differential efficiency. The coefficients of the technical efficiency dummies show a positive and significant correlation with foreign ownership, but not after controlling for size differences between foreign and domestic firms.

Tyler's research suggests that foreign firms tend to be no more productive than local firms once we control for differences in size (capital and labor) and industry. Unfortunately, the empirical results suffer from two serious biases. The first, which is noted by Tyler, is that by measuring output as sales "we are forced to implicitly assume that the ratio of value-added to total output is a random variable over the firm population" (1979, p. 117). If this ratio varies systematically by type of firm, statistical inferences are biased. It is shown below that in Brazil value-added/output ratios are significantly higher for foreign firms, so Tyler's results on this account are biased *against* the finding of a positive effect of foreign ownership on productivity. A second bias occurs because there is no provision for differences in the quality of labor hired by the two types of firms. If employees of foreign firms systematically have greater skills than employees of local firms, as is shown below to be the case, then the regression results will be biased *in favor* of a positive relationship between foreign ownership and technical efficiency; output which should properly be ascribed to human capital — a purchased input — is credited to foreign ownership and management.

Morley and Smith (1977) overcome the first source of bias, but, by ignoring white-collar workers, aggravate the second source of bias in estimates of the relative efficiency of foreign firms. They obtained access to data at the establishment level from the 1969 Industrial Survey. In each of 17 four-digit industries, value-added per production worker was regressed on size, capital intensity and a dummy

variable for foreign ownership. Size and capital intensity were not entered as continuous variables, but rather as a set of dummy variables denoting size classes and capital intensity classes. Size was measured by value-added and capital intensity by the cost of electricity consumption per production worker. The study lends some support to the thesis that foreign firms are more productive because they are more efficient than local firms, but the evidence is not overwhelming: at the 5% level, only 10 of the 17 regression equations are significant; in only seven equations is the coefficient of the foreign dummy significantly greater than zero.

Morley and Smith also regressed electricity consumption per production worker on size class dummies and a foreign ownership dummy. At the 5% level, nine of the 17 equations are significant and in five equations the coefficients of the foreign dummies are significantly greater than zero. They thus provide evidence that foreign firms tend to be characterized by higher capital/labor ratios than local firms in the same industry after controlling for differences in size. Newfarmer and Marsh (1981, pp. 57–61) reached similar results for their sample of electrical firms when they regressed the ratio of employment to fixed assets on ownership, firm size and other variables.

3. A NEW TEST USING MATCHED PAIRS

A microdata base utilized in a previous study (ECLAC, 1985) contains information from tax returns for the year 1978 for 12,435 firms, in 841 of which nonresidents hold more than 10% of the equity. It was possible to match 282 of the foreign firms to comparable local firms which appear to be owned solely by private Brazilian residents. Each pair was matched by sales volume and by the four-digit industry accounting for the largest proportion of total sales. The firms are not identified by name, and details concerning the product mix or conglomerate diversification are not known. No observations from industry 3099 — "other manufactured goods not elsewhere classified" — were used, since it is not likely that firms of a similar size in this "industry" will produce similar types of goods.

A major shortcoming of these data is that they fail to classify as "foreign" those firms which are controlled from abroad through holding companies or through other firms established in Brazil. Souza Cruz, the leading producer of cigarettes, for example, appears to be wholly-owned by residents of Brazil even though BAT Industries Ltd. of the United Kingdom holds

three-quarters of the shares through its Rio de Janeiro holding company. Similarly, General Electric do Nordeste S.A. is misclassified as a local firm because its shares are held by General Electric do Brasil S.A., a corporation registered in Brazil but wholly-owned by its US parent. This underestimation of the number of foreign firms has affected previous research based on these data (*viz*. Braga, 1981; Mascolo and Braga, 1984; and ECLAC, 1985).[4] In the present study every attempt has been made to avoid matching foreign firms with "local" counterparts that are controlled indirectly by transnationals by crossing the data with those of "Quem e quem na economia brasileira" (VISAO, August 1978 and August 1979) and Jean Bernet's *Interinvest Guide* (Rio de Janeiro: 4th edition, 1978 and 5th edition, 1983). Nonetheless, it is conceivable that some of the 282 pairs of local and foreign firms may in reality be pairs of foreign firms. If so, this will bias the observed differences between the two sets of firms toward zero.

It is worth emphasizing that this is not a random sample of foreign firms in Brazil. Many industries in which foreign firms are dominant, such as tobacco or rubber tires, are not represented at all due to the lack of locally-owned firms of comparable size. Volkswagen, Ford and General Motors are excluded from the study because no local automotive firm exists that is similar in size to these giants of the industry. On the other hand, 10 pairs of pharmaceutical firms are included, despite the predominance of foreign firms in that industry.

Since the matched pairs are drawn from diverse industries, comparison of the mean values for each type of firm or averages of simple differences can be misleading. Such comparisons inadvertently give a large weight, for example, to capital-intensive industries in measures of differences in capital intensity, or to export industries in measures of differences in export propensities. To avoid this, we follow Chung and Lee (1980) and calculate for each variable and each pair of firms the standardized difference, defined as the absolute difference expressed as a percentage of the average level for the two firms. Algebraically, if X_i represents the value of a variable for the ith foreign firm and Y_i the value for the local firm matched to it, then the standardized difference is

$$(100)(X_i - Y_i)/(X_i + Y_i)(1/2).$$

A negative difference indicates that the value for the local firm exceeds that registered by its foreign counterpart. Note that the standardized difference is bounded by +200% and −200%, values that result when one of the two firms of a

matched pair registers a positive value and the other zero for a particular variable. When both X_i and Y_i are zero, as occurs frequently with some variables, the standardized difference is defined as zero.

Previous studies based on "matched pairs" have relied on nonparametric techniques to estimate the sign and significance of difference between the two sets of firms. Significant difference may be trivially small or very large, but nonparametric techniques do not provide us with information as to which might be the case. Fortunately, the large size of our sample permits us, by virtue of the Central Limit Theorem, to assume normality and use standard techniques of statistical inference which provide information on the size as well as the statistical significance of any observed differences.

(a) Empirical findings for the full sample

Table 1 reports mean values by type of firm for a number of variables, along with the mean standardized difference and its standard error. The large sample size means that it is relatively easy to reject the null hypothesis that average differences are zero even when differences between the two types of firms are quite small. The pairs are matched on the basis of sales volume, so the 282 foreign firms are only 0.6% smaller, on average, than domestic firms. Nonetheless, the standard error for this statistic is a low 0.2%, so the difference is statistically significant in a "t" test at the 1% level. The fact that the difference is significant at all reflects instructions given to the research assistant who assembled the matched pairs. Since foreign firms are larger than local firms, when confronted with a choice between a slightly larger or a slightly smaller local firm to match with the foreign firm, he was asked to favor the former.

The two sets of firms are closely matched by volume of sales, but in other measures of size they differ considerably. Foreign firms are 6% *larger*, on average, in terms of value-added, and 14% *smaller* in terms of employment. Value-added was estimated as total sales revenue plus change in inventories less purchases of raw materials, advertising, electricity, fuel and goods to be resold. In addition, only 45% of the foreign firms operate multiple plants or establishments, whereas 52% of the domestic firms own more than one establishment. As a consequence, the average number of plants operated by foreign firms is significantly lower than the average number operated by their local counterparts. These statistics illustrate the futility of matching

foreign to local firms in terms of all aspects of size. The choice of sales as a variable to match the two sets of firms is unavoidably arbitrary.

Given that foreign firms are nearly the same size as their local counterparts in terms of sales, yet considerably larger in terms of value-added, it follows that they add more value per unit of output. The standardized difference of the ratio of value-added to output (sales plus inventory changes) averages 5.9% and is significantly different from zero at the 1% level in a two-tailed test. This result, in terms of sign though not significance, is similar to that found in an earlier study (Willmore, 1976, p. 512) for Costa Rica. The finding is consistent with the thesis that foreign firms are more vertically integrated, i.e. that they process more stages of manufacture within the firm, relying less on outside producers or imports for a supply of intermediate inputs. It lends no support to the belief expressed in early writings that transnational corporations "contribute less to domestic value-added than local firms,"[5] but a full study requires knowledge of the linkages of foreign and domestic firms with plants in local and overseas markets.

The higher value-added to output ratios observed for foreign firms may also be the result of specialization in higher-quality or more uniform-quality goods in addition to (or instead of) greater vertical integration. In other words, foreign firms may typically have higher ratios of value-added to output not because they produce more intermediate inputs in their Brazilian plants, but rather because the goods they produce command higher prices due to advertising, prestigious brand names, higher quality or greater quality control. The high advertising expenditure observed for foreign firms is consistent with this interpretation, as is the finding, reported below, that foreign firms employ techniques of production that are capital- and skill-intensive compared to those used by their local counterparts.

Foreign firms operating in Brazil are known to advertise heavily and to repatriate part of their profits as royalties and technical assistance payments which are claimed as costs and deducted from local income for tax purposes. Brazilian law, however, does not allow royalty payments when a nonresident owner holds 50% or more of the equity of a firm (see von Doellinger and Cavalvanti, 1975, pp. 88–96).

The statistics reported in Table 1 confirm that foreign firms do advertise much more heavily than comparable local firms. The fact that transnational subsidiaries account for a disproportionate share of advertising expenditures in Brazil (Newfarmer, 1977, pp. 205–214;

Table 1. *Test for significant differences between matched pairs of foreign and domestic firms (mean values for 282 firms unless otherwise indicated)*

Variable	Foreign firm	Local firm	Standardized difference (%)
Size of firm			
SALES — million cruzeiros	168.5	168.8	−0.6* (0.2)
VA — value-added, million cruzeiros	102.5	96.4	6.2* (2.3)
L — number of employees	338.5	416.5	−13.8* (4.1)
EST — number of establishments	1.9	2.1	−7.8† (3.7)
MULTI% — percentage of multi-establishment firms	45.0	51.8	—
Value-added/Output			
VA/Q — value-added as a percentage of total output	58.3	55.1	5.9* (2.2)
Product differentiation, Royalties			
ADV — advertising expenditures/domestic sales, percentage	1.2	0.9	20.3* (7.9)
ROYTOT — total royalty payments, thousand cruzeiros	261.0	123.1	8.5 (5.7)
ROYTOT% — percentage of firms paying royalties	14.2	10.6	—
ROYFOR — overseas royalty payments, thousand cruzeiros	126.3	45.8	9.0* (3.7)
ROYFOR% — percentage of firms paying royalties abroad	7.4	3.5	—
Export performance			
EXPORTS1 — exports of all firms, million cruzeiros	14.0	8.0	61.6* (8.2)
EXPORT% — percentage of firms that export	68.1	48.6	—
EXPORTS2 — exports (million cruzeiros) when both firms export (n = 111)	30.5	17.4	57.3* (11.8)
XSUB — export subsidies as % of export sales (n = 111)	16.2	18.0	7.2 (10.8)
Labor productivity			
VA/L — value-added per employee, thousand cruzeiros	374.3	295.2	19.9* (3.8)
VA/LP — value-added per production worker, thousand cruzeiros (n = 268)	838.6	491.1	26.4* (4.6)
Skill intensity			
NONPL — non-production workers as a percentage of total employment (n = 268)	35.4	28.7	20.3* (4.5)
W/L — annual wage per employee, thousand cruzeiros	91.6	65.4	30.5* (3.1)
WNP/L — annual wage per non-production employee, thousand cruzeiros (n = 268)	133.1	106.1	26.6* (3.4)
WP/L — annual wage per production worker, thousand cruzeiros (n = 268)	64.2	51.8	18.9* (3.1)
Capital intensity			
NWVA/L — nonwage value-added per employee (thousand cruzeiros)	252.2	206.5	12.8* (4.7)
NWVA/LP — nonwage value-added per production worker, thousand cruzeiros (n = 268)	545.3	342.8	20.0* (5.3)
ELEC/LP — electricity consumption per production worker, thousand cruzeiros (n = 248)	9.3	7.1	23.9* (5.6)

Note: The numbers in parentheses are the standard errors of the mean of the standardized difference. * indicates statistical significance at the 0.01 level and † at the 0.05 level. All tests are one-tailed except those for firm size and VA/Q, which are two-tailed. Royalties include payments for technical assistance as well as payments for licensed technology and "brand names".

ECLAC, 1983, pp. 78–80) is thus not attributable solely to their greater size or differences in product mix.

Only a tiny proportion of the firms in our sample registered any payments for royalty fees or technical assistance. This presumably reflects strict government control of such expenditures. Nonetheless, the average difference is positive for both total and overseas payments, and significant at the 1% level in the case of the latter.

The results for comparative export performance confirm those reported in ECLAC (1985). The exports of foreign firms are much higher, on average, than comparable local firms. Moreover, two-thirds of the foreign firms export at least part of their output whereas fewer than half the local firms are exporters. Restricting the sample to the 111 pairs in which each firm exports, the standardized difference between foreign and local firms averages 57% and is highly significant. These results are to be expected on *a priori* grounds, for the costs of exporting are much lower for foreign firms, which have access to market information and sales organizations through their parent companies overseas. The ECLAC (1985, Chapter 3) study reports first that a positive correlation exists between export volume and the rate of export subsidy and, secondly, that the foreign firms' share of subsidies tends to exceed their share of exports. The present study shows that the second finding may well be a spurious result stemming from the larger size of foreign exporters, for differences in the rate of subsidy for the 111 matched pairs of exporters are not significantly different from zero.

The results reported in Table 1 also reveal that foreign firms have much higher levels of labor productivity, even after controlling for scale and industry differences. The average difference is 26% in terms of value-added per production worker and 20% when productivity is measured as value-added per employee; both differences are significant at the 1% level. The division of employment between white-collar and blue-collar workers was not reported for all firms, so the number of matched pairs is reduced from 282 to 268 when this information is required.

Do foreign firms pay higher wages for the same quality of labor in Brazil? This question cannot be answered with the data available to us in this sample. What is evident is that foreign firms pay higher wages *and* employ higher quality labor compared to their local counterparts. The ratio of white-collar to blue-collar employees, a crude indicator of labor skills, is more than 20% higher for foreign firms. The average wage is also much higher for each category of employee: standardized differences are 26% in the case of white-collar employees and 19% in the case of production workers.[6] Disaggregate wage data are needed to reach definite conclusions, but it would be surprising if a major portion of such large wage differences were not attributable to differences in skill levels.

Transnational enterprises are often criticized for transferring capital-intensive technologies to less developed countries which require labor-intensive techniques if the manufacturing sector is to absorb their abundant supply of labor. The relevant question, however, is how well do foreign firms do, compared to similar local firms, in absorbing labor? The evidence from this sample of matched pairs of firms suggests that in Brazil they perform quite poorly.

Physical capital intensity has been measured by three different variables: nonwage value-added per employee, nonwage value-added per production worker, and electricity consumption per production worker. All three measures suggest that foreign firms utilize techniques of production that are significantly more capital-intensive than their local counterparts. This may be a result of the fact that they are accustomed to large-scale, capital-intensive production in their home countries and utilize similar techniques in their scaled-down Brazilian plants, or it may simply reflect the fact that foreign firms must pay higher wages and have access to less expensive credit compared to local firms. Our finding, because of a large sample size, differs from that reported by Morley and Smith (1977, pp. 283–286).

Not only do techniques of production differ markedly between foreign and local firms, there is also evidence that differences tend to be greater, the greater the skill- and capital-intensity of the industry. Table 2 reports the coefficients of rank correlation between standardized differences and the average levels of various measures of productivity, skills and capital intensity. The coefficients are not very large, but, with the exception of the correlation between differences in wages of white-collar employees (WNP/L) and average wages of white-collar employees, all coefficients are positive and statistically significant at the 0.01 level. In other words, techniques of production show some tendency to differ more by type of ownership in industries characterized by high skills, high capital intensity and high productivity.

(b) *Empirical findings for subsets of the sample*

The large sample of 564 foreign and local firms

Table 2. *Labor productivity, wages and capital intensity: Rank correlation between average levels and standardized differences*

	Spearman rank correlation coefficient
Labor productivity	
VA/L ($n = 282$)	0.156
VA/LP ($n = 268$)	0.184
Wages	
W/L ($n = 282$)	0.180
WNP/L ($n = 268$)	−0.013
WP/L ($n = 268$)	0.176
Capital intensity	
NWVA/L ($n = 282$)	0.151
NWVA/LP ($n = 268$)	0.187
ELEC/LP ($n = 248$)	0.185

Note: Data for 248–282 matched pairs of firms ranked by average levels and by standardized differences (difference divided by average level). For definition of variables, see Table 1. All coefficients except −0.013 are statistically significant at the 0.01 level in a two-tailed test.

affords us the luxury of calculating statistics for subsets of the data. Results are reported below for two distinct divisions of the sample: (i) combinations of single and multi-plant operations, and (ii) manufacturing subsectors. It would also have been interesting to divide the sample by the nationality of the foreign owners, but this information was not available.

Since foreign firms tend to operate fewer plants than their local counterparts, some of the differences reported in Table 1 might arise from differences in multi-plant operations rather than foreign or local ownership *per se*. To test this possibility, the sample was divided into four groups: 88 matched pairs which only operate single plants, 79 which only operate more than one plant, 67 for which the foreign firm operates a single plant and its local counterpart multiple plants, and 48 for which the converse is true. As can be seen in Table 3, calculated differences do not vary significantly between the four possible combinations of multiple and single plant operations. The highest value the F statistic attains in analysis of variance (ANOVA) tests is 1.73, which does not allow one to reject, even at the 10% level of confidence, the null hypothesis that the four standardized differences are equal. Therefore, it would appear that observed differences in the performance of foreign and domestic firms are not the result of differences in the extent of multi-plant operations.

In addition, average differences between foreign and local firms were calculated for each of the 20 subsectors (two-digit industries) covered by the sample. The significant results of these calculations, along with the standard errors and the F statistics of the ANOVA tests, are reported in Table 4. There is surprisingly little evidence of subsector heterogeneity in the results. In only one case — wages — is it possible, at the 5% level, to reject the null hypothesis that differences between the two types of firms do not vary by subsector. Greater heterogeneity might have been expected, given the existence of a significant, positive relationship between the standardized differences and average levels of these variables (see Table 2). Apparently the subsectors are themselves too heterogeneous to reveal these potential inter-industry differences.

In sum, the findings reported in Table 1 appear to be applicable throughout Brazil's manufacturing sector. Nonetheless, it is worthy of note that some of the variables achieve statistical significance in a large number of subsectors, whereas others do so in very few. Wages, for example, are significantly higher for foreign firms at the 5% level in 11 industries. In contrast, differences in advertising intensity attain statistical significance in only three subsectors. Advertising differences also show the least significant variations from subsector to subsector ($F = 0.93$), whereas variations in wage differences are statistically significant ($F = 1.70$).

4. SUMMARY AND CONCLUSIONS

The empirical analysis of the previous section leaves us with a number of definite conclusions as well as some unanswered questions concerning the typical characteristics of a foreign firm compared to its local counterpart of the same size operating in the same industry.

One finding of interest is that foreign firms in Brazil operate significantly fewer plants than their local counterparts. The difference is not large because single plant operations are common for both types of firms. Though unexpected, this finding seems reasonable for two reasons. First, foreign firms operate plants of a much larger scale in their countries of origin than they do in Brazil. Therefore, they can be expected to be less prone than local firms to divide their output among several plants in the smaller Brazilian market. Second, we found that foreign firms utilize quite capital-intensive techniques of production compared to their local counterparts, and capital intensity tends to increase the importance of scale economies.

Table 3. *Test for significant differences when multi-plant operation is similar or different (mean standardized differences of matched pairs)*

Variable	Both single plants ($n = 88$)	Both multiple plants ($n = 79$)	For: Single Dom: Multiple ($n = 67$)	For: Multiple Dom: Single ($n = 48$)
EST	—	−8.5 (6.6)	—	—
VA/Q ($F = 0.98$)	6.0 (3.4)	10.8* (4.3)	0.4 (4.5)	5.6 (6.0)
ADV ($F = 0.26$)	18.4 (14.7)	23.1 (14.4)	10.8 (15.9)	32.2 (19.6)
EXPORTS1 ($F = 0.48$)	66.5† (14.3)	46.4† (16.5)	64.7† (16.9)	73.1† (18.3)
VA/L ($F = 1.48$)	21.0† (7.0)	29.2† (7.1)	18.0* (8.1)	4.9 (8.3)
W/L ($F = 1.21$)	37.1† (5.2)	32.6† (5.5)	26.0† (6.6)	21.4† (7.9)
NWVA/L ($F = 1.73$)	13.1 (8.7)	27.9† (8.8)	5.5 (9.3)	−2.2 (11.3)

Note: The numbers in parentheses are the standard errors of the mean. * indicates statistical significance at the 0.05 level and † at the 0.01 level. All tests are one-tailed except those for EST and VA/Q, which are two-tailed. "n" refers to the number of matched pairs in the sample. The F statistics report the results of an analysis of variance (ANOVA) test for heterogeneity of the mean standardized differences.

Foreign firms also have significantly higher ratios of value-added to output, but it is not clear why this occurs. To what extent does this reflect greater vertical integration of production and to what extent does it reflect higher quality goods sold at higher prices? This is a point that requires further research and could profitably be included in detailed case studies of firms and industries. Chudnovsky (1979, p. 54), in his study of the Argentine pharmaceutical industry, actually found foreign firms to charge considerably lower prices than their local rivals, but this is not likely to be true for all industries and all developing countries.

Advertising expenditures and remittances for royalties and technical assistance are both significantly higher for foreign firms, and the evidence is overwhelming that foreign-owned firms export a much larger proportion of their output than do comparable local firms despite the fact that they do not benefit from a significantly higher rate of export subsidy. All these results are to be expected, since the advantages of the transnational corporation often stem from its possession of "brand names," proprietary technology, and links to overseas markets.

There is no doubt that foreign firms in Brazil typically have high levels of labor productivity compared to local firms of a similar size operating in the same industry. This could result from any one of a number of factors: (i) employees which have greater skills and training, (ii) more machinery and equipment per worker, (iii) greater technical efficiency, in the sense that the same output is produced with fewer inputs, or (iv) some combination of these three possibilities. The results of this study show very clearly that the first two factors play an important role in accounting for observed productivity. It is not possible, in the absence of a clearly specified production function, to measure differences in technical efficiency, so nothing can be inferred regarding the possible importance of this factor.

The fact that foreign firms utilize more capital- and skill-intensive techniques of production implies that they make less use of unskilled labor, the abundant factor of production in Brazil. This may be because they have to pay higher wages for labor of the same quality, or because quality controls for internationally known products impose rigidities in the production process to an extent unknown by local firms. Or it may simply reflect the absence of competitive pressures, permitting what Morley and Smith refer to as a

Table 4. *Test by subsector for significant differences between matched pairs of foreign and domestic firms (mean standardized differences in percent)*

Subsector	VA/O	ADV	EXPORTS1	VA/L	W/L	NWVA/L
Non-metallic min. ($n = 12$)	—	—	—	47.9* (13.8)	40.5* (13.5)	48.5* (16.4)
Basic metals ($n = 46$)	18.0* (6.2)	20.9 (16.3)	80.8* (18.7)	25.8* (7.2)	41.0* (5.8)	18.9† (10.0)
Machinery ($n = 44$)	—	45.8* (17.1)	52.4† (22.3)	18.2† (10.2)	32.5* (7.7)	—
Electrical equip. ($n = 23$)	9.2† (3.6)	—	91.3* (25.6)	—	23.6† (11.4)	—
Transport equip. ($n = 16$)	—	—	52.0 (38.7)	23.1† (9.8)	29.3* (8.8)	25.9† (13.5)
Wood ($n = 3$)	—	—	136.5 (62.2)	—	—	—
Furniture ($n = 2$)	—	—	—	—	—	—
Pulp and paper ($n = 10$)	—	—	137.12* (42.3)	—	45.6* (13.5)	—
Rubber ($n = 3$)	14.3 (7.6)	—	—	33.0* (1.3)	—	37.1† (11.0)
Leather ($n = 2$)	—	—	129.6† (13.1)	—	—	—
Chemicals ($n = 27$)	—	—	83.5* (21.8)	23.8 (14.3)	27.5* (10.9)	—
Pharmaceutical ($n = 10$)	—	—	—	—	37.1† (16.0)	—
Perfumes, soap ($n = 3$)	—	—	—	—	88.9 (47.6)	—
Plastics ($n = 8$)	—	141.8* (39.1)	102.5† (51.7)	65.7† (30.6)	76.8* (17.4)	64.2 (35.6)
Textiles ($n = 32$)	—	—	77.3* (24.9)	—	—	—
Clothing, footwear ($n = 8$)	—	—	—	—	—	—
Processed food ($n = 13$)	22.3 (13.9)	83.5† (37.1)	—	—	41.8* (11.7)	—
Beverages ($n = 7$)	−21.0 (10.7)	—	53.7 (34.8)	—	—	—
Printing ($n = 6$)	34.9† (9.3)	—	—	62.5† (21.7)	—	66.4† (32.2)
Other manufactures ($n = 5$)	—	—	—	—	48.6† (15.8)	—
F statistic	1.59	0.93	1.31	0.94	1.70†	1.08

Note: The numbers in parentheses are the standard errors of the mean. * indicates statistical significance at the 0.01 level and † at the 0.05 level. All tests are one-tailed except those for VA/Q, which are two-tailed. Statistics not shown were not significantly different from zero at the 0.10 level. "n" refers to the number of matched pairs in the sample. The F statistics refer to the results of an analysis of variance (ANOVA) test of the null hypothesis that the mean differences do not vary by subsector.

"limited search" for more labor-intensive techniques of production.

This study has benefited from access to an exceptionally large data base. As a result, in contrast to previous studies in Brazil and elsewhere employing the "matched pairs" approach, we have found quite large and significant differences between local and foreign firms. If local firms imitate their foreign rivals, this imitation is far from perfect. Ownership ties do make a difference. The implementation of policies which encourage or restrict foreign ownership can thus be expected to have direct effects on industry performance, quite apart from any indirect effects that result from modification of the behavior of locally-owned firms or changes in the size distribution of firms.

The finding that foreign firms differ from

domestic firms should not come as a surprise, for subsidiaries of transnational corporations form part of a much larger organization. Von Doellinger and Cavalvanti (1975, pp. 42–46) estimated that foreign subsidiaries operating in Brazil account for only 2% of the global sales of the respective transnational enterprises and less than 1% of their global assets. In a broad sense,

foreign-owned firms are thus much larger in size than any privately-owned Brazilian firm. Indeed, it is the ties to a parent company that give the foreign firm its advantage over local firms in export markets, enable it to attract and retain highly-skilled employees, and may explain its preference for capital-intensive and skill-intensive techniques of production.

NOTES

1. Blomstrom and Persson (1983) present evidence for Mexico that could be interpreted as support for such a "spillover" of technology from foreign to local firms. They report a positive coefficient of partial correlation between foreign presence in an industry and labor productivity of locally-owned plants, but their control for inter-industry variations in capital- and skill-intensity is very imperfect. For this reason, their finding may simply reflect the tendency of foreign firms to dominate industries characterized by high capital and skill requirements, hence high output per employee.

2. Katz (1984, p. 24) cites a comparison between "a locally-owned machine tool firm" and a "subsidiary of a British firm producing combustion engines" in support of the generalization that "subsidiaries of [transnational corporations] tend to develop stronger domestic technological capabilities in process engineering areas as well as in production planning and organization, rather than in aspects of new product design." (Katz, 1984, p. 24.) This may be true. But differences between the two types of products, namely rapid technological change in machine tools compared to internal combustion engines, might also explain the observed differences in research and development effort. Similarly, the (opposite?) conclusion that large locally-owned firms can, "as far as technological behavior is concerned," be grouped with "domestic subsidiaries of foreign firms" (p. 25) is based on very few observa-

tions, with insufficient control for other factors that might account for this result.

3. On the other hand, students of the pharmaceutical industry in Argentina (Chudnovsky, 1979, cited in Katz, 1984, p. 24) have concluded that domestic firms have a competitive edge over foreign subsidiaries that rely on parent companies for the development of new products.

4. The ECLAC 1983 study is based on published balance-sheet data, so does not underestimate the number of foreign-owned firms.

5. The quote is from Lim and Fong (1982, p. 582). See also Caves (1971, p. 13) and Newfarmer (1977, pp. 367–369). Lim and Fong in their article also present evidence in conflict with this belief. Lall, in his 1978 survey article, notes that the entire area of linkages and the creation of domestic value-added by foreign firms "cries out for detailed empirical research."

6. The wage and labor data reported in this study were taken from returns filed for payment of the industrial product tax (IPI) in calendar 1978. Wage data from corporate income tax returns for fiscal 1978 were also analyzed, but the results are not reported here, for they replicate those produced with the IPI data.

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