# Output and Productivity in Brazilian Distribution

Mulder, Nanno

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Nanno Mulder

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Institute of Economic Research*
Faculty of Economics
University of Groningen
P.O. Box 800
9700 AV Groningen - The Netherlands
tel. 31-50-633741
fax. 31-50-637337

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# Output and Productivity in Brazilian Distribution: A Comparative View

Nanno Mulder*
Groningen Growth and Development Centre
University of Groningen

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## 1. INTRODUCTION

This paper compares output and labour productivity in wholesale and retail trade in Brazil and the USA for the period 1970 to 1990. The USA was chosen as the benchmark country, because it is considered to be the international productivity leader. Brazilian productivity is compared with the country whose general economic performance reflects "best practice". The methodology follows that of Mulder and Maddison (1993), which compared Mexican and US performance in distribution. The paper is part of the International Comparisons of Output and Productivity (ICOP) project of the Groningen Growth and Development Centre. This project aims to compare output and productivity of all sectors of the economy by industry-of-origin comparisons. Performance of agriculture, mining and manufacturing in Brazil and the USA were already compared (see Maddison and van Ooststroom (1993), Houben (1990) and Maddison and van Ark, 1989). The benchmark year for these studies was 1975, because results for this year can be compared with those of the International Comparisons Project (ICP) of the United Nations, (ICP Round III). This study covers one of the main parts of the private service sector: wholesale and retail trade.

The aim of the present paper is twofold. Firstly, it includes tests for different methods to convert value added into a common currency (cruzeiros or US$). Secondly, it analyses factors which explain part of the observed productivity differential between Brazil and the USA, such as the employment structure of the distribution sector in both countries and the size of establishment.

## 2. WHOLESALE AND RETAIL TRADE IN BRAZIL AND THE USA

Distribution is the most important part of the service sector in terms of its share in employment and GDP[1]. The employment and GDP share are higher in the USA compared

[1] The 1990 share of distribution in total employment was 12.8 per cent in Brazil (IBGE (1992), *Pesquisa nacional por amostra de domicilios* (PNAD)) and 21.9 per cent (including eating and drinking places) in the USA (BEA, *Survey of Current Business*, May 1993). Its share in 1990 GDP

to Brazil.

Tables 1 to 4 show some characteristics of Brazilian and US distribution for 1975/7, like the number and density of establishments, the size of establishment, employment, sales, gross margins and value added. Table 1 presents the number of outlets and the number of outlets per head of population. There are more outlets per head in the USA than in Brazil for the total and for specific branches of distribution, except for the retail trade in nondurables. In the retail trade of food products, there were almost four times as many stores in Brazil.

**Table 1**
**Number of Establishments in Retail and Wholesale Trade**
**Brazil and the USA, 1975/7**

| | Number of Establishments | | Number of Establishments per 100,000 inhabitants | |
|---|---|---|---|---|
| | Brazil 1975 | USA 1977 | Brazil 1975 | USA 1977 |
| Wholesale Trade: | | | | |
| Durables | 13,325 | 202,599 | 13 | 92 |
| Nondurables | 35,485 | 139,834 | 34 | 63 |
| Food | 14,147 | 35,683 | 13 | 16 |
| Total (All branches) | 48,809 | 342,433 | 47 | 155 |
| Retail Trade: | | | | |
| Durables | 87,049 | 481,353 | 83 | 219 |
| Nondurables | 541,442 | 686,945 | 516 | 312 |
| Food | 400,680 | 223,092 | 382 | 101 |
| Total (All branches) | 628,491 | 1,168,298 | 599 | 530 |
| Wholesale and Retail Trade | 677,300 | 1,510,731 | 646 | 686 |

Sources: Brazil: IBGE (1981), *Censo Comercial 1975*; USA: Department of Commerce, Bureau of the Census (1981), *1977 Census of Retail Trade* and *1977 Census of Wholesale Trade*. Population figures: see Table 3.

was 7.3 per cent in Brazil (IBGE (1993), *Contas consolidadas para a Nação - Brasil 1990-1992*) and 17.1 (including eating and drinking places) per cent in the USA (BEA, *Survey of Current Business*, May 1993). Eating and drinking are included in retail trade. Data on eating and drinking places were not available in 1990, so they could not be separated from the rest of retail trade. Evidence for 1987 showed that the US shares are a few percentage points lower if eating and drinking places are excluded (see Mulder, 1994).

Table 2 shows the average and median size of establishments in Brazil and the USA, measured by the number of persons engaged. The "median" establishment is that where half of all persons engaged work in smaller establishments, and half in bigger ones. Median size is a better measure for productivity analysis than average size (see van Ark (1993), p. 137). The average US store was 2.6 times as big as the Brazilian, and the US median 3.3 times as big. The biggest US advantage was in retail food sales, and the only case of Brazilian advantage was in wholesale durables.

**Table 2**
**Average and Median Size of Establishment in Retail and Wholesale Trade Measured by the Number of Persons Engaged, Brazil and the USA, 1975/7**

| | Average Size | | Median Size | |
|---|---|---|---|---|
| | Brazil, 1975 | USA, 1977 | Brazil, 1975 | USA, 1977 |
| Wholesale Trade: | | | | |
| Durables | 9.6 | 12.1 | 26.8 | 17.7 |
| Nondurables | 7.0 | 13.0 | 17.2 | 23.6 |
| Food | 7.2 | 17.2 | 16.9 | 54.8 |
| Total (All branches) | 7.7 | 12.5 | 18.8 | 18.6 |
| Retail Trade: | | | | |
| Durables | 6.0 | 10.0 | 11.9 | 26.8 |
| Nondurables | 2.6 | 6.8 | 3.5 | 14.4 |
| Food | 2.1 | 9.2 | 2.3 | 38.4 |
| Total (All branches) | 3.1 | 8.1 | 4.9 | 19.7 |
| Wholesale and Retail Trade | 3.4 | 9.1 | 5.9 | 19.4 |

Sources: Censuses of Wholesale and Retail Trade as described in Table 1.

Table 3 shows employment in distribution. Three types of employment can be distinguished. Paid full-time and part-time employees, proprietors, and unpaid family workers. The Brazilian census includes all three categories. US censuses list data only on the number of paid employees. The same method as used in Mulder and Maddison (1993) is applied here to take account of proprietors and family workers[2]. Proprietors and family workers represented an addition of 11.4 per cent of paid employees which is much lower than in Brazil (where they represented a 48.6 per cent addition to paid employees).

[2] Ratios of proprietors and family workers to paid employees were taken from the *Labor Force Statistics Derived from the Current Population Survey: A Databook* (Bureau of Labor Statistics, 1982). These ratios were used to account for these non-paid parts of employment.

In Brazil, trade in food products accounted for 41.1 percent of employment in distribution. Employment in distribution as recorded in the Brazilian census was 6.2 per cent of total employment. For the USA, the augmented estimate of distribution employment (excluding family workers) was much higher, i.e. 12.1 per cent of total US employment.

**Table 3**
**Persons Engaged (Paid Employees, Family Workers and Proprietors) in Wholesale and Retail Trade, Total Persons Engaged and Population, Brazil and the USA, 1975/7**

| | Brazil, 1975 | | USA, 1977 | |
|---|---|---|---|---|
| | Persons engaged | of which: family workers and proprietors | Persons engaged | of which: family workers and proprietors |
| Wholesale Trade: | | | | |
| Durables | 127 | 8 | 2,458 | 188 |
| Nondurables | 248 | 27 | 1,817 | 139 |
| Food | 102 | 9 | 613 | 47 |
| Total (All branches) | 375 | 35 | 4,276 | 328 |
| Retail Trade: | | | | |
| Durables | 521 | 54 | 4,815 | 547 |
| Nondurables | 1,425 | 670 | 4,652 | 528 |
| Food | 852 | 544 | 2,042 | 232 |
| Total (All branches) | 1,946 | 724 | 9,467 | 1,075 |
| Wholesale and Retail Trade | 2,321 | 759 | 13,743 | 1,403 |
| TOTAL ENGAGED (Whole Economy) | 37,426 | | 98,492 | |
| Population | 104,851 | | 220,239 | |

Sources:
Brazil: IBGE (1981), *Censo Comercial 1975*; USA: Department of Commerce (1981), *1977 Census of Retail Trade* and *1977 Census of Wholesale Trade*. Total persons engaged and population in Brazil estimated from A. Maddison and associates (1992), *The Political Economy of Poverty, Equity and Growth: Brazil and Mexico*, OUP, New York, Tables A-2 and A-8; USA from OECD *Labour Force Statistics*.

Note: The US censuses for 1977 did not include family workers and proprietors, whereas the Mexican census did. The number of US proprietors and family workers was estimated as described in the text.

Sales, value added and the proportion of goods purchased by distributive establishments (including changes in value of inventories during the period considered) in Brazil and the USA are shown in Table 4. The share of wholesale trade in total distribution was higher in the USA than in Brazil (in 1975/7: 51 per cent in Brazil compared to 58 per cent in the USA, see third and fourth column of Table 4). Ratios of purchased goods to sales were

higher in Brazil than in the USA for all trades, except for the wholesale trade in nondurables. High percentages were found in both countries for food products. Low ratios were found in the wholesale and retail trade of durables. Table 4 also shows ratios of other inputs (like office supplies, communication services, fuels, etc.) than purchases of goods to sales. The average ratio of other inputs to sales in Brazil was 0.6 percentage points lower than in the USA. Ratios of other inputs to sales were higher in wholesale trade compared to retail trade in both countries.

**Table 4**
**Sales, Value Added, Ratio of Purchased Goods to Sales and Ratio of Inputs to Sales in Retail and Wholesale Trade, Brazil and the USA, 1975/7 (million 1975 US$, with Cruzeiros Converted by the Exchange Rate)**

| | Sales | | Value Added | | Ratio of purchased goods to sales | | Ratio of other inputs to sales | |
|---|---|---|---|---|---|---|---|---|
| | USA, 1977 | Brazil, 1975 | USA, 1977 | Brazil, 1975 | USA, 1977 | Brazil, 1975 | USA, 1977 | Brazil, 1975 |
| Wholesale Trade: | | | | | | | | |
| Durables | 465,245 | 17,803 | 99,693 | 3,309 | 74.4 | 77.9 | 4.2 | 3.5 |
| Nondurables | 603,126 | 44,115 | 79,373 | 6,780 | 83.5 | 82.1 | 3.4 | 2.5 |
| Food | 178,964 | 13,479 | 23,630 | 1,439 | 83.6 | 86.2 | 3.2 | 3.1 |
| Total (All branches) | 1,068,377 | 61,917 | 179,065 | 10,089 | 79.5 | 80.9 | 3.7 | 2.8 |
| Retail Trade: | | | | | | | | |
| Durables | 285,621 | 23,141 | 66,991 | 4,949 | 71.7 | 73.9 | 4.8 | 4.7 |
| Nondurables | 272,084 | 29,578 | 58,556 | 4,537 | 73.4 | 80.8 | 5.1 | 3.8 |
| Food | 142,349 | 14,996 | 26,265 | 2,200 | 76.8 | 82.1 | 4.8 | 3.3 |
| Total (All branches) | 557,705 | 52,719 | 125,547 | 9,487 | 72.5 | 77.8 | 5.0 | 4.2 |
| Wholesale and Retail Trade | 1,626,072 | 114,637 | 304,612 | 19,576 | 77.1 | 79.5 | 4.1 | 3.5 |

Sources: Brazil: IBGE (1981), *Censo Comercial 1975*; USA: neither census (Department of Commerce, Bureau of the Census (1981), *1977 Census of Retail Trade* and *1977 Census of Wholesale Trade*) contains data on purchases of goods by distributors and value added. Two other publications of the Bureau of the Census (1981), *Characteristics of Retail Trade* and *1977 Merchant Wholesalers*) were used to estimate purchased goods and value added as a percentage of sales for different kinds of trade. US prices adjusted to a 1975 basis by price indexes derived from Bureau of Labor Statistics (various issues), *Consumer Prices and Price Indexes* (applied to retail trade); and BLS (1976), *Wholesale Prices and Price Indexes, Supplement 1976, Data for 1975*; and BLS (1978), *Producer Prices and Price Indexes, Supplement 1978, Data for 1977* (applied to wholesale trade).

## 3. DERIVATION OF GROSS VALUE ADDED IN COMPARABLE "PRICES"

In order to compare Brazilian value added with that in the USA, it needs to be converted to a common set of "prices" (cruzeiros or US dollars). One of the aims of this

article is to show four methods to convert value added to a common currency and to compare the results of these methods in terms of relative labour productivity. Three methods were applied in earlier studies on international productivity comparisons in distribution: exchange rate conversion; conversion using a single PPP for total consumption or total GDP derived from ICP, and single deflation. The difference between method (ii) and (iii) is that the former uses only one expenditure PPP for the conversion of sales and value added of all types of stores, whereas the latter uses a large number of expenditure PPPs, of which each PPP applies to a specific expenditure category of goods (which are predominant in the shop concerned). A fourth method for comparing gross value added, which is a novelty of this study, is double deflation.

(i) *Exchange Rate Conversion*[3] (i.e. 8.13 cruzeiros to 1 US$), see Table 4. This method is not a very useful one, because exchange rates are often controlled and/or are subject to capital movements and speculation. They do therefore not provide a correct adjustment for differences in prices of goods and services between countries.

(ii) *Conversion by a Single Expenditure PPP*, i.e. conversion of sales and value added by a single ICP (Fisher) PPP for total consumption or total GDP. The former measure, as used in McKinsey (1992), represents the value given up by consumers in exchange for retailing services. The GDP PPP comparison represents income of distribution in terms of claims on the total economy (see Ito and Maruyama, 1991). The ICP Fisher PPP for total consumption in 1975 was 5.62 cruzeiros to the dollar and the PPP for total GDP 5.40. Brazilian value added data converted to US$ with these PPPs are not shown separately.

(iii) *Derivation of gross value added in comparable prices with single deflation.* Single deflation is the conversion of value added with one set of PPP converters, i.e. expenditure PPPs derived from the International Comparisons Project (ICP). This method was also used

[3] As applied in Jefferys and Knee (1962).

in previous studies[4]. ICP binary PPPs were available for detailed commodity categories which are here applied to convert sales and value added of wholesalers or retailers selling those types of commodities. Consumer expenditures are used as weights in cases where PPPs of specific commodity categories are combined in order to estimate a PPP for a group of trades. Two sets of weights can be used: Brazilian expenditure weights (i.e. derivation of a Paasche PPP) and US expenditure weights (derivation of a Laspeyres PPP). The geometric average of the Paasche and Laspeyres estimate is the Fisher PPP. The branch ICP Paasche and Laspeyres PPPs are shown in Table 5. Wholesale trade PPPs were higher than retail trade PPPs. PPPs for the trade in durables were higher than PPPs in the trade of nondurables. The lowest PPPs were found in the trade of food products. The single deflation PPP for total distribution was 8.78 cruzeiros per US$ (Fisher result) which was above the 1975 prevailing exchange rate.

**Table 5**
**ICP Reweighted Paasche, Laspeyres and Fisher PPPs for Gross Value Added, Wholesale and Retail Trade, Brazil and the USA, 1975/7**

| | Paasche PPPs (i.e. at Brazilian quantity weights) | Laspeyres PPPs (i.e. US quantity weights) | Fisher PPPs (geometric average of column 1 and 2) |
|---|---|---|---|
| | (1) | (2) | (3) |
| Wholesale Trade: | | | |
| Durables | 8.05 | 11.02 | 9.42 |
| Nondurables | 7.90 | 9.53 | 8.68 |
| Food | 4.16 | 7.43 | 5.56 |
| Total (All branches) | 7.95 | 10.45 | 9.11 |
| Retail Trade: | | | |
| Durables | 8.06 | 10.63 | 9.25 |
| Nondurables | 5.96 | 10.18 | 7.79 |
| Food | 4.26 | 6.94 | 5.44 |
| Total (All branches) | 6.90 | 10.36 | 8.45 |
| Wholesale and Retail Trade | 7.40 | 10.42 | 8.78 |
| Exchange Rate | 8.13 | 8.13 | 8.13 |

Source: Kravis, Heston and Summers (1982); detailed ICP augmented binary PPPs for Brazil/USA kindly supplied by Alan Heston.

[4] See Hall, Knapp and Winsten (1961) and Smith and Hitchens (1985).

(iv) *Derivation of gross value added in comparable prices with double deflation.* This method is discussed in detail in the following section.

## 3.1 Derivation of Gross Value Added in Comparable Prices with Double Deflation

ICP PPPs are not suitable converters for value added, because they apply only to sales which is identical to consumer expenditure. However, ICP PPPs do not represent relative prices of goods purchased by distributors destined for resale, nor do they represent relative prices of other inputs like communication costs, fuels, office supplies, Therefore, a method of double deflation was developed which means that two sets of converters were used, i.e. one set that apply to sales and another for purchases of goods for resale of establishments and other input costs. This method was first developed in a Mexico/USA comparison in Mulder and Maddison (1993) and is replicated here.

### 3.1.1 PPPs for Sales

ICP Paasche and Laspeyres PPPs (the same as used for single deflation) for the relevant categories were used as converters for sales, as shown in Table 6. These PPPs do not correspond to those shown in Table 5, because specific binary PPPs were weighted in the single deflation procedure with gross value added data and in the double deflation procedure with sales.

### 3.1.2 PPPs for Goods Purchased

The second step in the double deflation procedure was the conversion of purchases of goods destined for resale (including changes in the value of inventories) from the commodity

producing sector. This conversion was done with Paasche and Laspeyres PPPs taken from studies of the Groningen ICOP project. The main difference between the ICP and ICOP approach is that the ICP (or expenditure) approach estimates PPPs comparing final expenditures (i.e. private consumer expenditure, investment and government) across countries, whereas the ICOP (or industry-of-origin) estimates are based on ex-factory prices of goods from the commodity producing sectors[5]. These PPPs are therefore more suitable to convert purchases than ICP PPPs. ICOP Paasche and Laspeyres PPPs for branches are shown in Table 6.

**Table 6**
**ICP Paasche and Laspeyres PPPs for Sales, ICOP Paasche and Laspeyres PPPs for Purchases and Other Inputs, and Implicit Paasche and Laspeyres PPPs for Value Added, Retail and Wholesale Trade, Brazil and the USA, 1975/7**

| | Paasche PPPs (i.e. at Brazilian Quantity Weights) | | | | Laspeyres PPPs (i.e. at US Quantity Weights) | | | |
|---|---|---|---|---|---|---|---|---|
| | ICP PPP for sales | ICOP PPP for purchases | ICOP PPP for other inputs | Implicit PPP for value added | ICP PPP for sales | ICOP PPP for purchases | ICOP PPP for other inputs | Implicit PPP for value added |
| Wholesale Trade: | | | | | | | | |
| Durables | 8.11 | 4.89 | 4.76 | -4.30 | 10.88 | 7.56 | 7.86 | 26.05 |
| Nondurables | 7.09 | 8.25 | 4.85 | 4.23 | 9.87 | 9.75 | 8.52 | 7.05 |
| Food | 4.16 | 5.96 | 5.08 | 1.19 | 7.43 | 7.29 | 8.32 | 19.44 |
| Total (All branches) | 7.35 | 6.98 | 4.82 | 11.38 | 10.35 | 8.86 | 8.20 | 17.63 |
| Retail Trade: | | | | | | | | |
| Durables | 7.42 | 6.55 | 5.27 | 16.53 | 10.66 | 7.34 | 7.81 | 16.10 |
| Nondurables | 5.96 | 6.47 | 5.61 | 4.25 | 9.98 | 9.39 | 7.69 | 13.61 |
| Food | 4.24 | 4.83 | 5.73 | 2.44 | 6.94 | 6.73 | 7.73 | 8.55 |
| Total (All branches) | 6.49 | 6.50 | 5.44 | 6.76 | 10.27 | 8.57 | 7.75 | 14.94 |
| Wholesale and Retail Trade | 6.94 | 6.76 | 5.10 | 8.55 | 10.32 | 8.77 | 8.01 | 16.52 |

Sources: Author's calculations. ICP augmented binary PPPs for sales from Kravis, Heston and Summers (1982); ICOP binary PPPs for purchases and other inputs from Houben (1990), a revised version of Maddison and van Ark (1987), Maddison and van Ooststroom (1993).

[5] See van Ark (1993) for a further analysis of the ICP and the ICOP approach.

### 3.1.3 PPPs for Other Inputs

To arrive at gross value added, one has to deduct "other inputs" (than purchases of goods destined for resale) from gross margin, such as the cost of communication, electricity, fuels, insurance, packaging materials and transport. ICOP PPPs were also used to convert these costs. The Paasche PPPs for the conversion of Brazilian "other input" costs are shown in Table 6[6]. The Laspeyres PPPs which were used to convert US "other input" costs are also shown in Table 6[7].

### 3.1.4 Implicit PPPs for Value Added

Implicit PPPs for gross value added obtained with double deflation are calculated by dividing for Brazil the cruzeiro value of gross value added by the double deflated Paasche estimate in US$, see Table 6. For the USA, the double deflated Laspeyres estimate is divided by gross value added in US$ to derive the implicit Laspeyres PPP. The implicit Paasche PPP for total distribution is 8.55, the Laspeyres PPP is 16.52.

## 4. LABOUR PRODUCTIVITY IN DISTRIBUTION

Labour productivity expressed as gross value added per person engaged in national

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[6] ICOP Paasche PPPs were available for the following inputs listed in the Brazilian census: communication, electricity, fuels and lubricants, and freight and carriage (i.e. transport). The sum of the four items represented 1.35 percent of total inputs (including purchases of goods for resale). For the remaining part of "other input" costs, no ICOP PPPs were available. These conversion-resistant items were 2.8 per cent of total inputs. A weighted average of the ICOP Paasche PPPs of the four mentioned items was used to convert these residual input costs to US$.

[7] Neither of the US censuses contained data from which input costs could be estimated. Other sources (see sources Table 4) contain the information necessary. ICOP Laspeyres PPPs were available for fuels, office supplies, communications and electricity. Together these inputs accounted for 1.4 per cent of total input costs (including purchases). As for Brazil, a weighted average of these input PPPs was used to convert the remaining input costs to cruzeiros, which represented 3.7 per cent of total input costs (including purchases). Table 3 shows the Laspeyres PPPs for other inputs.

currencies within each branch of distribution is shown in Table 7. Labour productivity of each branch is calculated as a percentage of the average. As can be seen, differences between sectors are much more pronounced in Brazil than in the USA.

The results of the four methods of currency conversion in terms of relative productivity levels are presented here:

(i) *Exchange Rate Conversion.* The last column of Table 7 shows Brazilian gross value added per person converted to US$ with the exchange rate as a percent of the USA. Brazilian relative labour productivity is the lowest in the retail trade of food products and the highest in the wholesale trade of nondurables.

(ii) *Conversion by a Single Expenditure PPP*, i.e. a single Fisher ICP PPP to convert distribution value added. Brazilian labour productivity was 55 per cent of the US level using the ICP Fisher PPP for total consumption and 57 per cent using a Fisher PPP for total GDP.

**Table 7**
**Brazilian and US Gross Value Added per Person Engaged in National Currencies**
**Brazil/USA, 1975/7**

| | Brazilian Gross Value Added per Person Engaged (1975 cruzeiros) | Brazilian Gross Value Added per Person Engaged as a % of the average | US Gross Value Added per Person Engaged (1975 US$) | US Gross Value Added per Person Engaged as a % of the average | Brazilian Gross Value Added per Person (converted at the exchange rate) as a % of the USA |
|---|---|---|---|---|---|
| Wholesale Trade: | | | | | |
| Durables | 211,286 | 308.1 | 40,550 | 182.9 | 64.1 |
| Nondurables | 222,705 | 324.7 | 43,672 | 197.0 | 62.7 |
| Food | 115,062 | 167.8 | 38,561 | 174.0 | 36.7 |
| Total (All branches) | 218,826 | 319.1 | 41,877 | 188.9 | 64.3 |
| Retail Trade: | | | | | |
| Durables | 77,175 | 112.5 | 13,914 | 62.8 | 68.2 |
| Nondurables | 25,896 | 37.8 | 12,587 | 56.8 | 25.3 |
| Food | 20,999 | 30.6 | 12,860 | 58.0 | 20.1 |
| Total (All branches) | 39,636 | 57.8 | 13,262 | 59.8 | 36.8 |
| Wholesale and Retail Trade | 68,578 | 100.0 | 22,166 | 100.0 | 38.1 |

Source: Table 3 and 4.

(iii) *Derivation of gross value added in comparable prices with single deflation*: labour productivity using this method is shown in Table 8. Results are shown both at Brazilian

"prices" (conversion of US gross value added per person engaged with Laspeyres PPPs of Table 4), and at US "prices" (conversion of Brazilian gross value added per person engaged with Paasche PPPs). The geometric average of the Paasche and Laspeyres estimates, which is the Fisher estimates, is also shown. Low productivity was found in the retail trade of durables. High relative Brazilian productivity was observed in the retail trade of durables.

**Table 8**
**Single Deflation: Labour Productivity (Gross Value Added per Person Engaged) in Wholesale and Retail Trade Brazil and the USA, 1975/7**

| | At Brazilian "Prices"[a] | | | At US "Prices"[b] | | | Fisher Geometric average[c] |
|---|---|---|---|---|---|---|---|
| | Brazil, 1975 (million 1975 cruzeiros) | USA, 1977 | Brazil/ USA (%) | Brazil, 1975 (million 1975 US$) | USA, 1977 | Brazil/ USA (%) | |
| Wholesale Trade: | | | | | | | |
| Durables | 211,286 | 446,780 | 47.3 | 26,243 | 40,550 | 64.7 | 55.3 |
| Nondurables | 222,705 | 416,257 | 53.5 | 28,189 | 43,672 | 64.5 | 58.8 |
| Food | 115,062 | 286,471 | 40.2 | 27,644 | 38,561 | 71.7 | 53.7 |
| Total (All branches) | 218,826 | 437,681 | 50.0 | 27,528 | 41,877 | 65.7 | 57.3 |
| Retail Trade: | | | | | | | |
| Durables | 77,175 | 147,894 | 52.2 | 9,579 | 13,914 | 68.8 | 59.9 |
| Nondurables | 25,896 | 128,106 | 20.2 | 4,344 | 12,587 | 34.5 | 26.4 |
| Food | 20,999 | 89,197 | 23.5 | 4,924 | 12,860 | 38.3 | 30.0 |
| Total (All branches) | 39,636 | 137,434 | 28.8 | 5,747 | 13,262 | 43.3 | 35.4 |
| Wholesale and Retail Trade | 68,578 | 230,911 | 29.7 | 9,265 | 22,166 | 41.8 | 35.2 |

Sources: Table 3, 4 and 5.

[a] US gross value added per person engaged converted to cruzeiros with ICP Laspeyres PPPs of Table 5;
[b] Brazilian gross value added per person engaged converted to US$ with ICP Paasche PPPs of Table 5;
[c] Geometric average of the Paasche and the Laspeyres estimate.

(iv) *Derivation of gross value added in comparable prices with double deflation*, see Table 9. For some trades relative productivity could not be calculated because gross value added was negative. Overall relative Brazilian productivity is substantially lower using a double rather than a single deflation procedure.

**Table 9**
**Double Deflation: Labour Productivity (Gross Value Added per Person Engaged) in Wholesale and Retail Trade Brazil and the USA, 1975/7**

| | At Brazilian "Prices"[a] | | | At US "Prices"[b] | | | Fisher Geometric average[c] |
|---|---|---|---|---|---|---|---|
| | Brazil, 1975 | USA, 1977 | Brazil/ USA | Brazil, 1975 | USA, 1977 | Brazil/ USA | |
| | (million 1975 cruzeiros) | | (%) | (million 1975 US$) | | (%) | |
| Wholesale Trade: | | | | | | | |
| Durables | 211,286 | 1,056,529 | 20.0 | -49,187 | 40,550 | [d] | |
| Nondurables | 222,705 | 307,900 | 72.3 | 52,692 | 25,765 | 204.5 | 121.6 |
| Food | 115,062 | 749,760 | 15.3 | 96,373 | 38,561 | 249.9 | 61.9 |
| Total (All branches) | 218,826 | 738,330 | 29.6 | 18,087 | 41,877 | 43.2 | 35.8 |
| Retail Trade: | | | | | | | |
| Durables | 77,175 | 224,024 | 34.4 | 4,670 | 13,914 | 33.6 | 34.0 |
| Nondurables | 25,896 | 171,278 | 15.1 | 6,089 | 12,587 | 48.4 | 27.0 |
| Food | 20,999 | 110,015 | 19.1 | 8,611 | 12,860 | 67.0 | 35.7 |
| Total (All branches) | 39,636 | 198,104 | 20.0 | 5,709 | 13,262 | 43.0 | 29.3 |
| Wholesale and Retail Trade | 68,578 | 366,193 | 18.7 | 7,708 | 22,166 | 34.8 | 25.5 |

Sources: Table 3, 4 and 6.

[a] US gross value added per person engaged converted to cruzeiros with ICP Laspeyres PPPs of Table 6;
[b] Brazilian gross value added per person engaged converted to US$ with ICP Paasche PPPs of Table 6;
[c] Geometric average of the Paasche and the Laspeyres estimate;
[d] Ratio cannot be calculated because gross value added per person engaged is negative.

The overall double deflation results seem plausible, but for individual branches this is not always the case. For example, value added per person in the Brazilian wholesale trade in food products is above the US level (Fisher estimate). Brazilian relative productivity levels for one branch can be very different depending on the Paasche or Laspeyres estimate (see for example the wholesale trade of food products). One explanation for these seemingly implausible results is that when value added is a small percentage of sales, a small measurement error in the PPPs for sales or inputs has disproportionate effects on relative levels of value added. Double deflation is very sensitive to this kind of measurement error. PPPs used for the deflation of intermediate inputs were output PPPs (ex-factory prices), which are not completely appropriate, because of they exclude trade and transport margins.

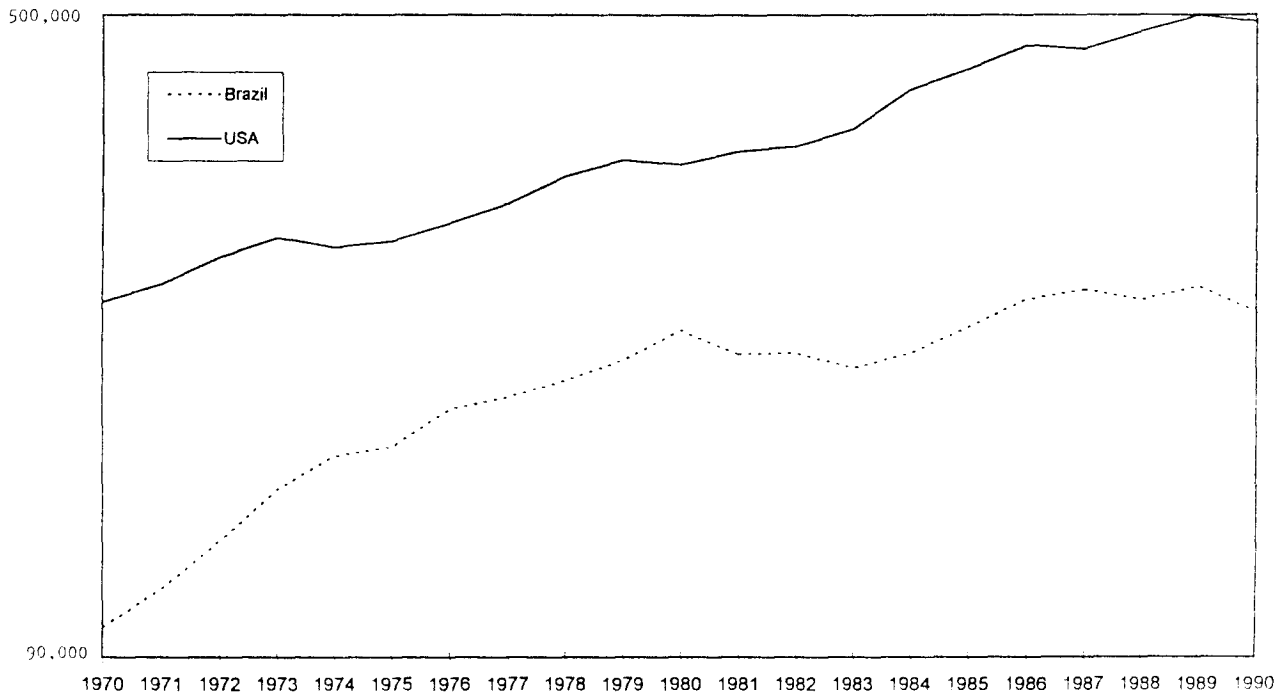
From a methodological viewpoint, I have a strong preference for double deflation, but because of the many possibilities of error involved, I conclude that Brazilian labour productivity probably lay in a range between 25.5 per cent and 35.2 per cent.

## 5. EXTRAPOLATION OF BENCHMARK RESULTS

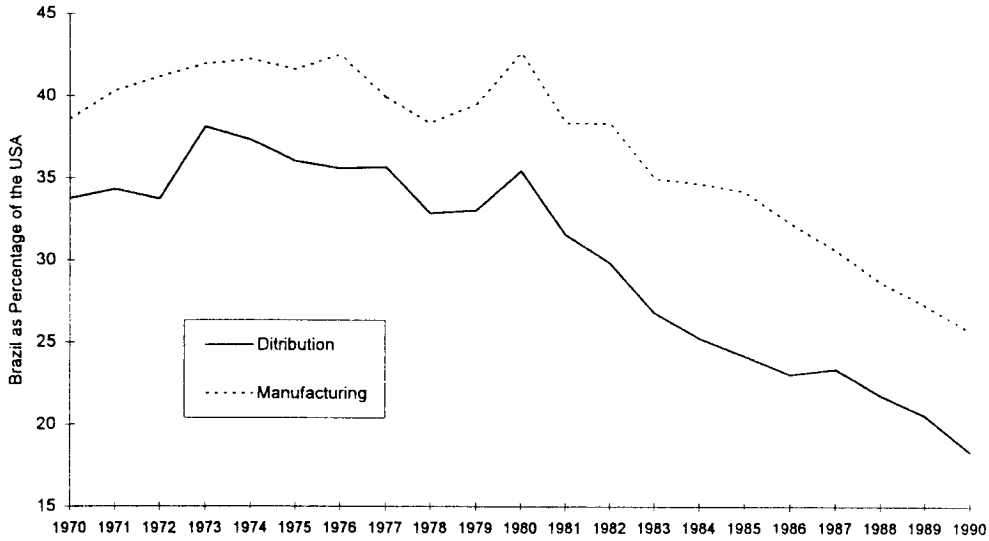
The 1975 benchmark results of relative productivity were extrapolated to the 1970-90 period using time series on GDP in constant prices and employment (see Appendix 1 for the sources used).

Trends in GDP per person engaged in both countries are shown in Graph 1. Brazilian GDP figures in 1975 constant prices were converted to US$ using the single deflated Fisher PPP of Table 5. Trends in both countries are similar for the 1970-75 period. After 1975, an downward trend can be observed in Brazil and an upward trend in the USA. Graph 2 shows Brazilian GDP per person engaged as a percentage of the USA. Brazilian performance improves relative to the USA in the periods 1970-73 and 1978-80. Brazilian relative productivity deteriorated strongly after 1980. Manufacturing performance (taken from van Ark, 1993) also is presented in Graph 2, and shows the same pattern as distribution. GDP per head of population in Brazil relative to the USA improves in the 1970s, but worsens in the 1980s (see Maddison, 1992).

**GRAPH 1**
**GDP per Person Engaged in Wholesale and Retail Trade, Brazil and the USA**
**1975 US$ (semi-logarithmic scale)**



**GRAPH 2**
**GDP per Person Engaged, Brazil as Percent of the USA**




The productivity gap in distribution between the two countries widens in the 1980s. As we saw in Graph 1, this is mainly due to the fall of GDP per person in Brazil. Economic growth per capita stagnated in the 1980s, caused by a number of events such as the oil crisis in 1979, the debt crisis 1982 and hyperinflation during the 1980s. Distribution also suffered from these events.

## 6. CAUSES OF INTERCOUNTRY VARIATIONS IN PRODUCTIVITY LEVELS

Having established Brazilian productivity levels relative to the USA using both the single and double deflation procedure, It is worth trying to analyse some reasons for the productivity differences.

### 6.1 Effect of Structure

Low Brazilian labour productivity compared to the US level may be due to a difference in sector composition. Low productivity in Brazil may be due to the relatively high concentration of employment in branches with low productivity. The effect of structural differences can be removed by weighting each country's branch labour productivity (value added per person engaged) by the labour input shares of one of the two countries (see van

Ark, 1993 for the formulae). Four calculations can be made: Brazilian and US value added per person engaged in cruzeiros can be weighted by Brazilian and US labour input shares, and Brazilian and US labour productivities in US$ weighted by Brazilian and US shares.

Productivity levels obtained by single deflation (Table 8) and employment shares (Table 3) were used to calculate the effect of structure. Thus corrected, Brazilian labour productivity rises with 5.3 percentage points. Structural differences do not therefore explain much of the productivity gap.

### 6.2 Effect of Establishment Size

As we have already seen in Table 2, the average and median size of establishments is quite different between Brazil and the USA for most branches of distribution. Differences in size are an important factor explaining differences in productivity levels in wholesale and retail trade, as discussed in Hall, Knapp and Winsten (1961), Nooteboom (1982), Schwartzman (1971), and Smith and Hitchens (1985). Economies of scale accrue with increases in the size of establishments. Labour productivity can be higher in establishments employing more people compared to establishments employing a few for a number of reasons. Firstly, each establishment has certain fixed costs. As size increases, these costs can be distributed over more service units (persons engaged) (Nooteboom, 1982). Secondly, distribution is characterised by the uncertainty of the stream of customers. This uncertainty per person engaged decreases with an increase in scale. The use of part-time labour can adjust the labour capacity to peaks in demand which increases the average utilisation rate of labour. Thirdly, self-service is much more common in larger stores compared to small ones, which reduces the average costs. Sometimes diseconomies of scale also are observed as size increases, because of problems of management. Schwartzman (1971) emphasised that the amount of service (packaging, home delivery, credit facilities, etc.) may decline with an increase in scale.

Employment size was measured in the Brazilian census as the number of persons engaged and in the US censuses as the number of paid employees. In order to compare both size classifications, I had to make an assumption of the number of family workers and proprietors working in US wholesale and retail establishments. Data limitations made it necessary to exclude non-merchant wholesalers and establishments not operated the entire year. The procedure used to account for the number of family workers and proprietors in total distribution (see section 2) also is applied here. Subsequently, the non-paid employees had to be allocated over the different establishments. I assumed that non-paid employees were equally spread over establishments with 0 to 14 paid employees. This means that for every establishment with less than 15 paid employees, 1.11 family workers and proprietors were added.

Seven establishments sizes were distinguished: i.e. 1 person engaged, 2 persons engaged, 3 to 5 persons engaged, 6 to 9 persons engaged, 10 to 19 persons engaged, 20 to 99 persons engaged, and establishments with 100 or more persons engaged. The size categories in the Brazilian census were not the same as in the US censuses. It is assumed that persons engaged are equally spread over a size category[8]. This assumption was used to adjust the US census size classification in order to compare it with Brazil.

The Brazilian census included information on the distribution of sales, input costs, and persons engaged over the size categories. These data were used to derive value added per person engaged for each size class. The US censuses give information on the distribution of sales and paid employees over the establishments of different size. Ratios of value added to sales derived from other sources (see footnote 1) were used to estimate value added for each size category. Dividing value added by the adjusted employment data gives labour productivity per size category.

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[8] This means that if there are 60 persons in the size category 3 to 5 persons engaged, one third of them will be "working" in establishments with 3 persons engaged, one third in establishments with 4 persons, and one third in establishments with 5 persons.

The reweighted ICP Paasche and Laspeyres PPPs of Table 4 were applied in order to convert value added. To estimate the effect of size, labour productivity of each size category was weighted with labour input shares of Brazil or the USA. Four estimates can be derived (two sets of labour input weights and 2 sets of prices, see also van Ark, 1993). The size effect on productivity (i.e. the geometric average of these four estimates) is shown in Table 10 for each branch of distribution and the total of distribution.

**Table 10**
**The Effect of Differences in Establishment Size on Comparative Productivity Levels in Wholesale and Retail Trade, Brazil and the USA, 1975/7**

| | Value Added per Person Engaged (USA=100.0) | |
|---|---|---|
| | Unadjusted for differences in size | Adjusted for differences in size |
| Wholesale Trade: | | |
| Durables | 55.3 | 80.9 |
| Nondurables | 58.7 | 78.0 |
| Food | 53.6 | 61.5 |
| Total (All branches) | 57.3 | 81.4 |
| Retail Trade: | | |
| Durables | 59.9 | 63.7 |
| Nondurables | 26.4 | 28.4 |
| Food | 30.0 | 38.1 |
| Total (All branches) | 35.3 | 40.4 |
| Wholesale and Retail Trade | 35.2 | 53.9 |

Sources: First column from Table 8 (Fisher estimates). Estimates of second column derived using GDP per person engaged (single deflation) of Table 8 and labour input shares of Table 3.

Note: The effect of size is derived by weighting each country's productivity by size class in absolute terms by the shares of persons engaged in Brazil or the USA. The figure presented in the second column is the geometric average of the four calculation which could be made (i.e. two sets of prices times two sets of labour input weights).

The first column of Table 10 shows Brazilian relative productivity levels before adjusting for size (derived from Table 8), and the second column shows relative productivity levels after the size adjustment. This effect is very important in the wholesale trade of durables of nondurables. Brazilian labour productivity for total distribution rises with almost

20 percentage points because of the size effect. This rise must not be seen as the contribution of economies of scale per se, because other factors also contribute to higher productivity in larger establishments, like the amount of capital per worker and the quality of the workers.

Table 10 shows that differences in size have a substantial influence on comparative productivity levels. Smith and Hitchens (1985, p. 49) analyse factors which help explain why there are differences in shop (establishment) size. They developed the following identity: Y/S = P/S * Y/P, where Y = total retail sales, S = number of shops and P = population size. Average shop size (Y/S) is determined by the average number of inhabitants per shop (P/S) and retail sales per capita (Y/P). This last factor is seen a surrogate measure of the standard of living. It should be noticed that the size of an establishment is now measured by sales and not, as before, by the number of persons engaged. Smith and Hitchens (1985) and Schwartzman (1971) found that both measures are strongly correlated.

Table 11 compares these 3 elements. Sales are converted by ICP Paasche and Laspeyres PPPs of Table 2. US establishment size is almost seven times the Brazilian (using Fisher PPPs), measured as sales per establishment. The number of people served per establishment is larger in Brazil compared to the USA. Differences in size of establishment are mainly due to differences in living standards between the two countries.

Smith and Hitchens (1985, p.53) give various reasons why better living standards lead to higher productivity. Firstly, in a country with a higher standard of living one can find more luxury shops and less necessity shops compared to a poorer country. If labour productivity is higher is luxury shops, then it does improve US labour productivity. Secondly, higher standards of living might be conducive to larger shops, and to productivity gains on that account. Thirdly, higher living standards increase the average transaction size. The first argument, which is the effect of structure, plays a minor role as we already saw. Differences in living standards contribute substantially to size of establishment, see Table 11. No estimates were available on the average transaction size in both countries.

**Table 11**
**Determinants of Comparative Shop Size, Brazil and the USA, 1975/7**

| | Shop size (sales per shop | Number of people per shop | Living Standard (sales per capita) |
|---|---|---|---|
| **Paasche estimates (thousand 1975 US$)** | | | |
| Brazil | 186 | 155 | 1,201 |
| USA | 1,076 | 146 | 7,383 |
| USA/Brazil (Brazil = 1.00) | 5.79 | 0.94 | 6.15 |
| **Laspeyres estimates (thousand 1975 cruzeiros)** | | | |
| Brazil | 1,376 | 155 | 8,889 |
| USA | 11,216 | 146 | 76,933 |
| USA/Brazil (Brazil = 1.00) | 8.15 | 0.94 | 8.66 |
| **Geometric average (Fisher)** | 6.87 | 0.94 | 7.29 |

Sources: Sales from Table 4, Fisher and Paasche PPPs for total distribution from Table 5; Population figures from Table 3, number of establishments from Table 1.

## 7. CONCLUDING REMARKS

With gross value added in comparable prices derived by traditional single deflation, Brazilian labour productivity was found to be 35.2 per cent of the US level. With double deflation, Brazilian relative labour productivity was lower, i.e. 25.2 per cent of the USA. Mulder and Maddison (1993) estimated that Mexican relative labour productivity in 1975 was lower using single deflation than double deflation: Mexican productivity was 28.4 per cent of the US level using the former method and 36.9 per cent using double deflation. Brazilian relative labour productivity is about 20 per cent higher than the single deflated estimate if a single ICP Fisher PPP was used to convert value added.

A number of features of Brazilian distribution which were presented in this paper are characteristic for a low income country. Firstly, the predominance of food products trade. Secondly, the much smaller average size of establishments in Brazil compared to the USA. Thirdly, the much higher proportion of proprietors or family workers in total employment in Brazil. Nooteboom, Thurik and Vollebregt (1986) looked at structural changes in food retailing in 24 various countries, of which Brazil and the USA. For Brazil they observed a huge increase in scale, measured as sales per shop in the period 1974-83. In 1983, the food

shop density was higher in Brazil than in the USA, as they expected for a lower income country. The share of independents remained the same in Brazil during the 1974-83 period and went down in the USA.

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## APPENDIX

(available upon request from the author)

**Groningen Growth and Development Centre Research Monographs:**

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